Request for Proposal Energy Storage

Cooperative Name

Project Name (e.g., Cooperative Name Energy Storage)

Project Number

Date Issued

Cooperative Name

Cooperative Address

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# Part 1: Introduction

## Purpose:

Co-op Name, hereinafter called the ''Owner,” is requesting that certain Suppliers (“Supplier”) submit a Proposal (“Proposal”) to perform the Services as set forth and described herein pursuant to the terms and conditions of this Request for Proposal. This Request for Proposal (“RFP”) is neither a contract nor an offer. Suppliers shall not receive any rights whatsoever from submitting a Proposal.

## Project Objectives:

Define the expected results. This can be a bulleted list of benefits, including: reduce peak load by **XX** (% or KW) for a period of **YY** time, reduce the impact of renewable variability, frequency regulation, etc. Details concerning specific current conditions are provided in Section 1.3. Additional information on the current conditions may be provided in *Part 5: Technical Requirements*.

## Current System:

The following section provides a high-level description of the Owner Name system. Details of the system, including a One-Line Diagram, are included in Section 5.1 of this RFP.

Provide a description of the electric system of the Owner. This section should include, at a minimum:

* Area covered by the existing electrical system;
* General characterization of electrical loads (commercial, residential, etc.);
* Generating capacity and nature of generation, including renewables feeding into the system;
* Number of substations; and
* Energy consumption.

Example:

The Owner’s activity consists of approximately 6,100,000 square feet of building space within 800 various facilities. The average electrical load for the entire activity is 6.8 MW, and the peak load for the entire activity is 13.3 MW. The average annual energy consumption for the utility is approximately 60,000 MW-hours. Currently, the Owner has the following distributed energy resources: 930 KW of PV, 3 MW of landfill gas power, and the base is considering 2.2 MW of combined heat and power. The desired XXX (storage solution) will power critical loads at the base. These loads consist of two feeders with four loops with an average load of 3.3 MW, and peak load of 6.1 MW will be supported by the microgrid. The additional distributed energy resources potentially available to the microgrid are 275 KW of PV, 3 MW of landfill gas energy, energy storage, natural gas generators, and combined heat and power plants. Existing control systems are currently Johnson Controls. Building controls systems compatibility and interface will be considered during development of project requirements. Additional information on the current system can be found in *Part* 5: Technical Requirements.

## Owner / Issuing Office:

*For one point of contact*

This RFP is issued by Owner Name. The contact person is:

Contact Name, Contact Title

Owner Name

Owner Address

Contact Email Address

*For two points of contact*

This RFP is issued by Owner Name. For contractual questions, the contact person is:

Contact Name, Contact Title

Owner Name

Owner Address

Contact Email Address

For technical questions, the contact person is:

Contact Name, Contact Title

Owner Name

Owner Address

Contact Email Address

## Obtaining Documents:

The plans, specifications, and construction drawings, together with all necessary forms and other documents for the Supplier, may be obtained from the Owner or from Other Source of Documents. The plans, specifications, and construction drawings may be examined at the office of the Owner or at the office of Other Source of Documents.

# Part 2: Review Process:

This section defines how the RFPs will be evaluated. Two options are presented, depending on how the specific evaluation will be conducted. The first is a single-step process, in which all proposals will be evaluated in their entirety. The second option is a two-step process, in which the proposal executive summaries will be evaluated to determine which proposals should be evaluated further.

**Option 1: Single-Step Process:**

Proposals will be reviewed by the evaluation team to determine the degree to which the proposed solution complies with the project objectives and whether the organization meets the experience, technical requirements, and selection criteria defined in *Part 3: Evaluation Criteria*.

**Option 2: Two-Step Process (Used when a large number of proposals are expected):**

Proposals must include an executive summary, as specified in *Part 6: Required Information and Proposal Formatting*. Each executive summary will be reviewed by the evaluation team to determine the degree to which the proposed project fits with the project objectives, whether the organization meets the experience requirements, and whether the technical approach meets the project requirements (see *Part 3: Evaluation Criteria*). Each executive summary will receive an evaluation, based on the project description provided, as to whether or not it compares “favorably” or “unfavorably” to *Part 3: Evaluation Criteria*. Favorable and unfavorable determinations will be defined by the degree of adherence to *Part 3: Evaluation Criteria* and the objectives of the project. If an executive summary receives an “unfavorable” rating, the Supplier’s full Proposal will not be evaluated further. If an executive summary receives a “favorable” rating, the Supplier’s full Proposal will be reviewed and evaluated in its entirety according to all Selection Criteria described in *Part 3: Evaluation Criteria*.

## Rejection of Proposals:

The Owner reserves the right to reject any and all Proposals received as a result of this RFP.

## Minor Irregularities:

The Owner reserves the right to waive minor irregularities or minor errors in any Proposal, if it appears to the Owner that such irregularities or errors were made inadvertently. Any such irregularities or errors so waived must be corrected in the Proposal in which they occur prior to acceptance thereof by the Owner.

## Incurring Costs:

The Owner is not liable for any cost incurred by the Supplier prior to award.

## Pre-Proposal Conference:

*If a Pre-Proposal Conference Is Held*

A Pre-Proposal conference will be held for this RFP at **[Place; Date and Time]**. Questions that arise as a result of this RFP may be presented at this conference. (Note: This could be a question-and-answer session held by telecom or webinar. If so, add appropriate date, time, and dial-in or webinar information.)

*If No Conference*

No Pre-Proposal conference will be held. All inquiries shall de directed as outlined in Section 2.5.

## Inquiries

Questions that arise as a result of this RFP must be submitted **no later than 5:00 p.m., [Time Zone & Date]**.Inquiries may be submitted electronically to the Owner atEmail address [\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_], or made in writing to the attention of the Contracting Officer,Owner Name, Owner Address. All inquiries should reference RFP Name and RFP Number (if applicable).

*A Pre-Proposal Conference [will / will not] be held prior to submittal of proposals. [If so, provide date and place.]*

Inquiries will be responded to during the Pre-Proposal Conference. A summary of the responses will be posted on the Owner’s website at Web Address under “Questions & Answers.”

*If there is NO Pre-Proposal Conference*

Inquiries will be responded to and posted on the Owner’s website at Web Address under “Questions & Answers.”

## Changes to RFP:

The owner will email the Supplier’s Contracting Officer when information is posted to the website.

## Due Date:

To be considered for an award, a Proposal must be received by the Owner **no later than 12:00 p.m., DUE DATE**. Proposals must reference the RFP Name and Number. Proposals may be submitted electronically toEmail address no later than 12:00 p.m. on the due date. A confirmation will besent by the Owner within 24 hours of receipt of the Proposal. If a confirmation is notreceived, the Supplier must contact the Owner’s point of contact as identified in Section 1.4. Electronic submission of PDF documents cannot exceed 15 MB.

Suppliers unable to submit a Proposal electronically must mail or deliver one original Proposal with signature and four (4) additional copies of same to the Owner, Owner Address. Proposals must be received by the Owner **no later than 12:00 p.m., DUE DATE.** Fax Proposals will not be accepted. Proposals hand delivered to the Owner shall be accompanied with a pre-printed receipt, provided by the Supplier, indicating Proposals were “Hand Delivered.”

Any Proposal received subsequent to the time specified will be promptly returned unopened to the Supplier.

## Proposals:

To be considered, Suppliers must submit a complete response to this RFP, using the format specified in *Part 6: Required Information and Proposal Formatting*. The Proposals must be signed by an official authorized to bind the Supplier to the provisions of this RFP. For this RFP, the Proposal must remain valid for at least one hundred eighty (180) days.

Proposals will be accepted only from those prequalified Supplier(s) invited by the Owner to submit a Proposal. **(Note: This applies only if a two-stage process is being implemented.)**

## Acceptance of Proposal Contents:

The contents of this RFP and the Proposal of the selected Supplier may become contract obligations if a contract award ensues. Failure of the selected Supplier to accept these obligations may result in cancellation of the award.

## Economy of Preparation:

Proposals should be prepared simply and economically, providing a straightforward, concise description of the Supplier’s ability to meet the requirements of the RFP, using the format provided in *Part 6: Required Information and Proposal Formatting*. Hardcopy Proposals may be binder clipped. Staples, fancy bindings, colored displays, promotional materials, and so forth, are not desired. Emphasis should be on the completeness and clarity of content.

## Prime Responsibility:

The selected Supplier(s) will be required to assume responsibility for all services offered in their Proposals, whether or not they possess them within their organizations. Further, the Owner will consider the selected Supplier(s) to be the sole point of contact with regard to Contract matters, including payment of any and all charges resulting from the award.

## Partner / Sub-Supplier Responsibilities:

Organizations partnering with selected Supplier(s) must comply with the requirements of the RFP and will be held to the same standards as prime Supplier(s). Organizations partnering with selected Supplier (s) must enter into a partnership agreement. A copy of the partnership agreement must be provided to the Owner. Partnering organizations may be non-profit or for-profit entities.

# Part 3: Evaluation Criteria:

In estimating the best value to the Owner, the Owner will consider, in addition to the price quoted in the Proposals, the following, discussed in more detail in Sections 3.1 to 3.5:

* Executive Summary
* Technical Approach
* Management Approach
* Key Personnel and Staffing
* Past Experience

All technical evaluation factors will be weighted equally OR provide weighting factors.

The cost proposal will be evaluated separately from the technical proposal.

## Executive Summary:

The Owner will evaluate the executive summary based on the clarity and completeness of the approach for executing the work for each of the major tasks identified in *Part 4: Statement of Work*.

The executive summary will be evaluated only if a two-stage process is performed. In this case, the executive summary alone will be evaluated to determine a “short list” of vendors that will have their entire proposals evaluated. Requirements for the executive summary are given in *Part 6: Required Information and Proposal Formatting.*

## Technical Approach:

The Owner will evaluate the Technical Approach factor based on the clarity and completeness of the approach for executing the work for each of the major tasks identified in *Part 4: Statement of Work*.

At a minimum, the following technical solution components shall be addressed:

* Discussion of system operation;
* Description of technology chosen and benefits to the Supplier of the chosen technology, including, but not limited to, chemistry and charge / discharge rates;
* Description of services and capabilities, such as islanding, power conditioning, ability, frequency regulation, ability to switch between services offered (renewable energy smoothing to peak load management);
* Ability to incorporate Energy Storage (ES) technologies into existing Owner systems;
* System Monitoring, System Evaluation, System Reporting; and
* List of technical Deliverables (including drawings) to be provided by the Supplier after contract award.

Proposals will be evaluated for the technical value (strength) of the proposed solutions in meeting the overall objectives of the Owner project and minimizing technical risk to the Owner. Technical solution evaluation will also consider the risks of not meeting the schedule.

## Management Approach:

The Owner will evaluate the degree to which the Supplier’s management approach reflects an adequate level of understanding of the services to be provided for all major tasks as set forth in *Part 4: Statement of Work*. The Owner will evaluate the degree to which the Supplier explained its operating methods for maintaining control of the project and project costs. The Quality Control Plan (QCP) will be evaluated to assess completeness, relevancy, and efficiency as it relates to *Part 4: Statement of Work* and whether it reflects the Supplier’s plan to monitor and perform quality assurance during the entire task order period. The Owner will evaluate the degree to which the Supplier has described major risks, reflecting an understanding of the project’s scope and complexity, as well as the degree to which the proposed mitigation plan lessens those risks.

Proposals will be evaluated for the value of the project management techniques and methodologies identified to achieve project objectives. Specific approaches identified will be considered. Overall project risk to the Owner will be assessed and evaluated.

As a minimum, the following components shall be addressed:

* List of project deliverables to be provided by Offeror after contract award, such as QA / QC plans, etc.;
* Scheduling of Work to include design, procurement of components, installation, commissioning, monitoring, evaluating, and reporting;
* Safety and Security;
* Techniques used to meet tight schedule requirements and manage schedule;
* Techniques used to manage cost;
* Techniques used to manage overall quality (include design, construction, evaluation, cyber security, and operational evaluation);
* Management of Sub-Suppliers and vendors (non-internal resources); and
* Ability to work interactively with Owner staff on project.

## Key Personnel and Staffing:

The Owner will evaluate the **quality** and **quantity** of the experience, skills, and qualifications for each Key Personnel. The Owner will evaluate the Staffing Plan to determine whether it is reasonable and realistic for the project described in this RFP.

The Supplier shall provide a narrative explanation of the relevant experience related to this type of work and identify key resources that will be applied to the project. Availability of additional contingent resources to maintain the schedule and deal with unpredicted circumstances shall be addressed.

Proposals will be evaluated for the value of the relevant experience and available resources. In addition, risk will be assessed based on both experience of staff and resources actually to be applied to this project, which includes an assessment of organizational flexibility and resources to deal with unpredicted situations and occurrences.

## Past Experience:

The Owner will evaluate Past Experience based on the following qualitative and quantitative factors, which are of equal importance, OR provided weighting:

* Quality of products or services, including past reliability data
* Effectiveness of management
* Initiative in meeting requirements
* Timeliness of performance
* Cost control
* Business practices
* Customer satisfaction

Suppliers with no past experience history, whose past performance is not relevant, or for whom past experience data are not available, will not be evaluated favorably or unfavorably on past performance. Every attempt will be made to ascertain meaningful past experience information on which the Supplier’s past experience can be evaluated. If a Supplier does not submit the past experience information required, and the Owner becomes aware that the Supplier, in fact, has relevant past experience history, the Supplier may be deemed ineligible for award.

Proposals will be evaluated for the relevance of past performance leading to an assessment by the Government and subsequent confidence of the Government that the Offeror will successfully complete the contract. At its unilateral discretion, the Owner may contact customers for input, consider institutional knowledge and records on other projects, and review ratings from any formalized Owner systems for consideration in the evaluation.

## Price Proposal Valuation:

The Price Evaluation Criteria for Award is “Price Reasonableness.” Prices that are excessively high or low may be considered unrealistic and unreasonable. The competitiveness of the Supplier’s price will be evaluated, taking into consideration the most probable cost of doing business with the Supplier, based on the merits of the Technical Proposal.

## Debarment Certification:

The Supplier must provide to the Owner a suspension and debarment certification in the form of a completed Form AD-1047 (*USDA Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion*). Form AD-1047 is provided at the end of this RFP.

## Due Diligence:

Prior to the submission of the Proposal, the Supplier shall make and be deemed to have made a careful examination of the plans, specifications, construction drawings, and form of the Proposal, and shall review the location and nature of the proposed construction, the transportation facilities, the kind and character of soil and terrain to be encountered, the kind of facilities required before and during the construction of the project, general local conditions, environmental and historic preservation considerations, and all other matters that may affect the cost and time of completion of the work. The Supplier will be required to comply with all federal, state, and local laws, rules, and regulations applicable to its performance, including those pertaining to the licensing of Suppliers, and the Anti-Kickback Act of 1986 (*41 U.S. C. 51 et seq*).

##  Terms and Conditions:

The Supplier is required to provide detailed comments on the Owner’s standard form agreement contained in Part 7, if included, and provide the Supplier’s form agreement if it is not.

# Part 4: Statement of Work:

The scope of work for the Energy Storage (ES) shall include the following principal elements. The Supplier shall be responsible for identifying and providing any and all other additional equipment, components, and services necessary to install a fully functional ES. All tasks defined below shall comply with the requirements and specifications defined in *Part 5: Technical Requirements*.

## Task 1: Project Management Plan (PMP):

The Supplier shall provide a project manager to assist the Owner in planning, initiating, managing, and executing the project. Specific reporting and documentation requirements are presented in *Part 5: Technical Requirements*. Among other responsibilities related to this role, the program / project managers shall:

* Provide project leadership and communications with the Owner and other interested stakeholders;
* Provide project planning and scheduling;
* Coordinate the project management role to include:
	+ Performance monitoring and measurement
	+ Reporting and documentation associated with project / program objectives
	+ Stakeholders briefing
	+ Project support, integration, and close-out service
* Be responsible for all Supplier work performed under this contract. The project manager shall be responsible for providing status reports and monthly project reports to the Owner’s project manager and contracting officer.

The PMP shall present the Supplier's plan for completing the project. The Supplier’s plan shall be responsive to the defined tasks and describe, in further detail, the approach to be used for each aspect of the project, as defined in the Technical Proposal. At a minimum, the PMP shall include the risk, quality, and technical management approach, work breakdown structure (WBS), detailed schedule, cost requirements, and proposed personnel. The Supplier shall keep the PMP up to date throughout the period of performance.

## Task 2: ES Design and Fabrication:

The Supplier shall be responsible for the design and fabrication of the ES system so as to satisfy the requirements defined in *Part 5: Technical Requirements* and include:

* ES & inverter
* Control System
* Electrical connections
* Interface to SCADA system
* Interface to Communication System

All design and equipment shall comply with the latest versions of:

(Sample standards)

1. ANSI – American National Standards Institute
2. ASTM – American Society for Testing and Materials
3. IEEE – Institute of Electrical and Electronics Engineers
4. IEC – International Electrotechnical Commission
5. ISA – Instrument Society of America
6. NEC – National Electrical Code
7. NEMA – National Electrical Manufacturers Association
8. NIST – National Institute of Standards and Technology
9. NFPA – National Fire Protection Association
10. NESC – National Electrical Safety Council
11. OSHA – Occupational Safety and Health Administration
12. UL – Underwriters Laboratories
13. Others

The Supplier shall meet all federal, state, county, local, and municipal codes and regulations.

The Supplier shall provide and support three (3) design reviews with the Owner’s staff prior to fabrication of the system components. In some cases, parts of the system can begin fabrication prior to the system design being completed. Approval of the Owner’s project manager shall be received by the Supplier before initiating any component fabrication prior to completion and approval of the final design.

The three (3) design reviews shall be conducted at:

* 30% Completion
* 50% Completion
* 100% Completion

## Task 3: Permitting and Site Preparation:

The Supplier shall coordinate with the Owner to determine all required permits and obtain them for the installation of the ES.

The Supplier shall also be responsible for all site preparation.

## Task 4: Factory Acceptance Testing:

The Supplier shall conduct a Factory Acceptance Test (FAT) of the ES and control system at its factory prior to shipment, when applicable. If a FAT cannot be conducted at the factory, the Supplier shall request a waiver from the Owner. The waiver shall include a risk mitigation plan to account for potential issues during Commissioning that would normally be expected to be corrected during a FAT.

The Supplier shall capacity test 100% of the production cells and control systems to ensure compliance with design requirements. The Supplier may propose optional alternate testing programs that result in a benefit to the Owner. However, the base Proposal shall include capacity testing of 100% of the cells. All Proposals for alternate testing shall include details of the proposed plan and the cost benefit to the Owner.

The Supplier shall provide the Owner with the opportunity to witness the FAT and shall provide adequate advance prior notice of such tests to allow the Owner sufficient time for scheduling and travel to the testing site(s).

The Supplier shall test and submit test data for the cells designated for use on this project. At a minimum, the following tests shall be performed:

* Capacities, Amp hour, and Watt hour;
* Heat Generated;
* Efficiencies (AC to AC);
* As applicable, maximum noxious and toxic material release rates (along with relevant Material Safety Data Sheets (MSDSs) for chemicals and for any fumes that might be generated in case of overheating or a fire);
* Ability of control systems to operate ES, including initiation of ad-hoc commands; and
* Communication system interoperability with ES.

Detailed test requirements are defined in *Part 5: Technical Requirements*.

## Task 5: Installation and Utility Interconnection:

The Supplier shall conduct the following as part of the installation task:

* Perform set-up and configuration of the ES system at location
* Interconnect the ES system with location for interconnection
* Install and complete any terminations required for system installation
* Install any required communication system equipment and wiring, as defined in *Part 5: Technical Requirements*
* Interconnect ES with local Remote Terminal Unit (RTU)
* Install / integrate control system with existing SCADA / Emergency Management System (EMS) system

## Task 6: Acceptance Testing and Commissioning:

After shipment and installation of the ES and associated control system, the Supplier shall commission the system prior to it being placed into operations.

The Supplier shall develop and perform field testing procedures to ensure that the ES will perform as designed and that the system meets the performance criteria specified elsewhere in these Specifications. All modes of operation as described in these Specifications shall be tested. The Supplier shall determine that the ES is fully operational and suitable for acceptance testing, as witnessed by the Owner. The Supplier shall document all acceptance and performance tests performed. The Supplier shall submit documentation, analyses, and a summary in a test report for the Owner’s records. The acceptance test procedure will be developed by the Supplier and shall demonstrate to the Owner that the ES is operational and performs as specified. These tests shall include, at a minimum:

* Verification of sensors, metering, and alarms;
* Verification of all control functions, including automatic, local, and remote control; and
* Verification of performance criteria.

The Owner’s staff will be present for all tests and shall confirm, through signing the test results report, successful completion of either FAT and / or Commissioning.

Detailed test requirements are defined in *Part 5: Technical Requirements*.

## Task 7: Training:

The Supplier shall provide both on-site and remote training and training documentation as defined in Section 5.14, Operator Training and Tools.

All training courses and materials shall cover the following:

* ES System
* Inverter Operations
* Control Systems
* Operations and maintenance
* Communications

## Task 8: Operations and Maintenance (O&M):

The Supplier shall provide O&M support as defined in Section 5.12, Inspection, Acceptance Testing, and Startup.

# Part 5: Technical Requirements:

## Service and Site Conditions:

### Location:

Describe the location (e.g., XX Substation); use street address. Also include items such as elevation.

### Environment:

Site environment conditions specific to this procurement are identified in Figure 5‑1.

|  |  |
| --- | --- |
| **Item Description** | **Characteristic** |
| Avg high temperature – January |  |
| Avg low temperature – January |  |
| Lowest temperature – Annual |  |
| Avg high temperature – July |  |
| Avg low temperature – July |  |
| Highest temperature – Annual |  |
| Max precipitation – 24 hours |  |
| Mean precipitation – annual |  |
| Max snow – one month |  |
| Mean snow – annual |  |
| Avg wind speed – annual |  |
| Peak wind gust |  |
| Avg dew point – January |  |
| Avg dew point – July |  |
| Heating Degree Days – Annual |  |
| Cooling Degree Days – Annual |  |
| Seismic Zone (per ICBO 1994) |  |
| Design elevation |  |
| High salt content in the air |  |
| Maximum dust loading |  |
| Known static electricity issues |  |

Figure 5‑1: Environmental Characteristics

### Electrical Infrastructure:

The ES will be connected to the Owner’s power grid at a site-specific voltage, frequency, and phase configuration, as detailed in Figure 5‑2. The connection may require additional equipment, which will be supplied by the Owner (or by Others). Conditions on some utility feeders may vary substantially from nominal. The ES shall be designed for maximum flexibility with regard to differing site-specific voltages, frequency, phase imbalance, and protection requirements.

|  |  |
| --- | --- |
| **Item** | **Characteristic** |
| Electrical Infrastructure: AC SystemInterconnection Requirement at PCC | US: TBD V ac, 60 Hz3 phase, wye or delta3-wire or 4-wire |
| Electrical Infrastructure: ExpectedVariations at PCC in Voltage,Frequency, and Phase Imbalance | Voltage: ± 10%Frequency, US: 58.5 Hz to 61 HzPhase Imbalance: ± 3% |
| Electrical Infrastructure: AvailableFault Current at Host PCC | TBD MVA three phaseTBD MVA single phase |

Figure 5‑2: Electrical Characteristics

Cooperative Insert One-Line Diagram Here

Figure 5‑3: One-Line Diagram of System

#### ES Interconnection:

The ES will be interconnected with the Owner’s electrical system at the Point of Common Coupling (PCC) between the ES and the Owner, as defined in IEEE 1547. It is expected that the PCC will be at an Owner low-voltage ac bus / feeder or at the low-voltage terminals of an Owner distribution class transformer, whichever is applicable.

#### Owner Grid Characteristics:

The ES shall be capable of continuous operation under variable voltage, frequency, and phase imbalance conditions at the PCC, as described in Figure 5‑2. Information on available fault current and other characteristics of the Owner's power grid will be provided by the Owner. This information shall be confirmed as having been received and understood by the Supplier for each Owner site during the site-specific engineering phase.

### System Operation Data or Information:

Owner system operation and interconnection data will be determined after selection of the Owner site.

### Other:

Telephone lines will be available at the Owner site boundary. Water may not be available. Connections to such utilities will be provided by the Owner, as needed. The Owner (the Supplier, in case of Optional Supplier installation) shall provide a (temporary) construction fence that matches in function and ties in with the existing fence and gates. It shall be the responsibility of the Supplier to coordinate with the Owner to ensure whatever site security measures it deems necessary for its on-site operations during the startup of the ES at each site.

### Supplier Responsibility to Obtain Site Data:

It shall be the responsibility of the Supplier to obtain the data needed to design an ES suitable for multiple site installations, as well as the site-specific data needed to install the ES at the site.

## Design, Fabrication, and Construction Requirements:

The Technical Specification includes a number of general and supporting Specifications for equipment and components, including those in Section 4.2. In cases of conflict between the codes, standards, and general specifications and this technical Specification, this technical Specification shall govern, and the Supplier shall notify the Owner in writing of any such conflicts. Work shall not proceed until such conflicts are resolved.

The design of all aspects of the ES shall be subject to the Owner's approval.

The methods and materials specified herein are intended to represent minimum requirements.

Reliance thereon shall not diminish the responsibility for meeting performance and other requirements stated herein.

### System-Level Design and Performance Requirements:

The major equipment items shall include ES, power conversion system (PCS), output / isolation transformer, storage and PCS cooling system, and local and remote control / monitoring equipment. Additional equipment shall include HVAC, wiring, connectors, protective devices, grounding, junction boxes and enclosures, instrumentation, building(s) or enclosures, and all other items needed for a fully functional, utility-interactive ES to meet the requirements set forth in this Specification.

All systems and components of systems, including electrochemical cells (if a battery system is bid), switching devices in the PCS, components of monitoring and control systems, and components of auxiliary systems, must utilize proven and previously demonstrated technology. Electrochemical cells, PCS switching devices, and control system hardware and software must be commercially available and in use for other markets. Electrochemical cells must be replaceable (in small orders) with a maximum six-week lead time under normal business conditions. Designs employing experimental or otherwise undocumented components are not permitted.

The ES shall be characterized using language and methods consistent with IEEE 1679: “Recommended Practice for the Characterization and Evaluation of Emerging Energy Storage Technologies in Stationary Applications.”

The ES shall be IEEE 1547 compliant where possible. This Specification acknowledges that some of the communication-enabled grid-supportive functionalities, as identified in Section 5.2, are outside of current IEEE 1547 requirements. It is noted that these are being addressed by the IEEE 1547.8 activity, which is in process at the time of this Specification, as the Owner may require the ES be able to island from a fault on the grid.

All equipment supplied under this Specification shall meet or exceed the surge withstand capability requirements of IEEE C37.90 (latest version).

The prudent design of the ES should include careful consideration of resonance and ferroresonance.

#### Space Requirements:

The ES shall be capable of being installed in [insert space available for ES system; e.g., 1,000 to 1,500 square feet (not necessarily rectangular)], including all Supplier-supplied equipment, required set-backs, and equipment access aisles.

#### Design Life and Life-Cycle Costs:

The ES shall have a design life of a minimum of ten (10) years. To meet this requirement, it shall be permissible for the Supplier to make periodic replacements or upgrades to the ES equipment, components, and unit ES, as required. The ES should be designed and, in particular, energy storage capacity specified such that ES replacement within the two-year (2-year) demonstration period is not required. If a failure or performance problem indicates that replacement of one or more unit ES is required during this period, it will be done under warranty at the Supplier’s cost, and the resulting performance problem and replacement noted in the demonstration results. Outage time as a result of replacement will also be charged as an “Accountable ES Outage” for the purpose of computing ES availability (see Section 5.2.1.3).

The ES shall be designed to facilitate rapid and easy replacement of the unit without significant down time.

The ES shall be designed to provide the lowest levelized life-cycle cost in cents/kWh or $/MWh, using the owner’s discount rate of X% over thirty (30) years. The design philosophy shall minimize and optimize the overall ten-year (10-year) discounted life-cycle costs to the Owner, and not be based simply on initial capital costs or low maintenance costs, etc.

Informational Note: by definition, life-cycle costs include the following: initial system cost, unit energy storage replacement cost, periodic equipment upgrades, maintenance costs, auxiliary system energy consumption, charging energy costs (i.e., due to overall energy storage and PCS losses), and any other contributors to life-cycle energy cost.

#### Reliability, Availability, and Operability:

The ES shall be designed for high reliability, as follows:

* 99% starting reliability (unit shall start on 99 out of 100 attempts);
* 99% or greater availability annually during the first two (2) years of operation; and
* Less than seventy-two (72) hours mean time to repair (MTTR), from the time of notification of a need for repair to the time of completion of repairs (i.e., inclusive of time for arrival of spare parts and repair personnel at the location of the ES).

Availability is the percentage of hours that the ES is available during the year. The availability guarantee shall begin upon start of Owner operations (facility “Commissioning”). Annual availability shall be calculated as follows: [1-(Σ accountable ES outage durations in hours/8760)] x 100.

For calculation of availability, the following definitions shall be used:

Accountable ES outages are outages caused or necessitated by the ES equipment that result in reduced capacity or loss of essential function of the ES. These outages may be initiated by failure of components; loss of energy storage capacity; or the operation of protective devices, alarms, or manual action. Such outages include both forced outages due to equipment problems and scheduled outages for ES maintenance.

Accountable ES outage duration is the elapsed time of accountable ES outages from the instant the ES experiences reduced capacity or is out of service to the instant it is returned to service or full capacity. If the ES experiences reduced capacity, but is determined by the Owner to be available for service even if the Owner elects not to immediately return the equipment to full capacity, such time will be discounted from the outage duration.

The capacity of the ES refers to the Nameplate Ratings defined in Sections 5.2.2, 5.4, and 5.5. The ES shall be considered to be in an accountable outage if any of those ratings cannot be met. The ES shall also be considered to be in an accountable outage if a scheduled (or required) charge cycle cannot be completed.

It shall be possible to fully remove, repair, and replace in the field any failed or poorly performing component (including electrochemical cells and battery modules) in six (6) hours or less, assuming that spare parts, test equipment, and repair personnel are on the site. This capability shall be demonstrated in the factory acceptance test for unit energy storage and other key components.

The ES shall be capable of unattended operation, with remote monitoring and control by the Owner's operations center.

#### Planned Maintenance Outage:

Up to one (1) week each year will be permitted for a planned outage so as to perform any required maintenance.

A longer planned outage period may be allowed for a complete replacement of all cells or energy storage components in the ES. This shall not occur during the first two (2) years of operation, nor more often than in any subsequent two-year (2-year) period. The Supplier shall provide a guarantee for the maximum length of time required for this type of maintenance operation and define the costs for extended warrantees.

### Plant Nameplate Ratings:

#### Overall System Real Power and Energy Ratings:

During discharge, the ES shall be rated so as to supply at the PCC the continuous net ac real power and ac energy output specified in Figure 5‑4. “Net” power and energy means that losses and power consumed by required plant auxiliary systems (whether derived from the ES output transformer or from auxiliary distribution feeders provided by the Host) shall be subtracted from the gross power output of the ES to determine the “net deliverable power and energy” at the site. These ratings shall be referred to in all project documentation, including this Specification, as the “Nameplate Watt Rating,” and the “Nameplate Watt-hour Rating.”

|  |  |
| --- | --- |
| **Item Description** | **Requirement** |
| Nameplate Watt Rating, acNameplate Watt-hour Rating, ac | X MW, continuousY MWh @ X MW net ac output |
| Nameplate VAR Rating | Z MVAR, continuous |
| Nameplate VA Rating | X MVA, continuousY MVA, peak output |
| Ramp Rates | 10 MW/min, zero to full discharge power10 MW/min, zero to full charge power10 MW/min, full charge to full discharge power |
| ES Efficiency, ac-ac: Peak Management Use Case Frequency Regulation Use Case(Note: For standard CAWS, this may not be possible without heat from natural gas, propane, etc. during discharge) | [TBD] % (per Supplier)[TBD] % (per Supplier) |
| Maximum ES output to controlvoltage flicker and ramp rate | 50% of Nameplate Watt Rating100% of Nameplate VAR Rating |
| Maximum ES output “following”intermittent resource generation | 50% of Nameplate Watt Rating100% of Nameplate VAR Rating |
| Black Start Capability | Yes / No |
| Time to Switch from Charge to Discharge | X seconds |

Figure 5‑4: Rating Requirements

The Nameplate Watt Rating and Nameplate Watt-hour Rating shall be achievable during discharge for the full range of stated environmental conditions, provided that the ES is fully charged and the HVAC system has stabilized.

In all modes, the ES shall be capable of being discharged at reduced power levels from that specified above. However, in no case will the energy removed from the ES be greater than the Nameplate Watt-hour Rating.

#### Overall System Reactive Power Rating:

In accordance with the VAR-related control modes identified in Section 5.5, the ES shall be capable of dispatching both leading and lagging reactive power at the PCC, up to the rated VAR capacity specified in Figure 5‑4. This rating shall be referred to in all project documentation, including this Specification, as the “Nameplate VAR Rating.”

The ES shall be capable of simultaneously producing real and reactive power as long as no Nameplate Rating is exceeded.

If the ES is called upon to dispatch real power at less than its Nameplate Watt Rating, then it shall be capable of dispatching reactive power at levels exceeding the Nameplate VAR Rating, so long as the Nameplate VAR Rating is not exceeded.

#### Ramp Rates:

Certain intelligent control functions identified in Section 5.5 specify a Ramp Time, which is a period of time over which the output of the unit is to transition to new settings in response to control actions.

In support of these functions, the unit shall be capable of supporting configurable ramp rates over the range identified in Figure 5‑4.

#### Efficiency:

Successful introduction of ES by utility companies into their systems under rate-based rules or investor financial concerns depends upon demonstrating a lower life-cycle cost for ES than for competing alternatives. To this end, the ES shall have a round-trip ac-ac energy efficiency that, in coordination with all other design and operational features of the ES, reduces, to the extent possible, overall life-cycle cost.

If the Owner has specific efficiency requirements for the ES or its components (energy storage, PCS), these are set forth in Figure 5‑4.

Losses and power consumed by required plant auxiliary systems (whether derived from the ES output transformer or auxiliary distribution feeders provided by the Host) shall be subtracted from the gross power output of the ES to determine the “net round-trip energy efficiency.” Unless otherwise specified herein, round-trip ac-ac energy efficiency calculations shall be calculated on a twenty-four-hour (24-hour) basis. That is, regardless of mode of operation, the energy consumed by auxiliary systems shall be accounted for during a full twenty-four-hour (24-hour) period. Further, for operation in which more than one charge-discharge cycle occurs during a twenty-four-hour (24-hour) period (e.g., Frequency Regulation), all charges and discharges shall be included in a single round-trip efficiency calculation for that twenty-four-hour (24-hour) period. Energy consumption outside of the twenty-four-hour (24-hour) period for which an efficiency is determined (e.g., energy consumed by auxiliaries while the ES is in a standby mode) is not to be included in efficiency calculations.

The Supplier shall clearly state in its O&M Manual (Section 5.16.10) and during Design Review (Section 5.9) the expected efficiencies of the major subsystems (energy storage, PCS), as well as the expected losses from auxiliaries.

## Use Cases / Applications:

The ES shall be capable of operating in a variety of Use Cases or offering a variety of applications to serve potential Owner needs for energy storage. The ES shall be capable of at least the following Use Cases over its entire life:

1. Peak Management (PM)
2. Spinning Reserve (SR)
3. VAR Compensation / Voltage Support (VC / VS) – available during charging or discharging
4. Frequency Regulation (FR)
5. Intermittent Resource Support (IRS)
6. Other Use Cases as defined (such as deferral of T&D upgrades, arbitrage, load following, maximum expected time the unit will have to meet daily peaks, the number of times the ES will be operated at maximum ratings to meet emergency peaks, the daily swings to meet requirements to provide frequency regulation, expected percentage of full load charge and discharge, etc.)

The Use Cases should not be interpreted as either “operating modes” or “control functions.” Section 5.5 presents the requirements for the ES Control Functions required to operate the ES in a manner that supports these Use Cases. While the naming of these Use Cases and, in some cases, the descriptions, are similar to the naming / description of the Control Functions specified in Section 5.5―the two should not be confused. Use Cases describe what the ES will be used for, while Control Functions describe how the equipment will be operated to achieve those uses.

The purpose for defining and describing the Use Cases is to provide the Supplier with essential information needed to ensure that the ES will have the desired life and performance characteristics. In particular, the requirements listed in this section should support the Supplier’s efforts to:

* Size the energy storage properly to meet the Owner’s needs
* Determine other ES subsystem performance capabilities
* Understand the various combinations of uses that the Owner may exercise

The operation of the ES at a given Owner site may also include some combination of the above Use Cases. The possible (or required) combinations are described in Section 5.3.1.

Each Use Case description below includes a capability requirement for a number of cycles and days per year of operation in that Use Case. On days of the year in which a particular Use Case is not being used, the ES shall be considered available for operation in some other Use Case, as long as the Nameplate Ratings specified elsewhere (Section 5.2.2, Figure 5‑2) are not exceeded.

IMPORTANT NOTE: The various Use Cases, Power Dispatch Profiles, and combinations thereof, described below, represent a wide range of energy storage and power conditioning system (PCS) capabilities. The ES shall be designed so as to accommodate the most stringent of the intended operation scenarios, such that any of the scenarios can be exercised without exception. The Use Cases described in this section presuppose the provision of a suitably designed control system, as outlined in Section 5.5 of this Specification. Accordingly, the descriptions of the Use Cases must be read and understood in conjunction with the description of the Control Functions specified in Section 5.5.

The following is a complete list of Use Cases / applications; the Owner should delete specific Use Cases not applicable to the procurement.

1. **Electric Energy Time-Shift:** Purchase off-peak electricity at low prices to charge the storage plant so that the stored energy can be used or sold at a later time, when the price of purchased electricity is high. This is sometimes referred to as arbitrage (a financial markets term for buying low and selling high).
2. **Electric Supply Capacity (or capacity deferral)**: Defer and / or reduce the need to build new generation capacity or purchase generation capacity in the wholesale electricity marketplace. This is defined in many markets either as a capacity credit or the avoided cost for new capacity.
3. **Load Following:** Supply power in response to a dynamic (minute-to-minute) balance between electric supply and load within a specific region or area. This is critical for leveling the load and reducing damage to G&T fossil generation due to cycling or two- shift operation.
4. **Area Regulation (or power system regulation):** Manage the interchange flows between control areas, especially to support frequency regulation. FERC 755 promotes ES as an option for frequency regulation, allowing for a higher premium to be paid where there are markets for ancillary services for the rapid response of energy storage in maintaining system frequency. This can be critical for managing the intermittency of solar, especially for small, isolated systems.
5. **Electric Supply Reserve Capacity (or spinning reserve or operating reserve)**: Ancillary service to provide electricity quickly when some fraction of the normal electric supply resources becomes unavailable unexpectedly.
6. **Voltage Support (or reactive power):** Maintain grid voltage with required stability by generating reactive power (VAR) that offsets reactance in the grid. Typically provided by transmission assets (capacitors and inductors) as well as generation resources, but also can be provided by ES.
7. **Transmission Support:** Rapid response (sub-one-second to 20-second) service to maintain the transmission system by helping to overcome disturbances such as voltage sag, unstable voltage, and sub-synchronous resonance.
8. **Transmission Congestion Relief:** Install ES at locations that are electrically downstream from the congested portion of the transmission system. Energy stored during slack periods can be selectively discharged to reduce transmission capacity requirements, congestion charges, or locational marginal pricing (LMP) for electric energy.
9. **Transmission and Distribution Upgrade Deferral**: Use ES to delay or avoid investments in transmission and / or distribution system upgrades (such as to avoid building a second transformer bank, adding capacitors, or adding new lines). This may be practical if the potential capacity upgrade would be needed only during the peak periods for a few hours.
10. **Substation On-Site Power:** ES may replace the thousands of lead-acid battery systems at substations. Newer ES technologies may reduce maintenance, improve reliability, and provide longer system life than existing systems.
11. **Time-of-Use Energy Cost Management**: Allows customers subject to Time-of-Use (TOU) rate tariffs to shift their electricity purchases to a lower-cost time of day.
12. **Demand Charge Management**: Allows customers paying high demand charges to reduce their current draw during peak demand periods (similar to #11 above, but focuses on power demand charges rather than energy use).
13. **Energy Service Reliability**: Use ES to provide highly reliable electric service. In the event of a complete power outage lasting more than a few seconds, the storage system provides enough energy to ride through outages of extended duration; to complete an orderly shutdown of processes; and / or to transfer to on-site generation resources.
14. **Electric Service Power Quality**: Use ES to protect loads against short-duration events that affect the quality of power delivered to the load. Some manifestations of poor power quality include variations in voltage magnitude, frequency variations, low power factor, harmonics, and interruptions.
15. **Renewables Energy Time-Shift**: Wind production typically occurs at night or on weekends, and solar production occurs in middle of the day (missing the late afternoon daily peak), when the value of the electricity may be low. In addition, solar is strongly affected by intermittent cloud cover. ES teamed with renewable energy generation can be charged using low-value energy from the renewable energy generation; that energy may be used to offset other purchases or sold when it is more valuable. It can also allow solar to ride through the effects of intermittent cloud cover (similar to #1 above, but specifically tied to a renewable energy project).
16. **Renewable Capacity Firming**: Use ES in tandem with intermittent wind or solar to provide a nearly constant power source. The resulting firmed capacity offsets the need to purchase or ‘rent’ additional dispatchable (capacity) electric supply resources (similar to #5 above, but specifically tied to a renewable energy project).
17. **Wind Generation Grid Integration**: Use ES to assist the integration of wind generation by managing or mitigating the more challenging and less desirable effects from high wind generation penetration. Wind integration challenges include issues related to short duration (voltage volatility, power quality) and long duration (output variability, transmission congestion, unexpected wind shortfall, minimum load violations). ES could also be used to mitigate the impact to the grid from sudden ramp rates caused by dramatic changes in wind speed (similar to #1–#9 above, but specifically tied to wind generation).

### Combining Use Cases / Applications:

This section will be used to define how functions will potentially be defined by the Owner. Because the storage system can be used for more than one “service,” the Owner will need to explain the possible combinations to be used.

## Energy Storage Subsystem:

The energy storage shall be capable of providing the type of service described herein. Only cells or modules that are commercially available, or for which suitable (not necessarily identical) replacement cells or modules can be supplied on short notice throughout the ES Test Program, will be allowed. For either premature cell or module failures and for end-of-energy-storage-life replacement, the Supplier shall guarantee cell or module availability and the length of down time (hours or days) required to replace cells.

The design, materials, and method of cell or module construction shall conform to the codes, standards, and other requirements of this Specification.

The cells or modules shall meet the seismic requirements specified by the current version of the International Building Code (IBC) for the planned location of the ES.

Cell and module design shall accommodate the anticipated vibrations and shocks associated with the periodic transportation of the ES, and shall resist deterioration due to vibrations resulting from highway transportation. External connections to the cells or modules, including inter-cell or inter-module connections (e.g., cables and / or straps) and cell or module monitoring equipment (e.g., thermocouple and voltage sensor connections) shall also be designed to prevent failure during transportation. If the cell or module is to be transported in a potentially corrosive environment (e.g., ocean transport), the cell or module shall be shrink-wrapped or otherwise hermetically sealed.

Terminal post seals shall not transmit stresses between the cover or container and the posts. External auxiliaries (if any) shall either be removed during transport or shall be mounted so as to prevent damage during shipment from one site to the next.

Cell and module terminals and interconnects shall have adequate current-carrying capacity.

Labeling of the cells or units of energy storage shall include manufacturer's name, cell type, Nameplate Rating, and date of manufacture in fully legible characters. All cells shall be traceable to point of origin for the purpose of addressing safety issues. The polarities of cell or unit energy storage terminal posts shall be embossed on the cover at the terminal.

### Storage System:

The storage system may consist of one or more units of energy storage. If the storage system consists of more than one unit of energy storage, these may be electrically interconnected in any desirable series and parallel configuration to achieve the overall system storage and power rating requirements. The ES system may operate at any dc voltage selected by the Supplier.

The ES shall include a monitoring / alarm system and / or prescribed maintenance procedures to detect abnormal “unit energy storage” conditions and notify proper personnel of their occurrence. Abnormal conditions shall include, but not be limited to:

1. Weak unit energy storage that could reasonably be expected to not provide rated capacity upon full discharge;
2. High resistance or open unit energy storage;
3. High resistance or open external unit energy storage connections;
4. Unit energy storage with temperatures exceeding operating thresholds; and
5. Internally shorted unit energy storage.

Unit energy storage monitoring, whether automatic or manual, should be specified so as to alert the proper personnel in a timely manner that an abnormal unit energy storage condition exists, or may exist. The intent of this requirement is to prevent the ES from suffering the degraded operation, premature capacity loss, or equipment damage that can result from certain types of unit energy storage failures commonly known to occur for the type of unit energy storage specified. All alarms shall be part of the control system and shall include remote display or annunciation capability.

## Control System:

### General Requirements:

The control system shall be designed to provide for automatic, unattended operation of the ES in all of the Use Cases described in this Specification (see Section 5.3). The control system design shall provide for local manual operation and remote operation or dispatch from a remotely located computer, or the Owner’s operation center.

The control system shall be programmable by the Owner for establishing or adjusting all parameters, set points, algorithms, limits, etc. required for effective operation in any of the Use Cases described in this Specification.

The control system shall include the capability for the Owner to adjust all of the settings for monitoring and managing the various functions as set forth herein. One purpose of the ES is to assist the Owner in responding to abnormal utility system conditions. Therefore, the Supplier shall design the control system, including its power supplies and connections to sensors, to be immune from utility voltage and / or frequency excursions, transients, and similar events.

### Control Functions:

The control system shall support the necessary functions and operating modes to enable the Use Case scenarios described in Section 5.3. To the extent possible, all ES control functions and operating modes shall be in accordance with standard functionalities for smart distributed resources, as documented in the IEC 61850-90-7. This standard, a part of the 61850 suite, describes standard functions and control modes for distributed energy resources.

The communication protocol for the ES shall be according to the IEEE 1815-2010, Standard for Electric Power Communications – Distributed Network Protocol (DNP3).

#### Control Function Summary:

|  |  |
| --- | --- |
| **Control Function** | **Description** |
| Direct Charge / Discharge Management Mode | A remote system instructs the ES; this mode can be used to support general energy arbitrage, peak load limiting, load following, spinning reserve, and frequency regulation |
| Scheduled Charge / Discharge Management Mode | A remote system provides the ES with a specific schedule for charging and discharging; this mode may be used to support general energy arbitrage and other uses in which the charging and discharging is known in advance |
| Autonomous Volt-VAR Mode | Instructs the ES how to manage its own VAR output relative to the local service voltage |
| Constant Power Factor Mode | Instructs the ES how to vary its own VAR output relative to its real power output |
| Autonomous Frequency-Watt Mode | Instructs the ES how to limit its own Watt level relative to the local system frequency |
| Autonomous Volt-Watt Mode | Instructs the ES how to limit its own Watt level relative to the local system voltage |
| Peak Limiting Mode | Instructs the ES how to manage its own Watt output to prevent the power level at a point of reference from exceeding a given threshold |
| Load / Generation Following Mode | Instructs the ES how to manage its own Watt input / output to follow (or partially follow) the power level at a given point of reference |
| Power Smoothing Mode | Instructs the ES how to dynamically modify its Watt input / output in response to fast changes in the power level at a given point of reference |
| Dynamic Reactive Current Support Mode | Instructs the ES how to provide dynamic additional reactive current support in response to fast changes in the local system voltage |
| Dynamic Volt-Watt Mode | Instructs the ES how to provide dynamic real power support in response to fast changes in the local system voltage |
| Managed Connect / Disconnect Function | Remotely instructs the ES to connect / disconnect to / from the grid |
| Time Adjustment | Remotely sets / adjusts the time in the ES |

Figure 5‑5: Control System Summary

#### Direct Charge / Discharge Management Mode:

This mode of operation involves the ES responding to signals received from a remote entity to manage its charging and discharging.

#### Scheduled Charge / Discharge Management Mode:

This mode of operation is similar to the Direct Charge / Discharge Mode, but utilizes a schedule for the charge / discharge levels.

Scheduling of charge / discharge settings allows for less frequent communication between the ES and remote and / or central applications. Schedules may repeat (daily, weekly, etc.), allowing an ES to continue to operate actively during periods of loss of communication.

#### Autonomous Volt-VAR Modes:

The ES may be used to provide reactive power support to the power system in response to locally observed voltage. This will be achieved via the standard Volt-VAR modes of operation.

This function enables autonomous behavior by providing a means for configuring the ES with Volt-VAR curves. Based on these curves, the ES observes the local system and modifies its VAR output in real time in response to voltage.

By definition, this standard Volt-VAR mechanism gives precedence to Watts delivered and received. Volt-Watt Modes may be used in conjunction to ensure that capacity for VAR support is available as needed.

#### Constant Power Factor Mode:

An alternative mechanism to manage the VAR generation of the ES is to set a constant power factor (VARs proportional to Watts). This mode is to be supported in the ES according to the IEC 61850-90-7 standard.

#### Autonomous Frequency-Watt Mode:

The ES shall support the standard Frequency-Watt Mode identified in IEC 61850-90-7.

This mode provides a configurable means by which the Watt level of the ES (delivered to or received from the grid) may be constrained based on the locally observed grid frequency. The configuration can be changed by remote configuration at any time; between configurations, the ES can autonomously and instantly respond to frequency.

#### Autonomous Volt-Watt Mode:

The ES shall support the standard Volt-Watt Mode identified in IEC 61850-90-7. This function is similar to the Frequency-Watt Mode, but with the local service voltage as the controlling variable. This function has a complementary relationship to the Volt-VAR Mode, in that it provides a means by which Watts may be reduced as voltage deviates from normal, thus providing more capacity for VARs.

The autonomous Volt-Watt Mode provides a configurable mechanism by which the Watt level of the ES (delivered to or received from the grid) may be constrained based on the locally observed service voltage. The configuration can be changed by remote configuration at any time; between configurations, the ES can autonomously and instantly respond to voltage.

#### Peak Limiting Mode:

The ES shall support an autonomous peak-limiting mode that allows it, once configured, to autonomously operate to limit the power level at a monitored point of reference.

#### Load / Generation-Following Mode:

The ES shall support an autonomous load / generation-following mode that allows it, once configured, to autonomously operate to follow the load / generation level at a monitored point of reference.

####  Power-Smoothing Mode:

The ES shall support an autonomous power-smoothing function that allows it, once configured, to dynamically produce / absorb real power (Watts) to compensate for fast changes in the power level of a remotely monitored reference point. This function differs from load / generation following described previously, in that the response is driven by changes in the monitored signal rather than its absolute value. It also differs in that the response produced by this function is temporary, returning to zero whenever the reference signal is stable at any level.

####  Dynamic Reactive Current Support Mode:

The ES shall support a reactive current support function that allows it, once configured, to dynamically provide additional reactive current in response to changes in the local grid voltage. This function differs from the autonomous Volt-VAR Mode described previously, in that the response is driven by changes in the local voltage rather than its absolute value. It also differs in that the response produced by this function is temporary, returning to zero whenever the voltage is stable at any level.

####  Dynamic Volt-Watt Mode:

The ES shall support a dynamic volt-watt function that allows it, once configured, to dynamically produce / absorb real power (Watts) in response to changes in the local grid voltage. This function differs from the autonomous Volt-Watt Mode described previously, in that the response is driven by changes in the local voltage rather than its absolute value. It also differs in that the response produced by this function is temporary, returning to zero whenever the voltage is stable at any level.

####  Managed Connect / Disconnect Function:

The control system shall support the ability to connect or disconnect its output to / from the Owner electric power system such that the converter output terminals are physically isolated from the utility system.

Disconnect shall accomplish the following:

* DC contactors / breakers and ES ac breaker open
* Noncritical power and control system power energized

Connect shall accomplish the following:

* DC contactors / breakers and ES ac breaker closed
* Noncritical power and control system power energized

####  Time Adjustment:

This function allows a remote host to set or adjust the time on the ES. Accurate time is needed for scheduling, time stamping of events, and other functions.

####  Shutdown / Startup / Standby:

The DNP3 AN2011-001 standard specifies start and stop controls. The control system shall employ these controls for an orderly and safe shutdown, even in the absence of utility power. The control system shall also employ these controls for an orderly startup sequence, which shall provide for a safe system reset from any standby or operating condition, such that the unit goes through a normal startup sequence in the same way it would when being powered up after loss of power or being in a shutdown state. The control system shall include provisions for a standby state (i.e., Watts and VARs set to zero but ES on), which shall be the end result of a normal startup sequence. It shall also be possible to enter the standby state from any of the other operating states except Connect / Disconnect.

Shutdown shall accomplish the following:

* DC contactors / breakers and ES ac breaker open
* Noncritical power supplies de-energized

Control system power may remain energized. This Control Function includes both normal shutdown and system trips requiring reset.

####  Initiation of Shutdown:

The control system shall initiate shutdown under the following conditions and shall remain in the shutdown state until a reset signal, either local or remote, is initiated. An appropriate alarm shall be set.

* Emergency trip switch;
* Loss of the low-voltage ac or utility grid voltage;
* AC circuit breaker trip (either side of transformer);
* Door interlock: Initiate shutdown when the door is opened. A "defeat" feature shall allow for maintenance. Interlocks shall be self-resetting;
* Smoke / fire alarm;
* Control logic trouble;
* DC ground fault (field adjustable setting);
* Failure to restart from the disconnect state after the programmed number of automatic restart attempts;
* Remote disable (no reset required);
* Utility system faults (balanced and unbalanced; line-to-ground, line-to-line, and three-phase);
* Abnormal frequency (high or low, per IEEE 1547);
* Abnormal voltage (high or low, per IEEE 1547);
* Islanding condition;
* Protection or control scheme failures, including:
	+ Failure of local interconnection protection system;
	+ Failure of critical breaker trip coil or interrupting device;
	+ Loss of DC supply; and
	+ Loss of transfer trip (if used to supplement anti-islanding).

####  Reset Alarms:

For all system-generated alarms, the control system shall provide for the resetting of those alarms according to Owner-prescribed and approved procedures. This function is intended for alarms that once set (e.g., by a fault condition, as listed above and elsewhere in this Specification), must be cleared by operator intervention to allow normal operation to be restored.

####  Ancillary Equipment Control:

The control system shall provide for the automatic operation of fans, HVAC, and similar ancillary equipment.

####  Modify Storage Settings:

The control system shall provide for modification of various set points and fixed operation / control settings associated with the various Control Functions.

####  Event / History Logging:

The control system shall provide for the automatic logging of the following information:

* All errors or failures
* All startup and shutdown actions
* All control actions
* All responses to control actions
* All limit violations, including returns within limits

####  Status Reporting

The control system shall provide for reading and reporting of various ES and Owner-supplied status information in accordance with the data collection and reporting requirements specified in Section 5.5.5.

####  Time Synchronization

The control system shall provide for synchronization of its real-time clock with a standard time source.

####  Change operational mode

The control system shall support the mechanisms inherent in the DNP3 AN2011-001 standard for activating / deactivating control functions. This will be used to support changing from one Use Case (Section 5.3) to another; from Standby to an Operation; and from an Operation to Standby.

####  Perform self-diagnostics

The control system shall provide for self-diagnostics.

### Control Panel

The ES shall include a local control panel or console that is easily accessible, either on or within the ES container. At a minimum, the following operator controls shall be located on the control panel:

* Trip / reset for the ES ac circuit breaker or contactor.
* Trip / reset for circuit breaker(s) on the high side of the Owner distribution transformer.
* Trip / reset for dc circuit breaker(s)/contactor(s).
* PCS on / off*.*
* Reset toggle or push button. When reset is initiated, the control system shall resume control and proceed to the appropriate operating mode.
* Reset cut-out selector switch to disable remote or local reset signals.
* A selector switch to manually set the operating state (i.e., shutdown, disconnect, and operate) and have the control system set the operating state automatically.
* A selector switch to manually set the operating mode and have the control system set the operating mode automatically.
* The control panel or console shall also include meters, indicators, and displays, as described in Section 5.5.5.

### Supervisory Control:

The ES shall allow for supervisory control access to locally or remotely adjust settings of operating modes and / or control parameters. This capability shall cover all functions, as described in Section 5.5. Supervisory access shall be implemented in the local control computer, as well as via a remote computer connected to the local control system by a remote communications link.

The ES shall have the equipment and capability to communicate with the Owner's operations center via a communications channel. Details on this communications link will be specified at the time of award.

At a minimum, the remote control link shall allow the Owner’s personnel to trip / reset the ac circuit breakers, reset the control system, and set the operating state and operating mode. The communications link also shall transmit status, alarms, and selected performance values to the Owner's operations center, as discussed in Section 5.5.5.

### Performance Monitoring and Data Acquisition:

The ES shall include a data acquisition system (DAS) to provide continuous monitoring and display of key operational parameters, and permanent archival of all measured parameters. The DAS shall include sensors, transducers, wiring, signal isolation and conditioning circuitry, and data acquisition and analysis hardware and software as required, to perform the functions described in this section. The DAS shall be of standard commercial manufacture and shall utilize hardened components suitable for a utility substation environment.

The DAS shall measure operational data, as described in this section, and shall record all data points to fixed and removable non-volatile memory. The DAS shall be capable of making all monitored data and events available through the DNP3 (could also be defined through IEC 61850, or other, as defined by the Owner) communication interface and shall permit display on a local screen of current values and recent historical trends (e.g., the previous 24 hours) for all recorded points. In addition, the DAS shall provide panel meter displays of certain operational parameters, as prescribed below.

Provision of monitoring and event data via the communication interface shall adhere to the DNP3 AN2011-001 standard to the extent possible. As with the control functions, the ES shall:

1. Utilize existing DNP3 (could also be defined through IEC 61850, or other, as defined by the Owner) data point mapping, as identified in the tables below.
2. Utilize additional standard DNP3 (could also be defined through IEC 61850, or other, as defined by the Owner) data points to the extent possible, as made available in upcoming revisions of the standard.
3. Identify common data point mapping.

The DAS shall preferably be based on PC technology running under MS-Windows XP or later operating systems. Other system architectures are acceptable but, regardless of system architecture, the DAS shall at a minimum provide remote data inquiry from PC-based platforms and data file export capabilities in ASCII format on independent media (e.g., USB drive) that are readable on PC-based systems.

All sensors, transducers, circuit boards, and test points in the DAS shall be easily and safely accessible for calibration, maintenance, and troubleshooting by the Owner.

The DAS shall continuously measure or calculate the data points identified and shall make them available via the DNP3 communication connection as specified. All measured parameters shall also be permanently archived in all modes of operation. For continuously varying quantities, the Supplier shall propose for the Owner’s review and approval an approach to data archiving suitable for each quantity measured. The final approach will be decided during product design.

Local displays of the information identified in the “On Local Display” column shall exist on the ES local control panel**,** console, or DAS computer. Digital displays, if used, shall be no less than 1-inch high and update at least once per second.

The DAS shall also continuously monitor and report (alarm) via the DNP3 communication connection. These events shall also be permanently archived.

Those events indicated in the “On Local Display” column shall have indicator lights or similar displays on the ES local control panel**,** console, or DAS computer.

As described in Section 5.5, the DAS shall also include a monitoring / alarm system (with prescribed response procedures) to detect weak unit energy storage.

The DAS shall provide unsolicited message capability for reporting critical alarms to the Owner. This should not be a polled operation that the Owner needs to initiate. The Supplier and the Owner will agree on a list of alarms that are reported the instant they are detected.

## Communication Interface:

### Communication Description:

Describe the communication system and interface required to communicate the information from the ES system. This should include:

* Description of the current system;
* If wireless, define the frequency, data rate, and protocols (including IPv4, IPv6, other)
	+ If an interface to a substation RTU
	+ Physical port description
	+ Protocols supported (e.g., DNP3, Modbus, IEC 61850)
	+ Cyber security
* If hardwired,
	+ Describe physical media of the system (fiber, coax, leased line)
	+ Describe the general technology (e.g., SONET, ATM, Ethernet, other)
	+ Describe protocols currently used on the system (including lower-layer protocols, such as IPv4 or IPv6)
	+ Describe the physical interface (FC connector, RJ45, etc.)
* Any specific requirements above the interfaces and description provided for the current system.

If a new communication system is to be installed, add requirements for the new system.

### Cyber Security and Control:

The Supplier shall develop a cyber security plan that addresses and mitigates the critical vulnerabilities inherent in both the hardware and software that comprise the control and data acquisition systems.

## Civil / Structural:

### General Requirements:

Soil-bearing stresses shall not exceed the allowable stresses for the soil parameters, as determined by the Supplier. A minimum factor of safety of 1.5 shall be provided against uplift, sliding, and overturning loads. Soil stresses shall be calculated using unfactored loads. All structures and foundation designs must include suitable evidence to show that their design is commensurate with greater than a ten-year (10-year) life.

ES buildings, containers, or other structures shall not exceed a nominal twenty-five-foot (25-foot) exterior height limit when installed at the Owner site, except in situations where substation or transmission line clearances over the ES equipment would require a lower height limit. However, when configured for transport, the ES dimensions must be such that special permits are not required for transportation over regular highways.

Calculations based on accepted engineering practice shall be supplied to show that the design of the entire ES will withstand repeated lifting and moving, and other loads related to periodically transporting the ES, and that the design meets all applicable building and transportation codes.

Unless specifically stated otherwise, the design of all structures, equipment, and foundations shall be based on applicable portions of national codes, these Specifications, and industry standards.

All components shall be painted, coated, or otherwise protected in a manner commensurate with the twenty-year (20-year) design life. Particular attention shall be given to prevention of corrosion at the connections between dissimilar materials, such as aluminum and steel, and steel and concrete.

All designs employing structural steel and cold-formed steel structural members shall be in accordance with relevant standards and specifications published by the American Institute of Steel Construction (AISC) and the American Institute of Steel and Iron (AISI), respectively (or their equivalents outside of North America) – see Section 4.2. All reinforced concrete design shall be in accordance with specifications published by the American Concrete Institute (ACI), or its equivalent outside of North America (see Section 4.2). All other components shall be designed in accordance with the Uniform Building Code (UBC) or its equivalent outside of North America (see Section 4.2). All reinforced concrete structures and foundations shall be designed by the Ultimate Strength Method. Structures and foundations of all other materials shall be designed by the Working Stress Method. All structures and foundations shall be designed for ductile behavior. All structures and foundations shall be designed to resist dead, live, plus wind, or seismic loads.

###  (Optional) Requirements for Supplier Installation:

This section shall apply only if the “installation by Supplier” option is specified.

The Supplier shall be responsible for obtaining all required permits and ensuring that all inspections by local authorities are complete as required.

Calculations based on accepted engineering practice shall be supplied to show that the design of the entire ES will withstand wind speed and / or gusts and other loads specific to the site, and that the design meets all applicable building and transportation codes.

All excavation shall be in accordance with OSHA regulations. Excavation spoils shall be disposed of as directed by the Owner.

All reinforced concrete work shall be in accordance with ACI specifications. All other materials and installation requirements shall be subject to the Owner’s approval.

### Mechanical:

All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed, and painted or otherwise suitably protected to survive outdoor conditions for the twenty-year (20-year) design life of the system.

Outdoor enclosures shall be weatherproof and capable of surviving intact under the site environmental conditions specified. Outdoor enclosures shall be equipped to prevent condensation.

Components mounted inside of enclosures shall be clearly identified with suitable permanent designations that also shall serve to identify the items on the drawings provided.

The site temperatures and the effect of temperature on component life shall be considered in developing the thermal design for all components, including the ES and PCS. There may be several separate heat removal systems to accommodate the particular needs of ES components and subsystems (e.g., energy storage, PCS, transformers, etc.). The heat removal and / or cooling system may include water cooling or mechanical vapor cooling, if desired by the Supplier. However, final rejection of all waste heat from the ES shall be to the ambient air. Air handling systems shall include filters to prevent dust intrusion into the ES.

The ES shall include an HVAC or ventilation system designed to maintain ES temperatures at levels acceptable to the Supplier's normal ES warranty conditions, conducive to acceptable ES life, and as required to maintain ES capacity for all seasons / climatic conditions at the site and all planned ES uses. The air handling / distribution system shall be designed to promote temperature uniformity within the ES.

## Other Design Requirements:

### Noise Levels:

Noise produced by any ES operation shall be less than sixty-five (65) LDN (day-night average sound level), measured at a distance of fifty (50) feet from any ES container or structure. (Check local codes to ensure that all noise statutes are included, such as peak dB.) The Supplier shall design and install noise mitigation to comply with applicable local noise codes.

### Fire Protection:

The Supplier shall design and install a fire protection system that conforms to good engineering practice. The fire protection system design and associated alarms shall take into account that the ES will be unattended.

If required by the type of fire protection system provided, the Supplier shall calculate and take into account the heat content of the energy storage cell materials in designing an appropriate fire protection system.

Separate fire protection systems may be used in the ES, PCS, and control areas. Halon or other chlorofluorocarbons shall not be used.

For systems in which ES cells are enclosed in moveable containers, the ES shall include provisions for local fire department personnel to extinguish internal container fires without the need to open container doors.

### Toxic Materials:

No toxic, non-biodegradable chemicals, such as PCBs or PBBs, should be used and, if used, should be identified with an appropriate MSDS and their probability and possible conditions of release into the environment.

If a significant amount of a toxic substance can be emitted from the equipment during a failure, fire, or emergency / protective operation, an alarm system to alert personnel shall be included in the equipment. Description of the toxic nature of the substances, as well as treatment for exposure, shall be included in the O&M Manual.

### Additional General Safety Requirements:

In addition to electrical and physical safety requirements embodied in other portions of this Specification, the design of the ES shall encompass due consideration for the following safety items:

* The use of visible disconnection points for wiring or cabling that will be handled in the course of installation and / or maintenance
* Self-protection functionality throughout
* Ground fault and loss of current monitoring
* Clear documentation in the Maintenance Manual of important steps
* Clear documentation in the Maintenance Manual and on the face of the equipment of important steps for emergency shutdown
* Clear documentation in the Maintenance Manual of grounding systems employed

### Spare Parts and Equipment:

The Supplier shall evaluate its design with regard to expected failure rates, modes, and effects; overall ES reliability; and planned mode of servicing. Based upon this evaluation, the Supplier shall recommend and furnish an initial complement of spare parts that are not readily available. For example, these spare parts may include spare unit ES and a small rectifier to maintain the unit ES, as well as fuses, PC boards, and switching devices (GTO, SCR, IGBT, etc.). The Owner may elect not to procure and / or stock spare parts. For example, this may be done for systems capable of continued, temporary operation at eighty (80%) percent of rated output or greater in event of a part failure or poor performance.

The initial complement of equipment shall include a supply of chemicals as may be needed to neutralize small acid or oil spills.

## Design Review and Support:

The Supplier shall provide design review and support services as follows:

1. Participation of the Supplier's technical representative(s) in design review meetings with the Owner, providers of interfacing systems, and / or their representatives to resolve design and design interface issues. The meetings will nominally be held in the offices of Supplier. However, alternate meeting locations for some or all of the meetings may be arranged, including a location at the offices of the Owner. They will be held on an average of once every three (3) months throughout the duration of the contract, beginning with a project kick-off meeting soon after award. During the early design phase, the meetings will be held more frequently.
2. Review of project design documents for interfacing with the Owner’s system.
3. Timely submittal of design documents and data for review by the Owner, providers of interfacing systems, and / or their representatives.

The Supplier's technical representative shall be a member of the technical design team for the proposed ES and shall have complete knowledge of the Supplier’s proposed design, as well as a general understanding of the design and purpose of the Owner's ES demonstration project. A marketing representative shall not be acceptable for this requirement.

The Supplier's technical representative shall have the ability to knowledgeably discuss the Supplier's design approach with the Owner, and / or its representatives, and shall have the authority to suggest and / or agree in principle to design modifications at the design review meetings, with a formal response within three (3) working days.

The Supplier's technical representative shall be reasonably proficient in both written and spoken English. It shall not be acceptable for the Supplier’s technical representative to require the services of an interpreter to carry out the requirements of this section.

## Shipping, Handling, and Storage:

### Preparation for Shipment:

The ES shall consist of a minimum number of transportable containers. Recording accelerometers shall be attached to the ES during shipment to determine if any non-design shocks or acceleration occur during shipment.

The method of preparation for shipment shall protect the ES and all other parts, auxiliary devices, and accessories against corrosion, dampness, breakage, or vibration damage that might be encountered in transportation and handling. The manner of packaging shall be such as to prevent tampering or pilfering and shall be acceptable to transportation companies.

The ES containers shall be packaged suitably for outdoor storage for up to two (2) months without modification. If temperature control for protection of ES equipment is required during site storage periods, the Supplier shall arrange with the Owner for suitable HVAC power feeds and / or auxiliary equipment for this purpose.

The containers shall be designed to prevent damage by normal handling, hoisting, jacking, and skidding into place.

### Site Receiving and Storage Requirements:

The Supplier shall provide, three (3) months in advance of shipment, complete instructions for the on-site storage, handling, and installation of the ES containers.

## Installation:

The Supplier shall design, fabricate, and install the ES and its systems to codes that ensure the safety of its entire plant for personnel and equipment under both normal and abnormal operating conditions and during the installation process.

The Supplier shall show on its schedule when outages are necessary for it to perform its work. Additionally, the Supplier shall notify the Owner twenty-four (24) hours in advance for final clearance.

The Supplier shall develop and submit a Health and Safety Program (HASP) at least sixty (60) days prior to mobilization at the Owner. The program shall be in conformance with the Owner’s Safety Program, work rules for the Owner site, and the requirements of the state or jurisdiction in which the ES will be installed. Unless specifically provided for by the Owner, the Supplier's program shall address and include the following:

* Designation of one or more qualified and competent individuals as safety representative(s) to be responsible for verifying conformance to safety standards;
* Specific review and approval of all work plans and methods by the safety representative;
* Periodic inspection by the safety representative of the Supplier's work and storage areas to ensure safe conditions and practices;
* Immediate reporting to the Owner of any and all deaths, injuries, or damage to property;
* Full cooperation in the conduct of inspections by the Owner or governmental agencies;
* Compliance with all applicable laws and regulations, and directives of the state or jurisdiction in which the ES will be installed. In the United States, this shall include OSHA and other agencies of competent jurisdiction. Copies of any OSHA citation notices shall be submitted to the Owner immediately upon receipt;
* Proper identification, storing, handling, and use of inflammable material to prevent accidental ignition; and
* Adequate fire extinguishing equipment appropriate for the operations being performed shall be provided by the Supplier, and the Supplier's personnel shall be trained in the use of such equipment.

Calculations and similar items demonstrating the electrical safety of the ES systems shall be furnished for approval by the Owner at least sixty (60) days prior to mobilization.

Prior to making the final electrical connections at the Owner’s PCC, the Supplier shall demonstrate to the Owner that:

* All wiring is correct;
* Protective relaying is correct and values properly set;
* Sensors and metering are calibrated; and
* Control system functions as designed, including automatic, local, and remote aspects.

The Supplier shall notify the Owner in writing when its entire ES is correctly installed and properly wired, and must receive notice of approval from the Owner before ES startup is attempted.

Similarly, the Supplier shall ensure that all relevant permits have been obtained and inspections performed before final connection to water, sewer, or similar utilities are made.

### Grounding:

A suitable equipment grounding system shall be designed and installed for the ES. This system shall be designed to be tied to an existing site grounding system. The system also shall be adequate for the detection and clearing of ground faults.

All exposed non-current-carrying metal parts shall be solidly grounded. Particular attention shall be given to prevention of corrosion at the connection of dissimilar materials, such as aluminum and steel.

The ES’s ground shall be connected by Others (unless the “installation by Supplier” option is specified) at one point to the site bare copper ground cables provided by the Owner at the ac interface. The means of connection shall include two physically separate cables for redundancy. The design shall allow for disconnect of the cables at the interface point so that each grounding system resistance-to-ground value can be measured independently.

The grounding of the ES shall not cause over-voltages that exceed the rating of equipment connected to the Owner’s distribution system. The connection of the ES shall meet neutral-to-ground voltage applicable codes or standards (e.g., less than 10 V rms) on 4-wire multi-grounded distribution system.

### Wiring:

NOTE: In the case of original equipment manufacturer (OEM) equipment purchased by the Supplier under a purchase order or a competitive solicitation for installation and use in the ES (e.g., the PC-based DAS), for which it is not practical or cost-effective to pass through certain requirements of this section, the Supplier may take exception to such requirements. However, the Supplier must identify the OEM equipment that may not meet these requirements, together with the requirements that will likely not be met.

All wiring shall be new and continuous for each wiring run; splices are not acceptable. Aluminum wire shall not be used.

Wiring that may be exposed to mechanical damage shall be placed in conduit or armored.

Wires shall have identifying labels or markings on both ends. The labels or markings shall be permanent and durable. Stick-on labels will not be allowed. All field wiring between separate equipment items supplied by the Supplier shall be color coded per Insulated Cable Engineers Association (ICEA) standards.

In general, and where practicable, control and instrumentation wiring shall be separated from power and high-voltage wiring by the use of separate compartments or enclosures, or separate wireways and appropriate barrier strips within a common enclosure.

ES and PCS control and instrumentation system wiring shall be bundled, laced, and otherwise laid in an orderly manner. Wires shall be of sufficient length to preclude mechanical stress on terminals. Wiring around hinged panels or doors shall be extra flexible (Class K stranding or equivalent) and shall include loops to prevent mechanical stress or fatigue on the wires.

For control and instrumentation wiring with both terminations inside a single enclosure, wire size shall be no smaller than No. 14 AWG for control, and no smaller than No. 20 AWG for instrumentation devices having small connectors or solder hooks. Control wire no smaller than No. 12 AWG for a single conductor shall be used for wiring between cabinets, panels, and devices. Current transformer circuits shall be No. 10 AWG throughout.

Insulation and jackets shall be flame retardant and self-extinguishing and shall be capable of passing the flame test of IEEE 1202-2006.

The shield of signal circuits shall be connected to a separate terminal at the terminal block. Signal circuit shields shall be grounded at one point only. Shielded wire makeup shall consist of two, three, or four twisted, insulated No. 20 AWG or larger conductors within a common conductive shield with drain wire and an overall jacket.

Wiring to terminal blocks shall be arranged as marked on wiring diagrams. Terminal groupings shall be in accordance with external circuit requirements.

Raceway and cable systems shall not block access to equipment by personnel. There shall be no exposed current-carrying or voltage-bearing parts.

## Inspection, Acceptance Testing, and Startup:

The Owner reserves the right to witness or have its designated representatives witness any or all tests, including startup, at no additional cost. (The Owner will bear its own travel and per diem costs.)

### QA / QC Program:

The Supplier shall develop and submit a quality assurance (QA) / quality control (QC) program that covers major ES and components (including the cells, PCS, control system, and other major system components). The scope of the program shall encompass sub-tier Suppliers and include plans covering design, testing, manufacturing, and installation. Control of manufacturing shall include material control, process control, and factory testing of equipment items. The Owner reserves the right to witness tests, review data, and enforce the Supplier's program.

### Factory Acceptance Testing:

The Supplier shall develop and submit to the Owner for its review and approval a comprehensive factory acceptance test (FAT) plan. The plan shall be submitted at least two (2) months prior to the expected test date. The Owner shall have the right to request reasonable changes to the test plan. The Supplier shall document all aspects of the acceptance and performance testing. The Supplier shall submit documentation, analyses, and a summary in a test report for the Owner's records. If a FAT cannot be conducted at the factory, the Supplier shall request a waiver from the Owner. The waiver shall include a risk mitigation plan to account for potential issues during commissioning that would normally be expected to be corrected during a FAT.

After the Supplier determines that the ES is fully operational, the Supplier shall conduct a FAT, witnessed by the Owner and by representatives of the Owner. The acceptance test shall consist of the Supplier demonstrating to the Owner that the ES is fully operational and performs as specified. This includes but is not limited to:

* Verification of sensors, metering, and alarms
* Verification of all control functions, including remote control and monitoring
* Verification of ES performance at full and partial power and energy ratings
* Verification of compliance with Specifications

During the factory acceptance test, the ES shall:

* Be operated and function as specified and designed in the all of the operating states, Use Cases, and duty cycles specified herein;
* Meet the power and energy requirements specified herein; and
* Have the efficiencies, response capabilities, and other features specified herein and / or proposed by the Supplier.

Operation of all control, protective relaying, and instrumentation circuits shall be demonstrated by direct test if feasible, or by simulating operating states for all parameters that cannot be directly tested. Automatic, local (control console), and remote operation of the controls shall be demonstrated.

Factory testing shall demonstrate operation at expected temperature extremes at the Owner site. If this is not possible for the full ES at the factory, independent laboratory certification of operation of critical components and subsystems in the energy storage, PCS, and control systems shall be submitted at the time of the factory test. The Supplier shall submit to the Owner ninety (90) days prior to the factory test a list of components and subsystems for which independent lab testing certification will be sought, for the Owner’s approval.

The Supplier shall perform any and all system modifications required during startup and testing.

The testing may be suspended as a result of ES malfunction and resumed only on rectification of problem items. Such suspension and resumption will occur at the sole discretion of the Owner.

The ES will not be accepted by the Owner until all acceptance tests have been successfully completed. In addition, the Owner will verify that all provisions of the contract have been met, including verification of all required submittals, any spare parts delivery, and any required system modifications.

####  Factory Testing of the Storage Device:

At a minimum, the Supplier shall perform capacity tests for 100% of the production unit energy storage to ensure compliance with design requirements.

In addition, the Supplier shall provide standard OEM production test data for the unit ES. Preferably, relevant data should be provided for each duty cycle specified in Section 5.3 for each of the following (as applicable to the duty cycle and cell type):

* Capacity (amp-hour and watt-hour)
* Heat generated
* Efficiency (complete cycle)

####  Factory Testing of the PCS:

At a minimum, the PCS shall be tested to demonstrate that all controls, protective functions, and instrumentation perform as designed and that the PCS has the functional capability to be automatically synchronized to and connected in parallel with a utility line.

Factory testing shall include a burn-in test. For this test, the PCS shall be operated at an elevated ambient temperature of 110oF for eight (8) hours.

### Acceptance and Performance Testing at Owner Site:

The Supplier shall develop and perform site acceptance testing procedures to ensure that the ES will perform as designed and that the system meets the performance criteria specified elsewhere in these Specifications. These procedures may involve special requirements and/or witnessing by the local independent system operator. To the extent achievable, all Use Cases and operating modes described in these specifications shall be tested. The Supplier shall determine that the ES is fully operational and suitable for acceptance testing, witnessed by the Owner.

The Supplier shall coordinate with the Owner for all tests when the ES is to be connected to the Owner’s power system. No such tests shall be performed unless permission by the Owner has been granted. The tests must be performed in a fashion to minimize unanticipated disturbances on the power system. These tests may have to be performed during the night or low load periods for certain types of tests.

The Supplier shall document all acceptance and performance tests performed. The Supplier shall submit documentation, analyses, and a summary in a test report for the Owner’s records.

After the Supplier has determined that the ES is fully operational, the Supplier shall conduct an acceptance test, witnessed by the Owner. The acceptance test procedure will be developed by the Supplier and shall demonstrate that the ES is operational and performs as specified. These tests shall include, at a minimum:

* Verification of sensors, metering, and alarms;
* Verification of all control functions, including automatic, local, and remote control; and
* Verification of performance criteria.

The test plan shall include a demonstration of all of the intended uses at the site.

The site acceptance test plan shall also specifically address testing for problems or failures that may have occurred during or as a result of shipment. Special attention shall also be given to demonstration of Owner interface protection circuits and functions, and control interfaces.

####  Function Verification:

After the ES has been installed, the Supplier shall perform comprehensive testing on the entire system to verify compliance with all requirements of this Specification. The Owner will witness these tests.

Special attention shall be given to demonstration of utility interface protection circuits and functions. Testing shall be conducted at full and partial power levels for both charge and discharge. Operation of all control, protective relaying, and instrumentation circuits shall be demonstrated by direct test if feasible, or by simulating operating states for all parameters that cannot be directly tested. Automatic, local, and remote operation will be demonstrated.

The Supplier shall perform any required modifications and repairs identified by the testing, prior to acceptance by the Owner.

####  Performance Verification:

The ES performance verification shall include tests as determined by the Supplier to verify that the performance criteria specified in these Specifications can be met or exceeded. Accordingly, the Supplier shall provide a total system performance verification plan to ensure correct ES response to system disturbances and operating scenarios described in this Specification.

The total system performance verification plan shall be submitted to the Owner for review and approval sixty (60) days prior to ES performance tests.

Each discharge cycle, as determined by the Supplier, shall be followed by the Supplier-specified normal charge cycle.

These tests shall demonstrate that the ES capabilities, efficiencies, response, and features are as proposed by the Supplier.

The Owner will not accept the ES until all acceptance tests have been successfully completed and all provisions of the contract have been met.

####  Actual Operating Experience:

It may not be possible, due to system constraints, to test all facets of the ES function as part of the performance verification tests specified above. The actual operating experience of the ES through a Performance Guarantee Period (PGP) of sixty (60) days after initial startup shall be deemed an extension of the performance verification tests. The PGP shall not be construed as a substitute for the Warranty requirements, as specified in Section 5.15.

Actual operating experience will be documented through a Supplier-furnished sequence of event recorders, oscillographs, digital fault recorders, and other system monitoring equipment capable of identifying system disturbances and associated ES performance.

Documented failure or malfunctions of any ES component during the period of performance shall be deemed as a failure of the system commissioning test. The Supplier shall, at no cost to the Owner, make the necessary repairs, replacements, modification, or adjustment to prevent the same failure or malfunction from occurring again. The replacement of certain ES components in response to a system failure may necessitate, at the discretion of the Owner, the duplication of certain performance verification tests, which shall be performed at the Supplier’s expense.

####  Other Compliance Tests:

The Supplier is responsible for obtaining before-and-after ES installation measurements to ensure that the ES complies with this Specification in the following areas. The Owner reserves the right to perform (or request others to perform), at the Owner’s expense, identical compliance test measurements for the following:

* Broadband frequency signal strength and noise voltage
* Harmonic voltages and currents (<2% THD)
* Allowable voltage fluctuations
* Audible noise measurements

## Maintenance and Repair:

### Maintenance Requirements:

The ES shall be designed so that routine maintenance may be carried out by either the Supplier (under a separate contract) or by a knowledgeable third party under contract to the Owner.

#### Maintenance-by-Supplier Option:

The Owner may desire to have maintenance of ES major systems not covered by the warranty performed by the Supplier under a separate contract (see Request for Proposal). Under an annually renewable contract, the Supplier shall supply all labor, equipment, and materials needed to maintain the ES performance and safe operation, including all maintenance required to satisfy the warranty terms and conditions.

The Supplier shall list all maintenance activities to be carried out under the maintenance contract. For each maintenance item, the list shall include a clear and readable description of the item, the expected frequency (maintenance interval), the time required to perform the maintenance, any anticipated parts replacement, and any potential problems in carrying out the maintenance.

In the interest of reducing maintenance costs under this option, the Supplier may propose that certain non-specialized maintenance activities be performed by Owner personnel. These activities may be excluded from the Supplier’s maintenance contract, but must be fully described, including estimated man-hours and frequencies. Such activities shall not include those activities for which the proper or timely performance are required for maintaining adherence to the Supplier’s warranty terms and conditions.

####  Maintenance-by-Owner Option:

After final acceptance by the Owner, maintenance and troubleshooting not covered by the warranty may be performed, as required, by the Owner under a third-party contract or by the Owner. The system shall be designed to facilitate the identification, location, and repair of problems that may occur by a knowledgeable technician.

Prior to startup, the Supplier, with the assistance of its major equipment suppliers, shall conduct a training class for third-party Supplier or Owner personnel at the factory. The training class shall be aimed at adequately familiarizing said maintenance personnel to troubleshoot, maintain, and operate the entire system properly.

The Supplier shall remain available by telephone or email and provide consultation for the Owner's third-party Supplier or the Owner on system malfunctions during the ES warranty period.

####  Pre-Acceptance Maintenance:

Prior to Acceptance of the ES by the Owner, the Supplier shall be responsible for maintenance of the entire plant up to the points of interface.

## Operator Training and Tools:

### General:

The Supplier shall provide training for the ES at the Owner’s ES site or its designated location, as specified below. Such training shall cover all efforts needed for the operation, routine maintenance, and rudimentary repair of the ES. The Supplier may assume that the utility personnel to be trained have a basic understanding and experience with typical utility equipment.

The Supplier shall determine the content and duration for each training session. All training materials must be submitted to and approved by the Owner and prior to the training sessions. Final copies of all training materials shall be provided to the Owner after the training has been completed.

In coordination with the Owner, the Supplier shall arrange for performance evaluation testing of all trainees (e.g., a written test) for all classes except the orientation training.

The above does not relieve the Supplier of its obligation to provide operation, maintenance, diagnostic, repair, safety procedures, and similar information in the ES Operation and Maintenance (O&M) Manual.

### Orientation Training:

The Supplier shall provide two (2) orientation training sessions. These sessions shall be suitable for managers, supervisors, and professional and technical personnel. Each session will be limited to a maximum of twenty (20) people.

The orientation training sessions shall be scheduled before commencing ES performance verification tests. An outline for this orientation training shall be submitted to the Owner ninety (90) days ahead of the actual date of training. Approval of this outline shall be obtained from the Owner.

The Owner will provide comments and / or approval thirty (30) days before the scheduled training date.

### Operator Training:

The Supplier shall provide the necessary training in proper operation of the ES and related equipment. This training shall be conducted after completion of the ES performance verification testing, but before system commissioning. This session will be limited to a maximum of twenty (20) people. Emphasis shall be placed on hands-on operating experience, interspersed with the critical background as necessary, including switching procedures and emergency response training.

### Maintenance Training:

The Supplier shall provide necessary training in maintenance of the ES and related equipment, providing that the option of maintenance by the Owner is chosen. The maintenance training shall be scheduled after successful completion of the availability guarantee period. This session will be limited to a maximum of twenty (20) people. The maintenance training shall include, but not be limited to:

* Normal maintenance methods
* Repairs and replacement
* Diagnostic procedures
* Equipment calibration
* Re-energization and grid synchronization
* Special tests
* Special tools
* Safety and grounding procedures

### Tools and Equipment:

The Supplier shall provide all “special tools and equipment” for maintenance and operation that are not normally or readily available. The Supplier shall submit a complete list of tools and equipment needed for erection / installation and maintenance and a list of special tools and equipment that will be provided, including prices. The Owner shall have the right to approve the specific special tools and equipment from a safety perspective.

Special tools and equipment shall become the property of the Owner at the completion of the ES installation. The Owner reserves the right to purchase additional quantities of tools, if desired.

## Warranty:

The Supplier shall provide a warranty for the entire ES and its constituent equipment.

At a minimum, the Supplier shall provide an unconditional, two-year (2-year) parts and labor warranty on all equipment, including the ES. After the two-year (2-year) unconditional period is over, the warranty shall include a component replacement policy (parts and labor) to ensure that the system continues to perform in accordance with this Specification. The cost of an extended warranty shall be provided to the Owner for consideration.

Warranty replacement shall be required for individual unit ES that degrade in performance to the point where the ES cannot meet the requirements specified in this Specification, and / or for unit ES that materially degrade the availability, reliability, safety, or functionality of the ES.

The warranty shall guarantee the availability of ES replacements delivered to the site within twenty-four (24) hours of notification, during the ES warranty period.

Additional warranty requirements are as follows:

* The warranty shall specify the terms and conditions of the warranty, including operating conditions requirements, procedures that must be followed, and all maintenance requirements. The warranty terms shall be easy to understand and shall be clearly stated. Warranty terms that are overly difficult to read or understand are not acceptable.
* The warranty shall provide an explicit statement as to the warranted cycle life and the warranted calendar life of the ES for each of the duty cycles described herein.
* The warranty shall include a proration formula, if any, to be used in crediting the Owner for unused life or capacity of equipment replaced or repaired. The formula shall be simple and easy for the Owner to understand. An example calculation shall be included.
* The warranty shall specify guaranteed ES replacement costs, tied to recognized inflation indices. The Owner shall be provided the option to secure the guaranteed replacement cost at the time of the initial purchase agreement.
* The warranty shall specify the scope of service included in replacement or repair of the equipment.
* The warranty shall specify all labor, materials, shipping charges, or other Owner expenses not included in the warranty.
* The warranty shall specify the estimated time to complete the repairs / replacement required to restore the ES to the warranted performance level. The time shall be given as the number of working days (M–F) from the time of the Owner’s notice to the Supplier that the ES has failed to meet the performance requirements.

## Documentation and Submittals:

### Documentation:

The Supplier shall furnish complete documentation that will be used for determination of contract compliance, as well as operation and maintenance of the ES.

The documentation shall be in English, well detailed, and instructive, so that all maintenance and modifications can be performed in the field without manufacturer’s support. All document and drawing submittals shall be clean and legible. Drawings shall conform to the requirements below.

Miscellaneous documentation and manuals shall be in bound form.

Review and acceptance of submittals shall not encumber the Owner with responsibility for the adequacy or safety of the Supplier's design.

Titles shall clearly indicate the function of the document, the Owner, and the location of the facility. At a minimum, titles shall contain the following information:

Project Title

Owner Name

Owner Address

At a minimum, Supplier’s documentation shall consist of the following:

* Construction and Installation Drawings
* Construction Materials Submittal
* Equipment Drawings and Specifications
* Operation and Maintenance Manual
* Maintenance Schedule
* Project Schedule
* Master Test Plan and Procedures
* Quality Assurance Manual
* Software Documentation
* Study Reports
* Test Reports
* Training Manuals

### Quantity of Submittals and Schedule for Submission:

All documents shall be submitted for Owner comment. The identity and quantity of documents required for Owner review and approval, and the schedule for their submission, shall be in accordance with the approved project management plan.

### Drawing Requirements:

All drawings shall be identified with a unique number assigned by the Supplier. Drawings and documents shall be submitted with document or drawing numbers, checker signature, approval signature, date, revision number, and a brief description of changes since the previous revision.

When a drawing or document is revised, a number or letter, date, and subject in a revision block shall indicate each revision. All drawing revisions shall be crossed out, not erased. Revised areas and revision numbers shall be circled. Alphabetic labels shall be used for preliminary drawings, and numbers shall be used for drawings issued for construction. Typical drawings are not allowed.

All drawings shall use Metric with English equivalents of weights and measures as currently used in the United States. The Supplier shall be consistent in its units selected throughout the performance of the contract.

All schematic and wiring diagrams shall be ANSI Y32.2 standard drafting symbols and ANSI device function designation system exclusively. For installation in European Union countries, drawings shall meet the appropriate standards listed in Section 4.2.

All drawings shall be carefully checked by the Supplier for accuracy; completeness of notes; clearness; continuity of wiring; correctness of phasing; and proper location of pipes, tubing, ducts, conduits, wiring, and equipment to be installed. The Supplier shall be responsible for the correctness of all details of the drawings.

During the construction and testing, the Supplier shall make a record of all field changes or corrections. After completion of the initial construction and testing, the Supplier shall revise all drawings so that they accurately reflect the as-constructed or as-built ES.

####  Computer-Aided Design Format:

The Supplier shall submit all final design and record drawings in digital form, including, but not limited to, the following: all construction and installation drawings pertaining to architectural, civil, mechanical, and electrical activities; bills of materials; interconnection, wiring, and cable diagrams; and all equipment drawings that may be subjected to revisions or modification. The format shall be AutoCAD Version 14. Electronic files in .dxf format are not acceptable. Files converted to AutoCAD Version 14 from other formats shall be carefully checked for conversion errors, and all such errors corrected before the files are submitted to the Owner.

Maximum drawing size shall be 30" x 42." Each drawing shall have the following data clearly displayed thereon:

* Owner’s Name / Owner Name
* Project Designation
* Specification Title and Number
* Equipment Name or Type and Rating
* Drawing Function

Where duplicate items or duplicate sets of equipment are furnished, drawings shall be furnished for each item or set of equipment. Where wiring is duplicated within units or sub-assemblies of an item or set of equipment, all wiring shall be shown complete for each unit or sub-assembly being furnished.

####  Drawing Review:

To coordinate the progress of the project design and verify that the designs comply with these Specifications, the Supplier shall submit to the Owner design review drawings and documentation at the 30% and 90% completion levels. The review drawings shall include, but not be limited to, the following design activities: equipment arrangement, plan, and elevation drawings and schematics; One- and Three-Line Diagrams (two-line diagrams for dc systems); wiring schematics; and piping and instrument diagrams (P&IDs). (Note: If Supplier installation is specified, the review drawings shall include, but not be limited to, the following, as appropriate: site development, conduit and cabling, grounding, and site communications schematics and diagrams. These drawings shall be marked “for review” and shall be submitted in the sequence of preparation so the design review may be performed in an orderly sequence.)

Intermediate partial review data may be submitted at any time in the project when the Supplier needs clarification of design requirements.

The design documentation submitted by the Supplier will be reviewed and returned to the Supplier’s originating office within thirty (30) days of the date of receipt at the Owner’s designated facilities. The Supplier’s maintained CPM schedule shall provide for the thirty-day (30-day) submittal reviews as noted for all submittals.

The preliminary drawings submitted (30% review) shall be accompanied by design memoranda which shall provide, when applicable, all data, calculations, and information necessary for the Owner to review and understand the proposed design. The 30% review level is defined as drawings and documents that define the design concept, but before detailed design is started. Examples of documents to be submitted at the 30% level may include equipment arrangement drawings, One-Line Diagrams, and design criteria documents.

The Owner’s review of drawings will be limited to a general review for compliance with the specification. Drawings will not be reviewed for technical correctness or design concept. The Supplier shall continue with design work while preliminary drawings are being reviewed.

The Owner shall have the right to require the Supplier to make design alterations for conformance to the design requirements of these Specifications without additional costs to the Owner. The review of such alterations shall not be construed to mean that the drawings have been checked in detail, shall not be accepted as justification for an extension of time, and shall not relieve the Supplier from responsibility for the correctness of the drawings. The Supplier shall make, at its own expense, any revisions needed to correct the drawings for any errors or omissions that may be found by the Owner.

The Supplier shall submit for review a set of final drawings ready for fabrication (90% review). After review, the Supplier shall stamp the final drawings “Approved for Fabrication” to indicate that these drawings will be the official drawings used for fabrication activities.

Note: If Supplier installation is specified, the Supplier shall submit for review a set of final drawings ready for construction (90% review). After review, the Supplier shall stamp the final drawings “Approved for Construction” to indicate that these drawings will be the official drawings used for construction activities. A final set of signed "Approved for Construction" drawings shall be available on site before construction may proceed. All construction issue drawings shall be signed and stamped by a professional engineer registered in the state where the ES is to be installed.

####  Design Data and Equipment Drawings:

Design data shall be provided for the storage system and PCS.

* Electrical operation and performance characteristics of individual ES cells, unit ES and ES strings, including voltages (nominal, end of discharge, top of charge); currents (maximum and minimum); capacity (dc kWh); and round-trip efficiency as a function of discharge rate;
* Physical and mechanical characteristics (dimensions and weight, cooling requirements) of the cells, unit ES, and cell / unit ES strings;
* Electrical operation and performance characteristics of the PCS, including dc input voltage (maximum, minimum, nominal); ac output voltage and current; harmonic content in output waveform and on dc bus; and one-way efficiency in charge and discharge as a function of power level; and
* Physical and mechanical characteristics (dimensions and weight, cooling requirements) of the PCS.

Equipment drawings (layout and / or functional diagrams, as applicable), specifications, and design data sheets shall be provided, including but not limited to the following major assemblies, sub-assemblies, systems, and subsystems:

* Energy Storage
* PCS
* Control System
* Data Monitoring System
* HVAC System
* AC and DC Switchgear
* Transformers
* Containers
* Grounding System
* Protection System

The design data and equipment drawings shall fully demonstrate that the equipment to be furnished will comply with the provisions of this Specification and shall furnish a true and complete record of the equipment as manufactured and delivered. They shall be at a level of detail sufficient to assist the Owner in proper integration and operation of the Supplier’s equipment.

####  Interconnection Diagrams:

Interconnection diagrams shall be provided for major equipment that is either in separate containers or in physically separated compartments of a single container, and that must be interconnected to the Owner site after shipment. This includes equipment interconnections to the utility grid itself. These shall be on an individual sheet (or in a drawing series) for each major piece of equipment. The interconnection diagrams shall be complete within themselves and not require reference to another drawing. The physical arrangement of devices and terminals shall be shown as seen when wiring these devices and shall match the equipment layout.

####  Conduit Diagrams:

Conduit diagrams shall be prepared for any required conduits at the Owner site. These drawings shall show the approximate location, designation, and usage of each conduit.

####  Conduit and Cable Schedule:

The Supplier shall prepare a complete Conduit and Cable Schedule for the project. This document shall include, at a minimum, conduit designation, conduit material, conduit size, conduit length, cable number, cable type, insulation level, conductor quantity and size, cable destinations, brief description of cable usage, and cable routing, including conduits.

####  Bill of Materials:

The Supplier shall prepare complete Bills of Materials covering all material to be furnished by the Supplier for the construction of the project. Bills of Material shall be sufficiently complete so as to allow the Owner to purchase any single replacement part or assembly. The description of an item shall be complete but concise, listing only those things that are pertinent, such as rating, type, and manufacturer. A unit of equipment is not required to be broken down into more than one item on the parts lists.

####  Assembly Drawings:

Assembly drawings shall be submitted for each type of structure or equipment. Each piece or assembly shall be identified by its proper mark number, and at each connection shall be shown the gasket material, if required by the design, the number and length of bolts required, and the number and type of washers required for proper assembly of the structure or equipment.

On each installation drawing, there shall also be shown a complete tabulation listing all of the material needed for the assembly shown thereon, including all bolts, nuts, washers, and locknuts. The tabulation shall show the number of pieces required in the structure, the mark number of each piece, and the description of each piece.

####  Wiring Diagrams:

Wiring diagrams of the complete scheme shall be provided. The wiring diagrams shall indicate the approximate relative location of parts, including the type and location of all terminal blocks.

#### Nameplate Drawings:

Nameplate drawings of components shall be provided where it is general practice in the industry to furnish nameplates.

#### Seismic Loading Drawings:

Outline drawings shall be furnished, covering seismic information. The drawings shall show centers of gravity and the weight of the apparatus that the center of gravity represents. The drawings shall include the weight applied by the apparatus to each support column, skid, and hold down. Other data that shall be included are natural frequency and damping of major components, and maximum horizontal and vertical accelerations that the apparatus is capable of withstanding. These drawings shall be incorporated in the Earthquake, Transportation, and Wind Loading Calculations.

#### One-Line Diagram:

The Supplier shall provide a One-Line Diagram showing the major project layout and electric circuitry. Equipment shall be identified in a manner that assists in the review of system study reports and test plans, and is consistent with other drawings.

#### Three-Line Diagrams:

The Supplier shall provide Three-Line Diagrams for the AC System, showing the general bus arrangement and all major equipment. The drawings shall show the phasing and detailed interconnections of current and voltage transformers, controls, metering, and protective relaying.

#### DC Schematic Diagrams:

The Supplier shall provide DC Schematic Diagrams for all DC power and control circuits, showing the interconnections of individual functional units, including manual controls, relays, controllers, interfacing rack, fiber optic links, measurement systems, and power supplies.

#### Record Drawings:

A complete set of record drawings reflecting the “as constructed” condition of the ES shall be furnished by the Supplier. These drawings shall be submitted to Owner within thirty (30) days after final acceptance of the ES at the conclusion of the availability guarantee period.

### Maintenance Schedule:

The Supplier shall prepare a comprehensive maintenance schedule listing required maintenance for all equipment based on specific maintenance triggers. This schedule will cover the equipment design life and make direct reference to maintenance requirements listed in the O&M Manuals.

### Master Test Plan and Procedures:

The Supplier shall submit a Master Test Plan and Procedures indicating the order in which the tests will be conducted and the test method being used, along with required instrumentation.

### Quality Assurance Manual:

Within sixty (60) days after award, the Supplier’s standard QA Manuals shall be provided.

### Study Reports:

The Supplier shall submit all design study, simulation, and site acceptance test reports to the Owner in a timely manner in accordance with the documentation requirements. These reports shall contain assumptions, study methods, results, significant findings, and conclusions. The Supplier shall prepare the following study reports as specified below:

####  Earthquake, Transport, and Wind Loading Calculations:

The Supplier shall provide Earthquake, Transport, and Wind Loading calculations for all critical equipment. Critical equipment is defined as any equipment required for the full range of operation for the ES, including the transportation containers.

####  Transient Voltage Studies:

The Supplier, in coordination with the Owner, shall prepare transient voltage and insulation coordination studies to define system performance and protection requirements under transient conditions.

####  Noise Study:

The Supplier, in coordination with the Owner, shall perform studies to identify and mitigate possible sources of audible noise.

####  Grounding System Study:

The Supplier, in coordination with the Owner, shall perform studies to determine the parameters for the ES grounding system. Such a study shall identify step and touch potentials, as applicable. The grounding system for the ES will be connected to the ground grid at the Owner. The Owner will provide a copy of the grounding study for its intended ES site for the Supplier’s use in preparing the grounding system study for the ES.

####  Electrical System Studies:

The Supplier, in coordination with the Owner, shall prepare electrical system studies as required to size and configure the ES and determine control response and settings. These studies, at a minimum, will address and solve related concerns regarding the following:

* Harmonic analysis of the existing system, including possible interactions with existing capacitor banks and SVC harmonic filters;
* Minimum system requirements and configuration for proper operation of the ES (i.e., requirements to stabilize a self-commutated PCS);
* Requirements for spinning reserve, VAR support, black start, and other support as described in these by the Owner; and
* Fault coordination and system protection in coordination with the Owner.

### Test Reports:

The Supplier shall prepare test reports. Formal test reports are required for all tests listed in the Master Test Plan and Procedures. The test report will include the subject test plan, required data and discrepancy reports, or failure reports resulting from performance of the tests.

### Training Manuals:

Forty-five (45) days prior to the start of training, the Supplier shall provide draft training manuals and course outlines for review for the training courses specified in Section 5.14. The training manuals will include relevant portions of the O&M Manuals and Software Documentation and will be retained by the students. Copies for Owner management shall be provided as well.

### O&M Manuals:

The Supplier shall furnish O&M Manuals for all of the equipment, as applicable. Clarity and readability shall be of the highest commercial standards. The books shall be oriented toward operation and maintenance of the equipment without the services of a manufacturer’s representative. The portions devoted to descriptive matter and theory shall be limited to those essential to a proper understanding of the equipment for satisfactory operation and maintenance.

Three (3) initial review copies of an O&M Manual shall be provided two (2) months prior to the FAT. The Owner’s review comments shall be addressed and resolved and a new version submitted (three (3) copies) prior to the FAT.

Six (6) copies of the final version of the O&M Manual shall be submitted within thirty (30) days of the successful completion of the site acceptance testing. One of these copies shall be suitable for reproduction. The Supplier shall correct all drawings or other material as may be needed to reflect the configuration of the ES after startup and site acceptance (including final relay settings and calibrations).

The O&M Manual shall include the name, telephone number, and address of the person designated to serve as the initial point of contact for questions regarding operation, maintenance, and diagnosis or repair of malfunctions. The Supplier shall notify the Owner if this point of contact is changed during the warranty period.

The O&M Manual shall be easy to use and shall include visual aids for locating and using its information, such as a cross-referenced index, color and graphic coding of topics, "quick-start" and "summary" sections, a glossary, and similar items.

#### Information:

The O&M Manuals shall include, but are not limited to, the information specified below:

* Manufacturer’s Definitions: All terminology peculiar to the Supplier’s equipment shall be clearly explained by the Supplier in a supplementary section bearing the heading "Definitions."
* Factory Specification of the Equipment.
* Shipping Instruction, Warehouse Storage, and Handling Instruction: List major components for warehouse inspection, and site receiving and storage instructions.
* Parts and Factory Service Instruction: Factory repair policy shall be provided. Describe in detail the procedure to obtain spare parts or factory service: (1) under normal conditions, (2) under emergency conditions. Specify the mailing address and telephone number(s) of the service department.
* Installation Instructions: Installation instructions and information to supplement the installation drawings shall be furnished. This information shall include power requirements, assembly procedures, safety precautions, grounding instructions, alignment instructions, installation test requirements, and details associated with equipment testing to verify proper performance.
* Preventive Maintenance Instructions: Preventive maintenance instructions shall be furnished for all subsystems, indicating manufacturers’ recommended maintenance intervals based on specific maintenance triggers. These instructions shall include required test procedures, alignment instructions, cleaning requirements, and instruction for visual examinations.
* Maintenance Schedule: The maintenance schedule shall include maintenance trigger points for each type of equipment. Such trigger points shall identify monitored parameters that can be used to perform preventative maintenance when needed, based on operating conditions rather than time-based maintenance. The preventive maintenance instructions shall include a table indicating the average man-hours required to complete a maintenance action, outage time if required, and on-line / off-line requirement for the maintenance action.
* Troubleshooting Instructions: Troubleshooting instructions shall be to the spare parts level, with adequate details for quick and efficient location of cause for equipment malfunction.
* Include adjustment limits, timing diagrams, troubleshooting and recommended corrective action steps, and resetting requirements before return to service. For mechanical items, information on tolerances, clearances, wear limits, and maximum bolt-down torques shall be supplied.
* Parts Information: This section shall contain a complete parts list and subsections that include a breakdown to the smallest assembly considered a replacement part, showing name and description, catalog number, quantity used, and reference by item number on the applicable drawing. The description shall include electrical and mechanical ratings, settings, nameplate drawings, additional instructions or instruction books, testing requirements, wire list, curves, drawings, and inspection and installation instructions.
* Spare Parts: A list of spare parts as recommended by the manufacturer shall be provided, including the descriptive information listed in the preceding paragraph.
* Tools Information: A list of all tools needed to install or maintain the equipment shall be provided. Tools shall be identified by either the Supplier’s part number or manufacturer’s part number and cross-referenced where applicable. All special tools supplied with the equipment shall be identified as such on the tool list.
* Theory of Operation: Include a system overview and detailed information pertaining to the individual systems and subsystems that make up the ES, as shown on a Supplier-supplied outline and logic, schematic, and One-Line Diagrams. The control and protective functions shall be numbered and cross-referenced to ensure easy identification on the above diagrams. Specifically, the Supplier is required to provide a narrative describing the control and protective logic of each function, such that the operating principles can be readily understood. Portions devoted to describing fundamental theory shall be limited to those essential to a proper understanding of the equipment operation.
* User Interface: The instructions shall describe the User Interface in detail and specifically include instructions and examples for calculating and setting all user-controlled parameters.
* The description shall identify in detail exceptional system conditions (if any) where the conventional settings may need to be altered.
* Installation Procedure: This section shall include a detailed step-by-step instruction of the ES test procedure and calibration. Additional information shall include power requirements, assembly procedures, safety precautions, grounding instructions, and installation test requirements.

#### Revision:

The O&M Manual shall be revised at appropriate intervals to advise the Owner of safety bulletins or issues and changes to the operation and maintenance of the system that have been determined by the Supplier over the ten-year (10-year) anticipated life of the ES.

### Digital Controller Software Documentation:

All controller software and any subsequent fixes, patches, or upgrades shall be fully documented. The Software Design Document shall detail the design of the controller software.

#### Software Overview:

The Software Design Document shall provide an overview of the controller software. This overview will include a list of controller algorithms and a description of how each of these algorithms interrelates with the others. This description shall either be provided as a narrative or as software control flow diagrams.

For all software modules, the Supplier shall provide easily understood methods and procedures for generating new and / or revised messages and documentation files (e.g., lists, events, reports, alarms, etc.).

#### Documentation of Individual Modules:

The Software Design Document shall include separate documentation for each controller module or algorithm. Information specific to individual modules or algorithms shall include the following:

* A functional description of the module;
* A Data Flow Diagram that depicts the interfaces between the module and other controller software routines;
* A Module Interaction Summary that narrates the information presented in the Data Flow Diagrams;
* A list of GLOBAL data elements used within the module, including a full description of each data element, its type, how it is used, and its range of values;
* A list of LOCAL data elements used within the module, including a full description of each data element, its type, how it is used, and its range of values;
* A list of control inputs required by the module;
* A list of outputs directly affected by the module;
* A pseudocode (structured English) or flow diagram description of the algorithm’s high-level design;
* Other information required for an understanding of the function of the algorithm;
* PLC code, logic diagrams, and / or ladder logic diagrams; and
* All code, including PLC code, shall be internally commented to such a level that the function of the code is clearly understood.

#### Data Dictionary:

The Data Dictionary shall be an alphabetically arranged source of information on each data element used in the controller software system. The Data Dictionary shall provide a description of each data element used in the controller software, including descriptions of the following:

* Data element type;
* Data element use by the Applications Software;
* The acceptable range of values for the data element;
* The program modules in which the data element is used; and
* The Supplier shall provide a written procedure detailing how to generate a new version of the Data Dictionary, as required.

#### Error Messages List:

The Error Messages List shall be a source of information on error messages issued by the controller. The Error Message List shall include information on the following:

* Error messages generated by the Operating System
* Error messages generated by the Hardware Diagnostics
* Error messages generated by the Applications Program

This information shall include a description of the type and meaning of each error message, how it is used, and what corrective action is required to solve the problem.

The Supplier shall provide a method and a written procedure detailing how to add / modify error messages.

### Digital Controller Hardware Documentation:

The Supplier shall provide manufacturer’s standard specifications and model numbers of all controller hardware.

### Relay and Control Settings:

The Supplier shall provide complete documentation of all protective relay and ES control settings, in coordination with the Owner. Such documentation shall include all calculations and coordination curves used in the development of the settings.

### Progress Reports:

The Supplier shall submit regular Progress Reports, to be submitted by the tenth (10th) working day of each month for the previous month's activities. These reports should be concise letter reports of one to two (1 to 2) pages and shall include schedule updates illustrating the baseline and current status for the project activities. Also, they shall include the status of sub-tier Supplier activities and fabrication progress photographs. The reports shall briefly describe project activities during the previous month, milestones attained, and activities planned for the next reporting period. The reports also shall include details of problems encountered and the solutions applied. The Owner reserves the right to verify contents of the Progress Reports through visits to Supplier facilities or sub-tier Supplier facilities, with prior notice.

### Submittals in Support of Owner Installation:

For each Owner site installation, the following items shall be submitted to the Owner:

* A schedule showing the chronology of major activities required to ship, start up, and site acceptance test the ES at each site. The installation schedule will be provided by others. The Supplier’s schedule shall use a bar chart, critical path diagram, or similar methods to show the relationship among the required activities and their start and completion dates. Major milestones shall be shown on the chart and listed in a table.
* Comments on ES installation / construction drawings, specifications, and calculations prepared by others.
* Detailed site acceptance testing and startup plans for the Owner's review and approval three (3) months prior to each site startup.
* An Interim Report of about twenty (25) pages documenting the transportation and initial startup activities at each Owner site.

###  (Optional) Submittals for Supplier Installation:

For each Owner site installation, the following items shall be submitted to the Owner:

* A schedule showing the chronology of major activities required to ship, start up, and site acceptance test the ES at each site;
* Documents and drawings including, but not limited to, those listed below:
* Site-specific plot plan showing the ES overall plant layout plans and elevations
* Site-specific electrical single-line and protective relaying diagrams
* Site-specific interconnection and wiring diagrams for connection of remote control and monitoring equipment to site interface equipment
* Site-specific conduit and / or cable schedules and diagrams
* Site-specific civil drawings and calculations
* Site-specific construction and installation procedures
* Cable and wire installation reports documenting continuity and insulation tests of field wiring

NOTE: Site-specific civil and structural drawings shall be wet-stamped by a registered civil or structural engineer of the state in which the ES is to be located.

* Detailed site acceptance testing and startup plans for the Owner's review and approval three (3) months prior to each site startup.

# Part 6: Required Information and Proposal Formatting:

## Proposal Format:

Proposals must be typed in a 12-point Arial or Times New Roman font with no more than forty (40) numbered double-spaced pages. The page count includes the Technical Proposal and / or attachments, but **does not** include the Title Page, Table of Contents, Executive Summary, or Resumes. Hard-copy Proposals must be single-sided and must have an original signature. Electronically submitted Proposals must have a scanned signature or e-signature.

All Proposals must include an Executive Summary. The Executive Summary should be placed at the beginning of the Proposal; must not exceed six (6) pages; and should include the name of the organization, summary of technical solution, and summary of experience with similar projects. Initial screening of the Executive Summaries will be conducted according to *Part 3: Evaluation Criteria*.

## Proposal Content:

The Proposals shall be separated into two (2) Volumes. Volume 1 is the Technical Proposal and Volume 2 is the Cost Proposal. The following sections outline the specific content to be included within each Volume.

### Volume I: Technical Proposal:

#### Executive Summary:

Provide a top-level summary for the Proposal. At a minimum, the Executive Summary should include the name of the organization, summary of technical solution, and summary of experience with similar projects.

#### Technical Approach:

This factor considers the Supplier's proposed approach for executing the work required for **each** of the major task items listed in *Part 4: Statement of Work*.

#### Management Approach:

The Supplier shall identify the management approach, techniques, and tools it will use to accomplish the objectives and requirements identified in this RFP. The Supplier shall tailor the management approach to successfully perform the major tasks as identified in *Part 4: Statement of Work*. The following are not subfactors, but rather are elements that the Owner will consider in evaluating the Supplier's Proposal. The Supplier shall address **each** of the following:

1. The Supplier shall discuss its management approach with respect to the services to be provided for all major tasks as set forth in *Part 4: Statement of Work*.
2. The Supplier shall explain the operating methods that will enable it to maintain control of the project and project costs, including its approach to: (i) validation processes and procedures to ensure high-quality performance (e.g*.*, ISO 9000 type or other quality certifications, Software Engineering Institute Capability Maturity Model Integration (CMMI) Level 3 or higher, and Project Management Institute and generally accepted Project Management Approaches); (2) internal control mechanisms for monitoring, reporting, and controlling costs; and (3) management of Sub-Suppliers.
3. The Supplier shall provide a QCP that provides performance metrics aligned with the Supplier’s Technical Approach (as submitted in Factor 1). The Supplier shall describe the QA methods that will ensure the proposed solution meets the objectives of the task order and achieves desired outcomes.

The Supplier shall describe the major risks (events with a high probability of occurring that could impact the project) associated with delivering the program and how these risks will be mitigated (action taken to lessen their impact).

#### Key Personnel and Staffing:

The Supplier shall describe its project staffing approach, describing the project staffing strategy; rationale for the proposed labor mix; and the experience, skills, and qualifications of the proposed Key Personnel. The following are not subfactors, but rather are elements that the Owner will consider in evaluating the Supplier's Proposal. The Supplier shall specifically address **each** of the following:

1. Key Personnel:  The Supplier shall address whether the proposed Key Personnel have some or all of the demonstrated experience, skills, and qualifications.
2. Staffing Plan:  The Supplier shall provide a written narrative that describes its capacity to provide the necessary resources for a project of the magnitude and complexity of the type set forth in this RFP in management, personnel, and Sub-Suppliers. This plan shall list all firms and / or Sub-Suppliers (by name or discipline) that will participate in this project, their roles (who does what), responsibilities (who decides what), and reporting relationships. The roles and responsibilities shall be linked to major tasks required by *Part 4: Statement of Work*. The staffing plan shall illustrate the project team that proposes the manpower required to accomplish all major tasks required by *Part 4: Statement of Work* and staffing proposed for each month of contract performance. Indicate whether the position is on the Supplier or Sub-Supplier staff.

#### Past Experience:

The Supplier shall provide three (3) references that can evaluate its performance on current contracts of similar size and scope, or contracts completed not more than three (3) years ago.

### Volume II: Cost Proposal:

The Supplier shall provide a cost proposal that includes the cost of all projected labor, travel, equipment, and other direct costs required to perform the activities listed in *Part 4: Statement of Work*.

The Supplier shall provide a summary of costs as defined in Figure 6‑1.

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Labor** | **Non Labor** | **Total Price** |
| Task 1: Project Management |  |  |  |
| Task 2: ES Design and Fabrication |  |  |  |
| Task 3: Permitting and Site Preparation |  |  |  |
| Task 4: Installation and Utility Interconnection |  |  |  |
| Task 5: FAT and Commissioning |  |  |  |
| Task 6: Training |  |  |  |
| Task 7: O&M |  |  |  |
|  |  |  |  |
| Travel and Other Direct Costs (define the number of trips and people per trip) |  |  |  |
|  |  |  |  |
| O&M (price per year) |  |  |  |
|  |  |  |  |
| Total |  |  |  |

Figure 6‑1: Cost Proposal Summary

In addition to completing the above table, the Supplier shall produce the following:

1. Bill of Materials for all non-labor items, to include item description, unit cost, number of units, and total cost; and
2. Labor cost summary by task, to include job category, hourly rate, hours per task, and total cost.

#  Part 7: Contract Template

The contract terms shall be defined by a written agreement that is not binding until fully executed by both parties. A copy of the Owner’s standard form agreement is included as a part of Appendix A. When the Consultant does not currently have a contracted agreement with the Owner, the Consultant must submit, as part of the response, comments to the Owner’s standard agreement in the form of redlines. The Owner will assume agreement unless otherwise noted by the Respondent.

While the Owner can show reasonable flexibility in contract terms and conditions, other factors being equal, preference will be given to Suppliers that take minimum exceptions. While all contract terms and conditions in the Owner’s standard agreement are important to the Owner, terms and conditions of particular importance to the Owner, and for which Suppliers should carefully consider their redlines, follow:

* License Grants (if applicable)
* Termination Rights
* Acceptance (if applicable)
* Standards of Performance
* Representations and Warranties
* Rights and Ownership of Intellectual Property
* Indemnification
* Limitation of Liability
* Insurance
* Choice of Law

Cooperative attach or imbed contract template here. It should go with the RFP, and its review is required with the response.

USDA Form 1047:



