INVITATION FOR MULTI-STEP BID

NO.: GPA-082-15

ENERGY STORAGE SYSTEM

PHASE I

Volume II

Technical Qualification Requirements

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1. OVERVIEW

The Guam Power Authority (GPA) is inviting qualified firms to participate in a Multi-Step Bid for the Energy Storage System Phase I project. GPA is seeking the services of an Engineer/Procure/Construct (EPC) for the design, procurement, installation and interconnection to the GPA power system of a 24 MW Energy Storage System (ESS) at the GPA Agana Substation compound and a 16 MW Energy Storage System adjacent to the GPA Talofofo Substation compound. The contractor shall design, procure equipment and materials, obtain required permitting, construct, install, interconnect, test and commission the project. The contractor shall also design and construct the interconnection of the ESS to the existing substation facilities. GPA seeks a "turn-key" project that will be fully operational upon commissioning and intends to enter into a 25-year Operations and Maintenance (O&M) Contract with the successful Bidder. The required services include compliance with all applicable local and federal laws as well as applicable local and national standards for the services rendered. GPA reserves the option to negotiate alternative contracting structures for a portion of the project to potentially benefit from greater economic savings. This Invitation for Multi-Step Bid (IFB) is Phase I of a multi-phased approach to procure Energy Storage Systems to support power system stability and renewable energy integration.

In this Phase I acquisition, GPA intends to acquire a total of 40 MW of energy storage capacity that can meet the following established requirements:

- The Bidder's technology meets the requirements described in this Volume.
- The Energy Storage Systems will be commissioned within 12 months from the award of the contract.
- The technology proposed for the Energy Storage Systems will have at least 1 year of commercial operations history in a utility environment.
- The Energy Storage Systems will deliver energy directly to the existing GPA transmission system.
- The Energy Storage Systems will have a minimum 20-year warranty.
- A 25-year Operations and Maintenance (O&M) Contract will be provided with the Energy Storage Systems.

GPA conducted a study to determine the feasibility of adding an ESS and the performance of the GPA system with the addition of the ESS. The GPA Energy Storage Feasibility Study can be found in Appendix H.

Persons or entities responding to this IFB are referred to herein as "Bidder(s)."

1.1. GPA Overview

GPA is a public utility corporation that provides electric power service throughout the entire island of Guam. GPA, in conjunction with private partners, operates and maintains 13 power plants, with a total rated capacity of 552.4 MW. The Authority also has installed and maintains an estimated combined total of 175 miles of 115 kV and 34.5 kV transmission lines and an estimated 585 miles of primary distribution lines, and 29 substations. In addition, GPA operates and maintains a total capacity of 18 MW for emergency generators to support 128 Guam Waterworks Authority water and sewage pump stations and sewage treatment facilities situated at various locations throughout Guam and 10 portable units.

An overview of GPA's generation resources and transmission systems is provided in GPA's Integrated Resource Plan, which can be found at the following webpage:
http://guampowerauthority.com/gpa_authority/strategicplanning/2012IRP.php

Guam Power Authority has approximately 175 miles of 115KV and 34.5KV transmission lines. There are 6 ea 115KV and 34 ea 34.5KV lines connecting 29 substations throughout the island. These Substations have 63 ea 13.8KV distribution feeders with approximately 585 miles of lines. The Guam Power Authority follows National Electrical Manufacturers Association (NEMA) ANSI C84 for delivery of power and imbalance.

The GPA Islandwide System Transmission Single Line Diagram can be found in Appendix V.

1.2. Proposed Energy Storage System Site

24 MW Agana Substation ESS

The 24 MW ESS site is the GPA Agana Substation compound with the ESS connected at the 115 kV voltage level.

The Agana Substation was constructed in 1949 and initially served as a power plant. Power generation ceased in 1995 and generation and auxiliary equipment have gradually been removed from the existing building. The facility currently consists of the abandoned power plant at the center of the property, and active 115kV substations to the north and east of the existing structure. Adjoining properties are currently designated for residential and light industrial use. The property has frontage on Route 33, Sergeant Roy T. Damien Jr. Street.

The Preliminary Environmental Assessment found historical documents indicating that the property has undergone environmental cleanup. Per a 2013 Environmental Condition of Property (ECP) conducted by NAVFAC, land-use controls are in effect for two (2) areas east of the building. No records of lead-based paint surveys have been found. Therefore, presence of the aforementioned substances in the existing structures is possible. It is anticipated that the entire building will need lead-based paint removal. As noted in the 2013 ECP, an investigation found asbestos-containing material in the structure and subsequent removal of the materials, particularly friable asbestos, was performed. However, some traces of asbestos may be left and the ECP notes that the transferee “shall be responsible for management of any asbestos in accordance with applicable laws”. It is anticipated that approximately 20% of the building will need asbestos removal. Based on the information provided by the assessment, the GPA Energy Storage Feasibility Study determined that the property is suitable for the construction of the proposed facility with appropriate additional studies and Hazmat Management Procedures. However, the successful Bidder shall be responsible for all mitigation efforts needed.

A preliminary structural evaluation of the existing concrete structure determined that the building is generally in good condition and minor renovations and retrofits are likely needed for the structure to meet current building codes. The successful Bidder shall be responsible for further structural analyses for final suitability determination and all renovation work needed for proper occupancy if the building is used to house part or all of the ESS. The concrete structure has an approximate area of 17,500 square feet.

A preliminary review of the Guam Waterworks Authority (GWA) system indicates that existing water and sewer lines are present approximately 200 feet and 500 feet south of the property along Route 33. More information on the project site can be found in the GPA Energy Storage Feasibility Study. Photos of the existing Agana Substation compound can be found in Appendix A of the Study. The Preliminary Environmental Assessment can be found in Appendix C of the Study. The Agana

Substation as-built survey of the existing site layout and record drawings can be found in Appendix Q of Volume IV.

16 MW Talofofo Substation ESS

The 16 MW ESS site is north and adjacent to the GPA Talofofo Substation Lot 427 with the ESS connected at the 34.5 kV voltage level.

With this project, GPA intends to expand the Talofofo Substation site to include the ESS within the compound. The proposed site is within Lot 421-R26 which is currently under the administrative jurisdiction of the Chamorro Land Trust Commission. Bill No. 360-33 proposes to transfer a portion of the property with an area of approximately 2,100 square meters (tentatively identified as LPortion 421-77) to the Guam Power Authority for the purpose of expanding the Talofofo Substation for the ESS. LPortion 421-77 is approximately.

The proposed site is currently used for farming banana trees, papaya, eggplant, breadfruit and other cultivated plants. The areas between the cultivated plants are maintained. Tangantangan trees (Leucaena leucocephala), vines and other vegetation are also present on the northern border of the property.

More information on the project site can be found in the Preliminary Environmental Assessment for Lot 421-R26 in Appendix Y. The Talofofo Substation as-built drawings can be found in Appendix W.

Climate data for Guam is provided in Appendix T. These data represent the hourly average temperature and humidity on a monthly basis.

2. PROPOSAL REQUIREMENTS

2.1. Technical / Qualitative Proposal

The Bidder shall demonstrate sufficient qualifications for this solicitation by providing the following sections as part of the Technical or Qualitative Proposal. Information for each ESS shall be provided where applicable.

2.1.1. Business Structure

The Bidder shall provide all of the following:

A. Company information such as name, local address, corporate headquarters (if any) and affiliate company in support for the performance of the required services.
B. Business structure and nature of services provided.
C. Copy of the Articles of Incorporation and By-Laws or other applicable forms concerning the business organization.
D. Certificate of Good Standing to conduct business in jurisdiction of residence.
E. Other supporting information, brochures, company profile publications that may assist in the evaluation and selection process
F. Insurance policy

2.1.2. Project Approach

The Bidder shall provide all of the following:

A. Detailed description of the work plan to perform, meet, and achieve the objectives of this solicitation.
B. Detailed description of the planned scope of work for each Basic Bid and Additive Bid Item. The details for the permits, warranties and operations and maintenance (O&M) services shall be provided here.
C. Brief description of information or coordination to be requested from GPA for the duration of the project.

2.1.3. Engineering and Equipment Plan

The Bidder shall provide information about the specific technology or equipment including the track record of the technology and equipment. The following information is required:

A. A reasonable but preliminary engineering plan which includes the following information:
   - Name of principal engineering firm responsible for facility design
   - Preliminary Oneline Diagram for the ESS and interconnection facilities
   - Preliminary site map and layout of the facilities, indicating the ESS and the interconnection to the GPA system
   - Major equipment considered or expected to be used
   - Equipment vendors selected/considered
   - History of equipment operations
   - Equipment procurement strategy
   - Methodology for measuring power and energy to verify all performance guarantees
B. Identification of expected key equipment suppliers and information that illustrates and discusses the proposed equipment, lead times for delivery to GPA, and suppliers prior experience with equipment operation in tropical island environments.

C. Indication if the Bidder has secured its equipment for the project. If not, identify the long-lead equipment options and describe the timing for securing equipment.
D. Bidders are encouraged to provide any additional information that will further describe the proposed projects technical feasibility and applicability to development on Guam.

2.1.4. Energy Storage System Components and Technology

The following information is required:

A. Basic description of the ESS including all system components.
B. Specification documents from the manufacturers of the proposed ESS components. Include the completed Tables 6.1, 6.2 and 6.3 from PNNL-22010 Rev 2 Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems. Bidders are encouraged to provide hourly and rolling average PJM performance scores for accuracy, time delay and precision using the PNNL-22010 signal as well as the supporting documentation. Similar performance scores from other North American Regional Transmission Organizations may also be provided. More points may be given on the Qualitative Proposal Scoring Worksheet to those with higher performance scores.
C. Detailed description of the storage technology including the chemical or kinetic energy storage characteristics.
D. Describe the characteristics of the storage technology that make the technology a good fit for the specified applications. For the 16 MW ESS, the Bidder shall describe the technology and algorithm to smooth the output fluctuations from the 25 MW solar farm such that ramp-rates are kept within 1% per minute. The SOC management control capability shall also be described if applicable.
E. Describe the charging and discharging characteristics including any requirements or limitations.
F. Describe the expected lifetime and the effects of time, and the amount and type of use on the lifetime of the ESS for all components.
G. Describe any potential environmental impacts the ESS and any of its components may have including toxic chemicals and disposal requirements. Describe how all components of the ESS can be disposed of when the ESS reaches the end of its life.
H. Describe the safety issues associated with the ESS components including typical failure modes and any design techniques used to mitigate any safety issues.
I. Evidence that the specific storage technology and all ESS components proposed are commercially available and can be found in operating utility systems. Include a listing of the systems currently in operation and describe the ESS specifications and application.
J. Describe how the ESS will respond to a fault condition.
K. A table specifying the annual performance guarantees for availability for 25 years. The ESS shall operate at an annual availability of 95% or greater, however, more points may be given on the Qualitative Proposal Scoring Worksheet to those with higher availabilities.
L. A table specifying the annual performance guarantees for AC-AC round-trip efficiency for 25 years. The AC-AC round-trip efficiency shall be determined at the 115 kV voltage level for the 24 MW ESS and at the 34.5 kV voltage level for the 16 MW ESS and include all system components (inverters, storage equipment, step-up transformers, plant station service and auxiliary loads, 115 kV or 34.5 kV transformer…etc.) involved with the charging and discharging of the ESS. The ESS shall operate with an AC-AC round-trip efficiency of 90% or greater, however, more points may be given on the Qualitative Proposal Scoring Worksheet to those with higher efficiencies.
M. Provide the total plant and station service annual energy requirements measured at the respective voltage level (115 kV or 34.5 kV). These energy requirements shall represent all of the energy required by the ESS components and all other support equipment while the ESS is in a quiescent

operating mode (not charging or discharging). The minimum, average, and maximum annual energy requirements shall be provided. The maximum energy requirements will serve as the annual performance guarantee. If the plant and station service energy requirements are expected to change over time, then provide a table listing the estimated quantities for 25 years. The climate data found in Appendix T shall be used as the basis for the HVAC related portion of the energy requirements.

N. A table specifying compliance for each required item in Section 4.

A Bidder's proposal shall be deemed unacceptable if the Energy Storage System requirements specified in Section 4 are not met.

2.1.5. Experience of the Proposed Project Team

The Bidder shall provide all of the following:

A. Supporting information describing the past and current successful experience of the Project Team members with similar projects within the past five years. Describe the Project Team members' roles in past projects. Provide the bid price and final contract price for the last five projects exceeding $5M. The Project Team shall include, at a minimum, the Project Manager, the Construction Superintendant(s) and the Design Team (civil, electrical, mechanical, structural, SCADA, geotechnical, etc.).
B. Supporting information demonstrating knowledge and experience in complying with U.S. federal and local standards pertaining to the requested scope of work.
C. Organizational chart of the Project Team with descriptions of the respective roles and duties of each team member.
D. Copies of Certifications of the Project Team.
E. Copy of current Certificate of Authorization (COA) issued by the Guam Board of Registration for Professional Engineers, Architects and Land Surveyors. As required in 10.E(1) of the PEALS Rules and Regulations, "Any corporation, partnership, joint venture or any other association of two (2) or more firms, whether organized under the laws of Guam or any other jurisdiction, may not offer to engage in the practice of engineering, architecture, land surveying or construction management services involving the practices thereof in Guam until such corporation, partnership, joint venture or association has obtained a certificate of authorization issued by the Board."

A Bidder's proposal shall be deemed unacceptable if the following are not met:

A. The proposed Design Team must include a Licensed Professional Engineer with a minimum of three (3) years of experience in the design of utility-scale Energy Storage Systems and the associated facilities required for proper grid interconnection.
B. The proposed Project Team must include at least one member with a minimum of three (3) years of experience in the construction of utility-scale Energy Storage Systems and the associated facilities required for proper grid interconnection.
C. The Project Manager must have a minimum of three (3) years of construction management experience. The Project Manager shall be the CONTRACTOR's main point of contact for GPA.
D. The person in charge of electrical wiring and installations shall be a licensed Master Electrician and/or Registered Electrical Engineer in Guam.

2.1.6. Time of Delivery

The Bidder shall demonstrate adequate time of delivery of the project within the specified completion time. A draft project schedule illustrating all major tasks identified in Section 3 with their respective

durations shall be provided. The Bidder shall provide a complete critical path schedule for the project from the contract award to project commissioning. For each project element, list the start and end date.

The Bidder shall identify the elements on the critical path. The schedule shall include, as a minimum, facility contracts, construction, siting, environmental permitting (anticipated submittal and approval), engineering, procurement, local permits and any other requirements that could influence the project schedule. The Bidder shall identify any status of permits, licenses and studies required. The project schedule shall include dates for all construction and applicable reporting milestone events.

The Bidder shall provide evidence of similar projects that have been completed within the specified time of delivery.

2.1.7. References

The Bidder shall provide at least three (3) letters of reference or recommendation from clients that received similar services from the proposed Project Team within the past five (5) years indicating:

A. Quality of work
B. Compliance with performance schedules
C. Cost-control ability
D. Level of integrity and business ethics

2.1.8. Exceptions to the Bid Documents

The Bidder shall indicate any exceptions to the bid requirements in this section. A Bidder's proposal shall be disqualified if the GPA Evaluation Committee finds any exceptions to the bid requirements unacceptable.

2.2. Priced Proposal

The Priced Proposal is itemized into specific activities as indicated in the Priced Proposal Worksheet in Appendix P. The Bidder must indicate a bid price for each Basic Bid and Additive Bid item and there shall be no double-charging. Separate Priced Proposal Worksheets are provided for the 24 MW ESS and the 16 MW ESS. The Bidder shall provide separate bid prices for each ESS.

The Bidder's Priced Proposal Worksheet shall contain bid prices for each of the specific activities and total bid package. GPA will evaluate the Priced Proposal and will decide to award either the basic bid, both the basic bid and additive bid, or none of the bid options to the Bidder.

3. SCOPE OF WORK

3.1. General Scope Requirements

The CONTRACTOR shall be responsible for all aspects of project implementation including:

A. Necessary permits
B. Adherence to all applicable codes and standards
C. Foundation design: using manufacturer's standard design or modified design with expected impacts clearly delineated
D. Interconnection equipment coordination with GPA
E. Installation design: addressing all electrical, mechanical and civil systems
F. Energy Storage System and other necessary equipment procurement and delivery
G. All on-site construction, equipment installation and interconnection
H. Commissioning, site acceptance testing and annual performance testing with coordination of third-party verification by other GPA contractor
I. Full documentation of all equipment, warranties, manuals, etc.

The CONTRACTOR shall include the submission of a Master Project Schedule outlining anticipated start and end dates for each of the functional activities listed above.

The CONTRACTOR shall provide all labor and materials including taxes, equipment, means, and operations necessary to purchase and construct the ESS and related features.

The CONTRACTOR shall provide operations and maintenance (O&M) services for a period of 25 years after commissioning.

3.2. Special Conditions

It shall be the CONTRACTOR's responsibility to verify the existing conditions at the site during either the official pre-bid walkthrough or subsequent site visits to the property. During the pre-bid walkthrough, all areas for project construction will be available for observation.

Any physical disruption to the site that is necessary for the construction and interconnection shall be repaired as nearly as possible to its original state.

The CONTRACTOR must maintain a clean worksite and take all necessary measures to prevent any erosion or distribution of loose material away from the site.

The CONTRACTOR must identify any malfunctioning or defective equipment and report such incidences to GPA. The GPA project manager will decide on the corrective action.

The CONTRACTOR must ensure that all product warranties are active when the project becomes operational. Documentation of product warranties shall be provided to GPA upon commissioning.

The CONTRACTOR shall be required to maintain detailed records. For compliance with GPA's requirements, the CONTRACTOR shall submit monthly reports that track % completion for the major project tasks.

Unsuitable materials as a result of CONTRACTOR's operations shall be disposed of in accordance with the local laws and/or policies of concerned agencies. Disposal, tipping fees/charges shall be at the CONTRACTOR's expense.

3.3. Basic Bid Items

The following are general descriptions of the Basic Bid Items listed in the Priced Proposal Worksheet. The Bidder shall include, in the Project Approach of the Technical Proposal, more detailed scope of work descriptions for each Basic Bid Item for evaluation.

3.3.1. Mobilization

The CONTRACTOR shall be responsible for all preparatory operations performed by the CONTRACTOR, including but not limited to, those necessary for the movements of its personnel, equipment, supplies and incidentals to the project site; for premiums on bonds for the project, and for other operations which it must perform or costs it must incur before beginning construction on the various items on the project site.

The CONTRACTOR shall use BMPs (e.g., silt screen, hydro-ax hand clearing, etc.) to comply with the Erosion and Siltation policy of the Guam Coastal Management Program (GCMP).

The CONTRACTOR shall use BMPs to comply with the Water Quality policy of the Guam Coastal Management Program (GCMP).

The CONTRACTOR shall use BMPs (e.g., dust control with non-potable water spray) to comply with the Air Quality policy of the Guam Coastal Management Program (GCMP).

The CONTRACTOR shall submit to GPA for approval a Schedule of Values and a proposed work schedule with milestones, deliverables and timelines no later than ten (10) days after issuance of the Notice to Proceed. The schedule shall be prepared in a bar chart format and shall display scheduled and actual progress. The schedule shall show the work broken down into major phases and key items with the dates work is expected to begin and be completed. The schedule shall be updated and submitted to GPA every month. The schedule shall show actual progress and any proposed changes in the schedule of remaining work. The CONTRACTOR shall not change the accepted project schedule without prior concurrence of GPA.

The CONTRACTOR shall erect a sign at the project site and shall submit a shop drawing for the approval of GPA prior to fabrication. The location of the sign shall be as directed by the GPA. Size of sign, lettering, and other pertinent data that should appear on the sign will be furnished by GPA to the CONTRACTOR.

3.3.2. Permits, Bonds and Codes

The CONTRACTOR shall secure all permits and bonds required for the construction of this project, including but not limited to those required by the Department of Public Works, Guam Waterworks Authority, Guam Telephone Authority and Department of Parks and Recreation.

The CONTRACTOR shall also be responsible for applying for and obtaining all other federal, local and other applicable permits, agreements, licenses, and certificates to complete this project, unless otherwise

stated in this document. Copies of the permits and approvals shall be submitted to GPA before starting work.

The CONTRACTOR shall adhere to all applicable codes governing electrical, mechanical, civil, structural systems, etc.

In the Project Approach of the Technical Proposal, the Bidder shall identify all federal and local permits, licenses and environmental assessments and/or environmental impact statements required to construct and operate the project. The Bidder shall identify environmental impacts associated with the proposed project and its plan to mitigate such impacts.

3.3.3. Construction Site Survey and Surface Investigation

The CONTRACTOR shall perform all survey and surface investigation work required for preparation of the design and as-built drawings and for construction completion. All costs required for furnishing instruments and miscellaneous survey materials shall be included.

3.3.4. Interconnection Design

The CONTRACTOR shall provide to GPA a design plan that describes all construction activities on the site in regards to the interconnection of the 24MW ESS to the GPA Agana Substation 115 kV bus and the 16 MW ESS to the GPA Talofofo Substation 34.5 kV bus. Interconnection may require an extension of the existing 115 kV or 34.5 kV bus and installation of 115 kV or 34.5 kV breaker and protection equipment. The design shall ensure the existing equipment are not overloaded. The design shall also include metering to determine the AC-AC round-trip efficiency, ramp-rate and any other required performance guarantees. Stability and system integration studies including a power flow and short circuit analysis may also be required to determine if the design requires any other transmission or substation upgrades.

The design plan shall include an underground fiber optic communications line, or other appropriate connection, from the Energy Storage System to a new Remote Terminal Unit (RTU) provided by the CONTRACTOR. The RTU specifications shall be submitted to GPA for review and approval. The RTU may be located within the ESS facility or the existing GPA control building if space permits. A communications line shall also be provided from the RTU to the existing communications cabinet located inside the 115 kV Control Building for the 24 MW ESS and the 34.5 kV Control Building for the 16 MW ESS. The CONTRACTOR shall provide a network diagram for the ESS and SCADA points list. The design plan shall also include all recommended additional equipment and upgrades.

The ESS shall also have a Human Machine Interface (HMI) at the GPA control center which shall be remotely connected to the ESS over the GPA network.

Refer to the Agana Substation As-Built Survey and Record Drawings in Appendix Q and the Agana Substation Existing Oneline in Appendix I. Refer to the Talofofo Substation As-Built Drawings in Appendix W and the Talofofo Substation Existing Oneline in Appendix I.

GPA reserves the option to remove this Bid Item from the CONTRACTOR’s scope of work and contract a third-party to provide the Interconnection Design.

The CONTRACTOR shall submit to GPA for review the 60%, 90%, 100% and pre-final design drawings in hard copy and PDF prior to the final design drawing submittal.

The CONTRACTOR shall submit to GPA the approved final design drawings in the following formats: hard copy of appropriate size, AutoCAD 2013 and PDF. Hard copies shall be plotted on 24"x36" reproducible mylar sheets with the GPA standard title block and stamped by a Professional Engineer in the respective discipline currently registered by the Professional Engineers, Architects and Land Surveyors (PEALS) Board. Plans and specifications must be able to pass the building permit review process prior to construction. Construction shall not commence until the design drawings are approved by GPA. The approval of GPA shall not relieve the CONTRACTOR from the responsibility of corrective actions if defective or inadequate work was overlooked.

3.3.5. Installation Design

The CONTRACTOR shall provide to GPA an integrated design plan that describes all construction activities on the site in regards to the electrical, mechanical, structural and civil engineering work needed for the installation of the Energy Storage System and associated facilities and equipment. The project design shall meet all applicable industry standards and codes including but not limited to Building Law Title XXXII Government Code of Guam, International Building Code, International Fire Code, Uniform Building Code, NEC, NESC, ASCE, IEEE and standard utility practices. In the event specific codes are not available for the ESS, current industry accepted best practices shall be employed. All construction work and equipment shall also comply with GPA standard specifications. The CONTRACTOR shall be responsible for obtaining such specifications from GPA.

The design plan shall include but not be limited to the following:

A. Site Plan:
   The Site Plan shall identify all construction activities that will be undertaken on the site. The CONTRACTOR shall perform site work as necessary to prepare site for construction activities. Security and access controls shall be implemented to prevent unauthorized entry to site during construction and to protect wildlife from site exposure. The CONTRACTOR shall obtain appropriate approvals and shall construct connections or new systems for electrical power, water, sewer, telephone, and other utilities.
B. Site Map:
   The Site Map shall indicate the proposed ESS location and the layout of other project components.
C. Foundation Design:
   The CONTRACTOR shall develop a site-specific foundation design to be submitted to the manufacturer for review. Foundation designs must be accompanied with the stamp of a registered Professional Engineer (PE). The CONTRACTOR is responsible for any required geotechnical surveying.
D. Single-Line Interconnection Diagram:
   The Single-Line Interconnection Diagram shall detail the on-site electrical configuration from the point of utility interconnection to the ESS.
E. Technical Specifications:
   The Technical Specifications shall include information not provided in the design drawings for overhead and underground electrical work, earthwork, concrete and any other additional specifications needed. ESS performance specifications, bill of materials and construction calculations shall also be provided.

The CONTRACTOR shall submit to GPA for review the 60%, 90%, 100% and pre-final design drawings and technical specifications in hard copy and PDF prior to the final design drawing submittal.

The CONTRACTOR shall submit to GPA the approved final design drawings in the following formats: hard copy of appropriate size, AutoCAD 2013 and PDF. Hard copies shall be plotted on 24"x36" reproducible mylar sheets with the GPA standard title block and stamped by a Professional Engineer in the respective discipline currently registered by the Professional Engineers, Architects and Land Surveyors (PEALS) Board. Plans and specifications must be able to pass the building permit review process prior to construction. Construction shall not commence until the design drawings are approved by GPA. The approval of GPA shall not relieve the CONTRACTOR from the responsibility of corrective actions if defective or inadequate work was overlooked.

3.3.6. Equipment Cost, Procurement and Delivery

The CONTRACTOR shall be responsible for the procurement and delivery of the Energy Storage System and other necessary equipment to construct and install this project in a turn-key manner. Any equipment and material prices shall be provided on the basis of CIF to the Guam job site unloaded.

The ESS shall comply with the specifications identified in Section 4. All equipment shall also comply with GPA standard specifications. The CONTRACTOR shall be responsible for obtaining such specifications from GPA. Bidders shall provide a breakdown of the cost components for this Bid Item.

The CONTRACTOR shall be responsible for factory tests at the point of manufacture of various products which are shipped to the jobsite, including but not limited to such items as the ESS or other electrical equipment, as required by GPA. The tests performed on the ESS shall be in accordance with PNNL-22010 Rev 2 Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems and provided to GPA. Three GPA representatives may witness the factory testing at the CONTRACTOR's expense.

The CONTRACTOR shall submit technical brochures, samples, shop drawings and details as required by the GPA project manager prior to purchase or installation.

All material and equipment must conform to applicable standards of organizations such as the American National Standard Institute (ANSI), the American Society for Testing and Materials (ASTM), the National Manufacturers Association (NEMA), and the Underwriters Laboratories (UL). Proof of such conformance shall be submitted to the GPA project manager for approval. References to various standards contained in the specification and drawings shall be understood to be the issue or revision in effect on the date of such deviation shall be detailed in a written request to the GPA project manager for approval and shall not be initiated until written approval is received by the CONTRACTOR from GPA.

3.3.7. On-Site Construction, Installation and Interconnection

The CONTRACTOR's primary scheduled activities shall include, but are not limited to:

A. Construction equipment delivery
B. Site work: leveling, trenching, etc. activities to prepare the site for construction
C. Foundation excavation and work
D. Concrete pour and curing for structural and civil work
E. Installation and construction of electrical lines and facilities as needed
F. Unloading of the Energy Storage System and associated equipment
G. ESS assembly and installation
H. Interconnection installation and construction work

The work for the 16 MW ESS in Talofofo shall include the installation of a perimeter chain-link fence and two access gates with 3-strand barb wire and all associated construction work for the expansion of the existing substation site. The work shall also include the provision of an access road to the ESS site to accommodate vehicles and equipment needed for construction and maintenance purposes.

All construction work must comply with applicable GPA standards. The CONTRACTOR shall be responsible for obtaining all applicable GPA standards.

The CONTRACTOR shall include the submission of a Master Project Schedule outlining anticipated start and end dates for each of the on-site construction, installation and interconnection activities.

Progress Meetings:
Weekly progress meetings shall be held throughout the duration of the project. GPA may request additional meetings if deemed necessary. Such meetings shall be attended by the CONTRACTOR either via phone or in person, by all active subcontractors and by GPA. The purpose of the meetings will be to discuss current work progress, design or construction issues, interface issues, and potential changes to the schedule. The CONTRACTOR shall make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within two days to GPA, participants, and those affected by decisions made. GPA reserves the right to change the CONTRACTOR's assigned Project Manager if he/she is uncooperative or unable to fulfill duty requirements.

Work Progress Reports:
The CONTRACTOR shall submit to GPA monthly reports on actual work progress. Such reports shall be submitted to GPA prior to the scheduled work progress meetings. The narrative shall contain a description of current and anticipated delaying factors, if any, impact of possible delaying factors, and proposed corrective actions. The reports shall be submitted as supporting documents for progress payments.

3.3.8. Commissioning and Performance Testing

The CONTRACTOR shall conduct pre-commissioning through final inspection activities with the GPA project manager to demonstrate the successful installation and fully functional operation of the Energy Storage System.

The CONTRACTOR shall provide:

A. Pre-Commissioning Inspection:
   The CONTRACTOR shall conduct a pre-commissioning walk-through inspection with the GPA project manager and document the pre-commissioning inspection findings in a brief report. The report shall include a list of equipment/products installed, commissioning activities and tests to take place during the Commissioning Process.
B. Commissioning and Testing:
   The CONTRACTOR shall provide a complete commissioning plan including test and startup procedures for GPA review prior to commissioning and testing. The CONTRACTOR shall complete commissioning process and testing of all installed equipment and subsystems to establish operating and start-up condition and operational parameters. Commissioning activities shall be witnessed by GPA and include, but not be limited to:
   a. Verification of operation of all controls and modes of operation
   b. Verification of appropriate levels of applicable fluids
   c. Verification of fire suppression system if applicable

d. Verification of lightning protection system
e. Verification of the utility meter operation
f. Verification that the ESS meets the power and energy requirements
g. Verification that all ESS control functions properly operate in automatic and manual modes
h. Verification that the ESS properly communicates and operates with the HMI and GPA's SCADA, EMS, SA and AGC systems
i. Verification and testing of fiber optic cable
j. Verification and testing of applicable safety protection systems
k. Verification of sensors and alarms

C. Delivery and Warranty:
The CONTRACTOR shall complete all inspection and commissioning requirements prior to final inspection. The ESS shall include a 20-year service and parts warranty.

D. Final Inspection:
The CONTRACTOR shall conduct a final inspection with the GPA project manager and document the findings in a final inspection report. The inspection shall concentrate on the items identified at the pre-final inspection and recorded in the pre-final inspection report. The final inspection report shall: (1) certify that all items of the design have been implemented and that the construction is complete, and (2) include a record of "signed and sealed" as-built drawings and specifications verifying that all development standards have been met. At the final inspection, the CONTRACTOR shall present a completed form for the Transfer and Acceptance of Real Property to GPA for signature and acceptance.

E. Documentation of All Equipment and Construction Work:
All documentation shall be provided in paper hard copy, PDF format and native file format where applicable. Documents that were created in Word or Excel, etc. shall also be provided in those formats in addition to the PDF format. The CONTRACTOR shall provide the following documents either during construction or upon commissioning:

a. As-built electrical, mechanical and civil drawings for all installed systems in the following formats: hard copy of appropriate size, AutoCAD 2013 and PDF
b. Installation and instruction manuals for all complete systems
c. O&M manual for the ESS and all other systems
d. Complete commissioning plan including test and startup procedures
e. Complete set of test results package and commissioning report for record
f. ESS control and protective settings
g. Maintenance schedule
h. Software documentation
i. Warranty documentation
j. Final inspection report
k. Statement of completion
l. As-built record of materials

F. On-Site Training Course:
The CONTRACTOR shall provide a two-day on-site training course to familiarize GPA personnel with the ESS functionality, operations and maintenance. The course agenda shall be provided to GPA for review and approval prior to the training course.

3.3.9. Demobilization

The CONTRACTOR shall demobilize facilities and construction equipment as necessary, and restore the site surrounding the Energy Storage System to pre-construction conditions. The CONTRACTOR shall remove any temporary facilities and implement erosion control measures such as seeding, mulching,

sodding, and erosion control fabrics; restore roads, structures, and utilities; and plant trees, shrubbery, grasses, and other vegetation. The CONTRACTOR shall document and report on these activities. All costs associated with withdrawing from the site after completion of work, including CONTRACTOR's personnel, facilities, equipment, cleaning and securing the site shall be included.

3.3.10. Warranty

The CONTRACTOR shall provide the standard warranty specified in Volume I, Section 4 for all work resulting from the project. Additionally, the CONTRACTOR and/or Energy Storage System manufacturer(s) shall provide a 20-year service and parts warranty that guarantees the ESS performs, at a minimum, according to the guaranteed availability of 95% and the guaranteed AC-AC round-trip efficiency of 90%. The availability and efficiency shall be assessed by GPA annually. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the performance guarantee is not met and shall resolve the issue within six months.

The 24 MW ESS must also maintain the 24 MW rated power output for 15 minutes while also satisfying the 12-hour Frequency Regulation Duty Cycle from PNNL-22010 Rev 2 Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems provided in Appendix U for the entire warranty period. The ESS must also be able to provide frequency regulation appropriately and as described in Section 4.4.2 throughout the entire warranty period.

The 16 MW ESS must also control the ramp-rate of the 25 MW solar farm to 1% of rated power output per minute (250 kW/min) at the guaranteed success rate of 97%. The net output of the solar farm and ESS shall be measured from a metering device to calculate the ramp-rate. The success rate shall be calculated every second for one-minute intervals. If the ramp-rate is less than or equal to 250 kW/min, it shall be counted as successful. At least 97% of the total number of calculated ramp-rates must be considered successful. The success rate performance shall be assessed by GPA monthly. The CONTRACTOR shall proceed with corrective measures within seven days of notification by GPA if the success rate falls below 97% for a given month and shall resolve the issue within six months.

3.3.11. Environmental Compliance, Clean-Up and Building Renovation

The CONTRACTOR shall perform all work required for any environmental clean-up required at the project site. The CONTRACTOR shall also ensure environmental protective measures are in place to prevent pollution, chemical spills or other environmental hazards during construction and throughout the life of the ESS.

For the 24 MW ESS, the CONTRACTOR shall also perform all work required for environmental clean-up including, but not limited to, lead-based paint and asbestos removal from the existing building at the Agana Substation. The CONTRACTOR shall be responsible for further structural analyses for final suitability determination and all renovation work needed for proper occupancy if the existing building at the Agana Substation is used to house part or all of the 24 MW ESS. The Preliminary Environmental Assessment can be found within the GPA Energy Storage Feasibility Study in Appendix H.

The Energy Storage Systems should be designed to meet normal utility standards regarding ambient temperature ranges, humidity ranges, air quality, emissions, seismic, audible noise (similar to power transformers), EMI, fire protection (NFPA standards), and flood protection.

3.4. Additive Bid Items

The following are general descriptions of the Additive Bid Items listed in the Priced Proposal Worksheet. The Bidder shall include, in the Project Approach of the Technical Proposal, more detailed scope of work descriptions for each Additive Bid Item for evaluation.

GPA shall have the option of instructing the CONTRACTOR to proceed with any Additive Bid Item throughout the duration of the contract negotiations or thereafter.

3.4.1. Full-Service Operations and Maintenance

The CONTRACTOR shall provide full-service operations and maintenance (O&M) of the Energy Storage Systems to GPA for a period of 25 years after commissioning. The service shall include all aspects of daily operation and monitoring of the ESS and all periodic maintenance procedures (daily, monthly, quarterly, semi-annually, annually) covering electrical systems, mechanical systems, grounding/lightning protection systems, fire suppression systems, etc. The CONTRACTOR shall supply any special equipment and tools required for the operations and maintenance of the project. The CONTRACTOR shall supply an initial complement of spare parts.

The ESS control system shall be designed to provide for automatic, unattended operation of the ESS. However, the control system design shall also provide for local manual operation or remote operation.

The CONTRACTOR shall remotely monitor the ESS and receive automatic alerts to alarm conditions. The CONTRACTOR shall respond to alarm conditions and provide required services to correct such alarm conditions within two hours from the inception of the alarm condition. For GPA's reference, the CONTRACTOR shall provide an operations and maintenance manual that includes the recommended corrective action and maintenance procedures for each alarm level or observed condition provided.

The CONTRACTOR shall mitigate any hazardous spills to prevent discharge to the surrounding site soil and hire a chemical disposal company in the event of a spill.

The CONTRACTOR shall provide monthly analysis reports of ramp-rate control data and frequency regulation data.

The CONTRACTOR shall provide services to amend the control algorithm to enhance system performance as needed.

The CONTRACTOR shall make monthly payments to GPA for the total energy received from the grid less the total energy delivered to the grid based on the GPA Rate Schedule I which can be found on the following webpage: http://guampowerauthority.com/gpa_authority/rates/documents/20151001.05-RS-I.pdf.

In the Project Approach of the Technical Proposal, the Bidder shall provide a description of the O&M plan for the project that demonstrates the long term operational viability of the proposed project. The plan should include a discussion of the staffing levels proposed for the project, the expected role of the CONTRACTOR or outside contractor, scheduling of major maintenance activity and the plan for testing equipment. The Bidder shall provide examples of the Bidder's experience with O&M services for other similar projects. The Bidder shall also provide a detailed list of all services that will be included in the O&M contract.

Contract performance shall be evaluated annually, within 60 days of the contract anniversary. Performance Testing shall be conducted by the CONTRACTOR annually for performance verification.

On-site data storage shall store necessary data for 90 days and shall have the capability of being remotely accessed and downloaded. In the Project Approach of the Technical Proposal, the Bidder shall provide a description of the performance testing procedures.

In the Priced Proposal Worksheet, the Bidder shall specify the Fixed O&M Fee for each contract year.

3.4.2. Additional Spinning Reserve Capability

The ESS shall have additional power and energy capacity to provide spinning reserve functions. This additional energy capacity is beyond the energy capacity required for the primary application and may increase the power and energy requirements. The real power and energy requirements of the ESS for the Spinning Reserve application are defined by the power over time curve shown in Appendix R. The ESS shall have the control functions specified below for the spinning reserve functionality.

3.4.3. Expansion Capability

The Bidder shall provide a discussion of the expansion capabilities of each proposed ESS in the Technical/Qualitative Proposal. The discussion shall consider the available space inside and outside of the existing powerhouse at the Agana Substation compound as well as the Talofofo property. The discussion shall include the capabilities, limitations, and any relevant issues with increasing the power capacity of the ESS and increasing the energy capacity of the ESS. The power ($/MW) and energy ($/MWh) cost for economic evaluation shall be provided in the Priced Proposal Worksheet including a detailed breakdown of components that go into the cost figures.

3.4.4. 5-Year Warranty Extension

The Bidder shall provide a cost for a 5-year extension for the warranty described in Section 3.3.10.

3.4.5. Underground Fiber Optic Communication Line

The CONTRACTOR shall design, procure equipment and materials, obtain required permitting, construct, install, interconnect, test, and commission the fiber optic cable in underground conduit or other approved fiber optic underground enclosure with a 24” minimum depth between the Agana Substation and the Tamuning Substation. The fiber optic cable shall be 96 strands and shall include a two-year full service and parts warranty with an option to extend for three additional years.

The CONTRACTOR shall be responsible for all aspects of project implementation including:

A. Necessary permits
B. Adherence to all applicable codes and standards
C. Foundation design: using manufacturer’s standard design or modified design with expected impacts clearly delineated
D. Interconnection equipment coordination with GPA
E. The fiber optic cable shall run from the Tamuning Substation communications cabinet to the Agana Substation communications cabinet
F. Installation design: addressing all electrical, mechanical and civil systems
G. Fiber optic cable and other necessary equipment procurement and delivery
H. All on-site construction, fiber optic installation and interconnection
I. Commissioning and performance testing with coordination of third-party verification by other GPA contractor
J. Full documentation of all equipment, warranties, manuals, etc.

K. Designs shall be accompanied with the stamp of a registered Professional Engineer (PE) and certified by RCDD

The CONTRACTOR shall supply Singlemode Fiber. Installed cable shall be 8 to 9/125 micron core/cladding, singlemode. All materials in the cable are to be dielectric. Installed fiber must meet or exceed the following performance specifications in the table below:

Cable Type	Wavelength (nm)	Max Attn. (dB/Km)
Singlemode, Inside plant	1,310	0.5
	1,550	0.5
Singlemode, Outside plant	1,310	0.35
	1,550	0.2

The fiber shall be 96-strand single mode (OS2) loose tube, gel-free fiber optic cable, equivalent or better, as described:

A. Outdoor and indoor use (Aerial or Duct installation)
B. All-dielectric construction
C. EIA/TIA -598 color coding for fiber optic cable
D. Wavelengths 1310nm/1383/1550nm
E. Maximum Attenuation 0.4 dB/km/ 0.4 dB/km/ 0.3 dB/km
F. Serial 1 Gigabit Ethernet 5000m/ - / -
G. Serial 10 Gigabit Ethernet 10000m / - / 40000m
H. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load)
I. Capable of a minimum crush resistance of 850 lb/in

3.4.6. Price Deduction Option for MW Capacity Size Reduction

The BIDDER shall provide a price deduction option for each ESS in $/MW for a reduction in the real power MW capacity offered in the basic bid. The minimum capacity rating shall be 18 MW for the Agana Substation ESS and 10 MW for the Talofofo Substation ESS. GPA shall have the option of selecting a lower capacity rating than the basic bid offer. The difference between the capacity rating in MW of the basic bid offer and the lower option will be multiplied by the $/MW price option to determine the total cost reduction from the basic bid.

4. PRODUCT DESCRIPTION

The bids for Energy Storage Systems shall be developed based on the requirements described below.

4.1. Energy Storage System Application

24 MW Agana Substation ESS

The primary application for the 24 MW ESS is to provide frequency regulation. The ESS is expected to work in tandem with the existing generation assets to regulate system frequency. The ESS is also expected to respond to fault conditions to minimize over and under frequency fluctuations. The frequency regulation application generally requires a relatively high power to energy ratio. Large amounts of energy are not required as compared to load shaping and other applications.

16 MW Talofofo Substation ESS

The primary application for the 16 MW ESS is to provide solar PV ramping support for the fluctuating output from the nearby 25 MW solar farm in Dandan such that ramp-rates are kept within 1% of rated power output per minute (250 kW/min) measured at the Talofofo Substation. The solar farm is currently owned and operated by NRG.

Each ESS also requires functionality for secondary or future applications. These applications include, but are not limited to, spinning reserve and voltage regulation. Both ESSs are expected to provide spinning reserve as a secondary functionality to respond to the loss of generation and reduce the frequency of under-frequency load shedding. For systems offered with energy capacities higher than the minimum requirements while economically competitive, additional functions may be considered.

4.2. Ratings and Basic Specifications

4.2.1. Nominal Ratings

The nominal ratings for the ESS are listed below. The nominal power and energy ratings are considered guidelines and may be subject to the power overload capabilities of the ESS. Bidders may offer systems with off nominal ratings provided the power and energy requirements meet the stated minimum performance requirements.

24 MW Agana Substation ESS

- Real Power: +/-24 MW (supplying and absorbing)
- Reactive Power: +/-24 MVAr (supplying and absorbing), limited with real power priority
- System Rating: 24 MVA
- Time at Rated Power: See Real Power and Energy Requirements
- Frequency Range: 55-65 Hz (ride-through)
- Voltage Range: 0.0-1.25 pu (ride-through)

16 MW Talofofo Substation ESS

- Real Power: +/-16 MW (supplying and absorbing)
- Reactive Power: +/-16 MVAr (supplying and absorbing), limited with real power priority
- System Rating: 16 MVA
- Time at Rated Power: See Real Power and Energy Requirements
- Frequency Range: 55-65 Hz (ride-through)

- Voltage Range: 0.0-1.25 pu (ride-through)

4.2.2. Specification Duration

The ESS shall meet the specified requirements over the total term of the O&M contract, 25 years.

4.2.3. Operating Assumptions

The ESS shall operate at an annual availability of 95% or greater and with an AC-AC round-trip efficiency of 90% or greater.

The ESS shall have a redundant communications network and back-up auxiliary power.

24 MW Agana Substation ESS

The Bidder shall assume that the ESS will respond to changes in system frequency outside a deadband with a droop setting. The deadband setting must be configurable within the range from 0.0 Hz to 0.25 Hz. The droop setting must be configurable within the range from 0.5% to 5%. Appendix S contains the system frequency data for a typical 24-hour period using one-second sampling. These data shall be used to estimate the impact on the expected ESS lifetime due to usage for frequency regulation. Additionally, the Bidder shall assume that the ESS will respond to fifty large system disturbances per year for the life of the ESS. These fifty events are expected to be the largest frequency excursions throughout the year and the ESS is expected to provide frequency support during these events within the capabilities of the ESS.

16 MW Talofofo Substation ESS

The Bidder shall assume that the ESS will smooth the output fluctuations from the 25 MW solar farm such that ramp-rates are kept within 1% per minute (250 kW/min) at the guaranteed success rate of 97%. The solar output shall be measured at the Talofofo Substation. The ESS shall offset the solar farm output such that the net output of the solar plant plus the ESS output does not increase or decrease at a rate greater than 1% per minute (250 kW/min). The ESS corrective signal shall be calculated at least once per SCADA cycle (4 seconds) and will limit the ramp between consecutive SCADA samples. The ramp limits should be implemented to limit the sample-to-sample change in net power. In the Project Approach of the Technical Proposal, the Bidder shall provide a description of the mitigation plan to smooth the solar farm output. The plan shall describe how the solar output will be measured and how the signal will be provided to the ESS control system using the 25 MW solar farm output data provided in Appendix X.

Additionally, the Bidder shall assume that the ESS will respond to fifty large system disturbances per year for the life of the ESS. These fifty events are expected to be the largest frequency excursions throughout the year and the ESS is expected to provide frequency support during these events within the capabilities of the ESS.

4.2.4. Real Power and Energy Requirements

24 MW Agana Substation ESS

The real power and energy required by the ESS throughout the 20-year warranty period must satisfy the 24 MW rated power output for 15 minutes and must also satisfy the 12-hour Frequency

Regulation Duty Cycle from PNNL-22010 Rev 2 Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems provided in Appendix U. These data shall be used to estimate the energy capacity required and the impact on the ESS due to the primary frequency regulation application. The ESS shall also provide regulation for the typical 24-hour system frequency profile using one-second sampling provided in Appendix S. The minimum power output requirement of 24 MW could be satisfied by what may be considered the overload capabilities of the system provided the overload capability can last for 15 minutes. The minimum power requirement does not necessarily define the nominal or continuous power ratings of the ESS.

The ESS power and energy requirements for the frequency regulation application shall be based on using preliminary deadband settings of +/- 0.1 Hz with a droop value of 0.5%. A specific energy quantity (MWh) is not directly specified. The system will primarily be used as a frequency regulation resource. The ESS must be able to simultaneously provide frequency regulation and spinning reserve within the limits of ESS power and energy capability. All Bidders are encouraged to describe the power overload capabilities of their proposed system.

16 MW Talofofo Substation ESS

The real power and energy required by the ESS throughout the 20-year warranty period must satisfy the 16 MW rated power output for one hour and must also be sufficient to control the ramp-rate of the nearby 25 MW solar farm to 1% of rated power output per minute (250 kW/min) at the guaranteed success rate of 97%.

The fully functional operating range of the ESS, with respect to energy, is defined in this specification as 0-100% State of Charge (SOC). This means that if the Bidder's proposed system is recommended or required to operate within the ESS manufacturer's stated specifications with a minimum SOC greater than 0% or a maximum charge less than 100%, then the Bidder must adjust the manufacturer's stated specifications to the fully functioning operating range of the ESS. For instance, if the manufacturer's specifications recommend operating the ESS within the range of 10-90% SOC, the total amount of available energy must be reduced by 20% to correspond to the 0-100% SOC range as defined for this Bid.

4.2.5. Reactive Power Requirements

The ESS shall have the capability to output up to the nominal real power capacity magnitude (+/-24 MW or +/-16 MW) of +/-24 MVAr or +/-16 MVAr, on a continuous basis. The real power order of the ESS shall take priority over the reactive power order. If the nominal reactive power capacity rating cannot be met, Bidders shall describe the reactive power capabilities of their proposed system.

4.2.6. Response Times

The ESS shall have the ability to change its output power from 0-100% of its maximum overload rating within 200 ms. This includes positive and negative real and reactive power.

4.2.7. Ride-through and Synchronization Capabilities

The ESS shall have the ability to remain online and functional during severe disturbances. The ESS shall not lose synchronism or trip offline for disturbances that the ESS is intended to mitigate. This includes the requirement to ride through rapid rate of change of frequency events and to ride through zero or near zero voltage events with recovery as the voltage recovers. All limitations related to the ride-through and synchronism capabilities of the ESS shall be stated.

4.2.8. SCADA/EMS/SA/AGC

The ESS shall have the capability to interface with GPA's SCADA, EMS, Substation Automation (SA) and AGC systems. The interface must include hardwired discrete and analog I/O, and communications based discrete and analog I/O. DNP 3 Secure Authentication (SA) (serial and TCP/IP) and IEC61850 communications protocol must be supported. All ESS control functions and setting parameters shall have read/write accessibility through the DNP 3 Secure Authentication (SA) (serial and TCP/IP) and IEC61850 communications protocol.

The ESS shall have a Human Machine Interface (HMI) at the GPA control center which shall be remotely connected to the ESS over the GPA network.

The ESS shall be capable of alerting GPA when conditions indicate that:

- Preventive maintenance should be performed to keep the ESS at the specified performance levels
- The ESS is in imminent danger of failing to meet specified performance levels or potential safety hazards exist
- The ESS can no longer meet the specified performance criteria or safety hazards exist

The monitor points of the ESS shall include but not be limited to AC voltage, current, power factor, MW, MVA, MVAR and DC voltage and current. Points of monitoring shall be determined during design. System temperature shall be monitored at a minimum of four points.

The ESS shall meet GPA's existing cyber security requirements.

4.3. Manual Operations

The ESS shall have the capability to fully operate without GPA's SCADA, EMS, SA and AGC systems. All ESS functionality shall be available and operator interface provided by a local control interface.

4.4. Control Functions

The control functions for the ESS are described below. It is important for Bidders to describe and illustrate the control modes and methods of operation proposed. The flexibility of the ESS controls shall also be discussed and provide indication of the ease of control system changes such as adding new control modes and methods of operation.

4.4.1. Control Function Definitions

- Operational – ESS is operating in its current mode, supplying or absorbing real or reactive power
- Power Order – The final real or reactive power signal used by the ESS to determine the power output. The power order may be a summation or limit of the individual operational control functions.

4.4.2. Droop Control / Frequency Regulation

A frequency droop control function shall be provided. This mode supports the primary application for the 24 MW ESS, namely, frequency regulation. This is intended to be the primary mode of operation for the 24 MW ESS. When enabled, the ESS will respond to help regulate over and under frequency conditions.

Basic Functionality

The droop control function is the normal operating mode. During normal operations the system frequency is near 60 Hz and the real power output of the ESS is at its setpoint, normally 0 MW. During normal operation, the ESS will attempt to regulate off-nominal frequency by supplying or absorbing real power. The amount of real power will be dependent on the system frequency, the droop setpoint, the droop deadband values, and the power setpoint. The ESS shall operate on its droop line, outside of the under/over-frequency deadband setpoints and within the physical and electrical limitations of the ESS.

The basic droop characteristic provides an input or output of real power based on the frequency deviation from nominal. When the frequency is within some deadband around nominal, the real power output should be equal to a base power setpoint, which will normally be zero. However, during certain system events such as a trip of a large generating unit, the power setpoint must be settable to a non-zero value. During charging of the ESS, the power setpoint is expected to be a negative value. The droop characteristic describes the difference in actual setpoint from the nominal setpoint, as frequency varies away from nominal.

The droop line shall be made up of piecewise linear segments. Four segments shall be provided for each side of the frequency deviation spectrum (positive and negative). Each segment shall be defined by the frequency start and stop points and the droop value.

Automatic Switching of the Power Setpoint

The real power setpoint should be able to be configured to respond to several types of discrete system events, including manual configuration. The types of discrete events envisioned include large frequency deviation, large rate of change of frequency (df/dt), and discrete control via external signal. The controls for these events shall operate in parallel, each producing a desired output. The power order will be determined based on the maximum desired output. The types of triggers are described below.

- Frequency – The frequency trigger is governed by over/under frequency setpoints and associated delay times. If the system frequency is found to be above or below the over/under frequency setpoints for a time period longer than the delay time setpoint, then a new power setpoint is computed and made operational.
- Rate of Change of Frequency (df/dt) – The df/dt trigger is governed by a df/dt setpoint, and predetermined scheduled output. If the system df/dt is found to be less than the df/dt setpoint (for an under-frequency event), then the ESS real power setpoint is changed to the predetermined scheduled output value and made operational. A total of eight groups of df/dt trigger setpoints shall be provided, four each for over-frequency and under-frequency.
- Discrete Control – The discrete control trigger is a hardwired input and discrete communication control input into the ESS control system. When triggered, the ESS will change the ESS real power setpoint to a predetermined scheduled output value, similar to the df/dt trigger. Four predetermined scheduled output values shall be available and correspond to four separate hardwired inputs and discrete communication control inputs.

Recovery

The ESS shall remain operational in droop control mode continuously, within the capability of the ESS. Typically, the real power setpoint will eventually be reduced to 0 MW following a disturbance and system recovery, over several minutes, as the system recovers from the disturbance.

State of charge and ramp down setpoints shall be provided to reduce the output of the ESS when the state of charge reaches its recovery setpoint. The ESS will then begin to ramp down the output to 0 MW based on the ramp down rate. This functionality allows the ESS to retain a set amount of energy for other ESS functions as necessary.

Manual Power Setpoint Changes

When not directly controlled by GPA's SCADA, EMS, SA and AGC systems, manual changes to the ESS power setpoint shall be accompanied by duration, ramp-rate, and final power setpoints. The duration is the time period where the ESS power output remains constant at the new power setpoint. The duration shall include a value to indicate an infinite period, or time period that is constant until the power setpoint is changed. The ramp-rate setpoints will determine the rate of the controlled ramps from the current power setpoint to the final power setpoint.

4.4.3. Isochronous Control

Isochronous control mode shall be provided. This mode allows the ESS to regulate the system frequency to 60 Hz. The isochronous control parameters shall be adjustable.

4.4.4. Voltage Control

Voltage control shall be provided. This function allows the ESS to regulate the voltage of a designated location. At a minimum, the scheduled voltage, min/max voltage deadbands, min/max reactive power output, and voltage droop setpoints shall be provided. The real power order of the ESS shall take priority over the reactive power order.

4.4.5. Ramp-Rate Control (16 MW ESS Only)

Ramp-rate control shall be provided. This is intended to be the primary mode of operation for the 16 MW ESS. In this mode, the ESS will supply or absorb real power at the point of interconnection in an attempt to control the power output of the nearby 25 MW solar farm such that the ramp-rate is limited based on the ramp-rate setpoint. Sufficient SOC management control must be provided for optimal ramp-rate control. Manual and remote changes to the ESS ramp-rate setpoint shall also be allowed if needed.

4.4.6. Smoothing Control (16 MW ESS Only)

Smoothing Control shall be provided. This mode allows the ESS to mitigate rapid fluctuations from intermittent power, such as PV, by absorbing or supplying power at appropriate times as determined by a control system in order to smooth out the high frequency components of the intermittent power.

4.4.7. Firming Control (16 MW ESS Only)

Firming Control shall be provided. This mode allows the ESS to provide or absorb energy to supplement renewable generation such that their combination produces steady power output over a desired time window. The ESS discharges power during periods for which renewable generation falls short of a specified threshold and absorbs power when renewable generation exceeds this threshold to provide steady power output over a certain window of time. Manual and remote changes to the constant power setpoint shall also be allowed if needed

4.4.8. Peak-Shifting Control

Peak-shifting control shall be provided. This mode allows the ESS to help reduce the peak load by discharging for a duration of time during the daily on-peak period for electric power and recharging during the daily off-peak period and be available again the following day.

4.4.9. Other Modes of Operation

Other modes of operation are anticipated in addition to the various control modes described in this specification. These modes support the core functionality of the ESS and include the charging, maintenance, self-protection, and testing functions. The Bidder shall include detailed descriptions of these functions including limitations.

4.5. Acceptable ESS Technologies

Acceptable ESS technologies in this IFB include commercially available batteries, flywheels and all other technologies that meet the requirements specified.

4.6. Proven Technology

The proposed resource technology and key components must have a minimum of one (1) year of operating experience in commercial utility application. If the proposed technology is a "scale up" of an existing facility, the operational performance data for the smaller plant must be at least 1/10 the proposed plant size or larger.

4.7. Other Design Conditions and Requirements

The following are design conditions and requirements for the proposed ESS:

- Ambient Temperature Range: Minimum of 50 degrees F, Maximum of 110 degrees F
- Peak Wind Gust: 170 mph
- Seismic Zone: Zone 4
- Audible Noise: Maximum of 65 dBA at 50 feet in any direction from the site fence
- Anti-Corrosion Protection: Effective protection for all exposed parts in wet, salty, sunny, corrosive, or abrasive environments or conditions
- Protection: Protective relaying features, circuit breakers or fuses which self-protect the ESS in the case of electrical faults
- Harmonics: Harmonic specifications of IEEE 519
- Grounding: Personnel protection for step and touch potential in accordance with IEEE 80 and also adequate detection and clearing of ground faults within the ESS
- Spill Containment: Mitigation against hazardous spills to prevent discharge to surrounding site soil
- Personnel Safety: Eyewash stations and any other equipment to ensure personnel safety
- Fire Protection: System shall conform to national and local codes (NFPA, GFD, etc.). Fire protection design and alarms shall take into account that the ESS may be unattended most of the time. If codes do not exist for the proposed ESS, current industry accepted best practices shall be employed.