**Lithium-Ion Battery Energy Storage System Technical Specifications**

**DISCLAIMER**

These technical specifications are intended as a resource only. ***It is the responsibility of government staff to ensure all procurements follow all applicable federal requirements and Agency-specific policies and procedures***. All procurements must be thoroughly reviewed by agency contracting and legal staff and should be modified to address each agency's unique acquisition process, agency-specific authorities, and project-specific characteristics.

**INSTRUCTIONS FOR USING THIS DOCUMENT**

This document is meant to be used as a customizable template for federal government agencies seeking to procure lithium-ion battery energy storage systems (BESS). Agencies are encouraged to add, remove, edit, and/or change any of the template language to fit the needs and requirements of the agency.

Sections that provide instructional language for the drafter are presented in (blue parentheses). Fill-in-the-blank areas are indicated in [red brackets].

**IMPORTANT:** The following items must be deleted from the template before solicitation:

* This title page and instructions for using this specification.
* All instructions, options, and background information within the template in blue or red font as well as any parentheses or brackets around instructions.

**Lithium-Ion Battery Energy Storage System Technical Specifications**

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# Abbreviations and Acronyms

A-E architectural and engineering

AC alternating current

AHJ Authority Having Jurisdiction

ANSI American National Standards Institute

ASCE American Society of Civil Engineers

ATS automatic transfer switch

BESS battery energy storage system

CRD Certification Requirement Decision

EES electrical energy storage

EMS energy management system

EPRI Electric Power Research Institute

ESS energy storage system

FAT factory acceptance testing

FPE fire protection engineer

HMA hazard mitigation analysis

Hz Hertz

IEC International Electrotechnical Commission

IEEE Institute of Electrical and Electronics Engineers

IFC International Fire Code

kVA kilovolt-ampere

kW kilowatt

kWh kilowatt-hour

LSFT large-scale fire test

MW megawatt

NEC National Electrical Code

NEMA National Electrical Manufacturers Association

NFPA National Fire Protection Association

NRTL nationally recognized testing laboratory

O&M operations and maintenance

PV photovoltaic

RACI responsible, accountable, consulted, and informed

SOC state of charge

SoO Sequence of Operations

SOW Statement of Work

UFC Unified Facilities Criteria

UL Underwriters Laboratories

# Generally Applicable Requirements

## Installation of Battery Energy Storage Systems (Scope of Work)

1. The Contractor shall design and build a minimum [Insert Battery Power (kilowatt [kW]) and Usable Capacity (kilowatt-hour [kWh]) here] behind-the-meter lithium-ion battery energy storage system (BESS). The Contractor shall provide all labor, material, equipment, engineering, maintenance, and capital to design, install, commission, and interconnect a BESS as required herein.
2. The BESS will [Describe project use cases here].
3. Electricity from the BESS must be provided at 60 Hertz (Hz) and at the appropriate voltage for electrical interconnection to the site at [specify the voltage service level and wiring] on the electrical distribution system. The BESS will interconnect at [specify interconnection location].
4. The BESS, and associated equipment, shall be provided in self-contained National Electrical Manufacturers Association (NEMA) enclosure(s) rated for the site conditions. BESS enclosures will be installed on a concrete pad or piers constructed by the Contractor at [specify location here]. Contractor-provided thermal conditioning systems shall maintain an ambient temperature within BESS warranty requirements.
5. BESS components and associated ancillary equipment shall have working space clearances required by local code, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of environment in compliance with the National Electric Code (NEC).
6. The Contractor shall supply a Sequence of Operations (SoO) or similar document for the BESS. This document must contain a detailed operational plan. The Contractor shall also prepare a written commissioning plan, including potential factory acceptance test specifications and site acceptance test specifications, that provides a description of the means and methods necessary to document and verify the system and its associated controls and safety systems are in proper working condition. The Contractor shall commission the BESS and provide a commissioning report documenting BESS performance during normal grid-tied operations [and during grid failure, if applicable]. Commissioning shall comply with the applicable codes and standards—for example, National Fire Protection Association (NFPA) 855 or the International Fire Code (IFC), and any requirements put forth by the local authority having jurisdiction (AHJ).
7. The Contractor shall provide [X] year(s) of turnkey BESS operations and maintenance (O&M) and warranty service. [Identify whether the Contractor or a designated O&M provider will be responsible for BESS O&M. One year is the recommended minimum time period for contractor-provided O&M. BESS manufacturers may require O&M support for the life of the asset to maintain their warranty. The Contractor shall provide a bid for an O&M contract for the full project life.]
8. The Contractor is responsible for all applicable permits, approvals, environmental compliance, freight, financing, procurement, monitoring, site inspection, billing, and incidentals as necessary to design, construct, and interconnect the complete BESS, described hereinafter.
9. The Contractor shall provide and install BESS as in accordance with applicable local codes and standards. This shall include NFPA 855 and/or the IFC.

## Existing Feasibility Studies and Engineering Studies Conducted by Others

The Contractor is responsible for ascertaining relevant site conditions to determine project feasibility and final BESS size, subject to the specified minimum size constraints, according to the terms of this solicitation. If any existing engineering studies or facility condition reports are provided through this solicitation with the site information package or from an Agency representative, the Contractor shall independently verify all information provided.

## Codes, Standards, and Regulations

The Contractor shall follow the applicable nationally recognized model building codes as well as other applicable national, state, and local codes. The most current of these local and nationally recognized codes, and any updated supplements in effect at the time of contract award, shall be used throughout the project design and construction. General codes and standards applicable to the BESS project can be found in this section.

The BESS and all associated components must comply with all codes and standards relevant to the operation and installation of energy storage equipment. All installed equipment must be tested and approved by a nationally recognized testing laboratory (NRTL). Batteries, enclosures, inverters, and other balance of system components must comply with the latest version of the following codes and/or standards, as applicable. (Always determine the applicable codes and/or standards according to local laws, regulations, and ordinances. Close collaboration with the local AHJ is recommended.)

1. All work must follow current/latest applicable requirements:
   1. NFPA 70—National Electrical Code.
   2. NFPA 72—National Fire Alarm and Signaling Codes.
   3. NFPA 855—Standard for the Installation of Stationary Energy Storage Systems.
   4. IFC.
2. Battery module and system certifications:
   1. Underwriters Laboratories (UL) 1973—Standard for Safety for Batteries for Use in Stationary and Motive Auxiliary Power Applications.
   2. UL 9540—Standard for Safety for Energy Storage Systems and Equipment.
3. Energy storage system (ESS) or BESS testing:
   1. UL 9540A—Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (when required by applicable code or identified by the Agency).
   2. CSA TS-800:24—Large-Scale Fire Test (LSFT) Procedure (when required by applicable code or identified by the Agency).
   3. (The system configuration must comply with manufacturer factory UL 9540 test certification.)
4. Grid interconnection standards, as applicable to the project as a whole:
   1. Institute of Electrical and Electronics Engineers (IEEE) 1547—Standard for Interconnection and Interoperability of Distributed Energy Resources With Associated Electrical Power System Interfaces.
   2. UL 1741—Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources, including Supplements A and B (consider Supplement Certification Requirement Decision [CRD]).
   3. UL 3141—Outline of Investigation for Power Control Systems.
   4. UL 62109-1—Standard for Safety of Power Converters for Use in Photovoltaic Power Systems—Part 1: General Requirements.
   5. IEEE P2030.5.1—Standard for Common Smart Inverter Profile.
   6. (Others as dictated by the utility, public utility commission, or independent system operator per service territory/operating area.)
5. Other codes and standards that will apply include:
   1. American National Standards Institute (ANSI) C12.1 (electricity metering).
   2. Seismic requirements consistent with American Society of Civil Engineers (ASCE) 7 Minimum Design Loads for Buildings and Other Structures.
   3. IEEE 2030.2—Guide for the Interoperability of Energy Storage Systems Integrated With the Electric Power Infrastructure.
   4. CSA C800-2025.
6. (Alternative International Electrotechnical Commission [IEC] standards where applicable:
   1. IEC 62619—Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes—Safety Requirements for Secondary Lithium Cells and Batteries, for Use in Industrial Applications.
   2. IEC 63056—Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes—Safety Requirements for Secondary Lithium Cells and Batteries for Use in Electrical Energy Storage Systems.
   3. IEC 62933-5-2, Electrical Energy Storage [EES] Systems—Safety Requirements for Grid-Integrated EES Systems—Electrochemical-Based Systems.)
7. (Other local codes and standards, as applicable.)

## Interconnection to Electrical Distribution Systems

### System Interconnection to the Utility Grid

It is the sole responsibility of the Contractor to meet [insert serving electric utility’s] interconnection requirements, SoO, single-line diagram, and equipment design standards imposed by the utility. The Contractor shall provide supporting documentation or drawings required by [insert serving electric utility]. Any local codes required by utility interconnection laws and regulations shall be followed by the Contractor.

**Agency-Owned Electrical Distribution System Requirements:**

1. Modifications or upgrades to the Agency-owned electrical system required to interconnect the BESS are the responsibility of the Contractor (e.g., service panel, generator coordination).
2. The Contractor is responsible for the proper circuit sizing, overcurrent protection, and coordination of the circuit(s) beyond the point of interconnection to the Agency distribution system, including modifications to the site’s electrical equipment and circuits. Any needed upgrades or modifications to existing Agency electrical distribution systems must be included in the review and approval process outlined in the submittal section herein.

**Serving Utility Electrical Distribution Systems Interconnections:**

1. The Contractor shall provide for interconnection of the behind-the-meter BESS with the utility-owned electrical distribution system and take actions to ensure the Agency- and utility-owned systems are compatible. Addressing utility technical interconnection requirements is the responsibility of the Contractor. Any modifications to the approved BESS design that would affect the electrical distribution system shall require the written approval of the Agency.
2. The Contractor shall ascertain costs of utility interconnection study and the cost of any upgrades required of utility-owned equipment and include those costs in the cost proposal. [Choose option: (a) Contractor shall pay utility for all costs, (b) site owner shall pay utility directly for costs.]
3. The Contractor is responsible for complying with all electric utility interconnection requirements, including upgrades, providing all necessary BESS details for the interconnection applications, and [Choose option: (a) funding, (b) complying with] any required interconnection studies to be performed by or on behalf of the electric utility. The Contractor is responsible for gaining approval from the electric utility for interconnection and any electric utility-required upgrades.

## Work Planning

The Contractor shall notify the Agency of any Contractor-planned utility service interruption not later than [insert number of working days] prior to beginning the scheduled work that requires the utility service interruption. The Agency shall coordinate all utility outages and secure a final date when the outage may proceed. (Typically, there are several entities the Contractor is required to coordinate with, each with specific notification requirements.) Every reasonable attempt shall be made to secure the Contractor’s requested date. Under no conditions shall the utility service be interrupted by the Contractor without prior written approval by the Agency.

## Permits and Licensing

The Contractor works with the Agency on the following:

1. Where allowed, the Contractor takes the lead in preparing all permitting and licensing applications that apply to the project, with support from the Agency.
2. The Contractor is responsible for complying with all permit requirements identified by the Agency.
3. Where allowed, the Contractor takes the lead in providing any supporting documentation, data, and information that may be required for permitting, with support from the Agency.
4. Where allowed, the Contractor takes the lead in coordinating and acting as the primary liaison with permitting and licensing agencies, with support from the Agency.
5. (It is important to ask for a responsible, accountable, consulted, and informed [RACI] chart with clearly mentioned expected roles for all the project stakeholders, minimizing potential conflict during project execution.)

## Local Involvement of the Authority Having Jurisdiction

The Contractor shall involve the local AHJ, or organization responsible for providing permitting (where locally required), for design review and approval. The Contractor shall submit all required construction documents, as stipulated in NFPA 855 and/or the IFC as applicable, for AHJ review. The installation shall not proceed until AHJ approval has been granted.

The Contractor shall coordinate emergency planning and training in accordance with NFPA 855 and/or the IFC.

(It is recommended that this emergency planning and training include inviting local firefighters, first responders, facility staff, and operation, maintenance, and repair personnel to an on-site training, where attendees will learn how the BESS works, review BESS safety systems, and review the emergency operations plan and response procedures. The emergency operations plan shall be developed by the Contractor and made available for use by facility personnel, maintenance personnel, and first responders. The Contractor shall coordinate with the local fire department on BESS siting, response procedures, first responder training, and posted instructions for shutoffs.)

## Federal, State, and Local Rebates and Incentives

The Contractor shall complete and submit in a timely manner all documentation required to qualify each system for available rebates and incentives. When allowed, tax incentive eligibility due diligence as identified by the Agency shall be the responsibility of the Contractor.

# Engineering and Construction

## BESS Project Description

1. The Contractor shall include BESS submittals in the proposal phase, including:
   1. A site plan showing the BESS footprint, including the location and layout diagram of the room or area in which the BESS is to be installed, including anchoring and/or structural support points. (Agencies may require additional input and levels of review to include local emergency management officials.)
      1. Size, location, distance between units, distance to exposures.
      2. Fire apparatus access.
      3. Fire protection water supply (hydrants, piping layout, water source).
   2. Electrical schematic diagrams (interconnection, system one-line diagrams, general arrangement drawings, schematic drawings).
   3. Logic diagram for SoO for BESS and larger controlling system (if available), provided by the Contractor.
   4. Communication diagrams provided by the Contractor (BESS, total BESS system, fire signal, etc.).
   5. (Identify whether a system will be air gapped, based on guidance from the Agency.)
   6. Usable energy storage capacity (in kilowatt-hours, kWh), considering allowable depth of discharge and maximum state of charge (SOC).
   7. Rated power (kilowatt alternating current, kW AC).
   8. Round-trip efficiency (including auxiliary loads).
   9. Cycle life.
   10. Annual degradation factor.
   11. Ambient temperature control system.
   12. RACI chart.
   13. Details on BESS fire suppression system equipment, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration prevention and/or venting systems, provided by the BESS manufacturer.
   14. Details on the hourly fire-resistance ratings of assemblies enclosing the BESS, provided by the BESS manufacturer.
   15. Details on the hourly fire-resistance rating of any walls in the vicinity of the BESS, such as exterior building wall ratings, BESS enclosure ratings, or similar.
   16. Alarm hierarchy, integration, and monitoring design as approved by the AHJ.
   17. A complete fire design package if required by the Agency, including but not limited to BESS cabinet fire alarm panel (if provided), BESS wiring and component diagrams, fire alarm design for BESS site (as applicable), and fire alarm system design completed by a fire protection engineer (FPE).
       1. Fire alarm drawings shall be prepared in accordance with NFPA 72 and any city, county, or state requirements.
   18. Hazard mitigation analysis (HMA) per NFPA 855 and/or IFC.
   19. Engineering validation reports for deflagration venting (NFPA 68) and/or deflagration prevention (NFPA 69) systems, or custom-engineered system meeting NFPA 855 requirements.
   20. UL 9540 Listing Certificate.
   21. UL 9540A test reports (Cell, Module, Unit, Installation, as applicable).
   22. CSA TS-800:24—Large-Scale Fire Test (LSFT) Procedure (when required by applicable code).
   23. Location and content of required signage.
   24. Manufacturer’s specifications, ratings, and listings of BESS and associated equipment.
   25. Equipment manufacturers and product names with technical specifications, brochure/catalog, operational manuals, communication manuals.
   26. Battery management system provider.
   27. SoO.
   28. Energy management system (EMS).
   29. Maintenance requirements.
   30. Commissioning and decommissioning plans. (Consider requiring recycling of BESS components where practicable and that the site will be restored to its previous condition.)
   31. Factory acceptance test specifications.
   32. Site acceptance test specifications.
   33. List of design documents and key deliverables/milestones.
   34. Attestation of By American requirements that meet agency guidelines.
   35. (Other standards according to unique Agency requirements).
2. The Contractor shall identify an appropriate location for the balance of system enclosure(s), and related components and environmental control systems that will meet the following criteria, based on BESS manufacturer input:

Ease of maintenance and monitoring.

Efficient operation.

Low operating losses.

Secured location and hardware.

Compatibility with existing facilities.

Minimum vegetative and landscape impact.

Minimum clearances around BESS and balance of system.

1. All balance of systems (wiring, component, conduits, and connections) shall be suited for conditions for which they are to be installed, based on information provided by the BESS manufacturer.

## Performance

(Incorporate use cases listed as items 1**–**3 below**.**)

1. Grid outage scenario: The Contractor shall integrate the BESS with [specify any existing photovoltaic (PV)/generator nameplate capacity in kilowatts (kW), specify generator model name if available] and automatic transfer switch (ATS) [include ATS model name and specifications]. Install a microgrid control system and modify the existing ATS as necessary to provide electricity to the building upon grid failure. (Optional language: The Contractor shall include the creation of a critical power circuit, including rewiring of the critical loads and installation of critical power switchgear, in the scope of work. [List the critical loads to be served, including their peak and average consumption.])
   1. Consider the following site-specific parameters in the system design. [Specify site-specific operating conditions: provide electric load interval data, required ramp rates for existing generators, additional information on the types of loads to be served, and required modes of operation. Provide detail on existing control and monitoring systems. Configure the BESS to provide seamless transition between utility power and microgrid. Optimize the system to minimize generator use to conserve fuel.]
   2. Undergo performance demonstration testing on a recurring basis to ensure the Agency’s desired site resilience and energy assurance. Interval testing shall occur approximately every 12 months after final acceptance to ensure provision of power to the site in the event of a utility-provided power outage or interruption. This activity requires pre-coordination with the serving electric utility in accordance with the approved interconnection agreement, and that coordination shall be led by the Contractor in consultation with the Agency’s facilities management staff. This periodic demonstration shall stagger months, seasons, load, time of day, and weather variabilities but shall be conducted at least once every 12 months. Periodic testing will be the responsibility of [specify entity responsible for O&M]. In the event of an actual utility power interruption exceeding [insert specified duration], the BESS’s performance will satisfy this requested demonstration, thereby resetting the interval to 12 months prior to the next required demonstration. Any deficiencies or anomalies beyond the expected design parameters, in an actual event or demonstration event, are to be reported to the Agency within 48 hours in writing, with recommended remediation or corrective steps to prevent recurrence.
2. (Agencies may require a site-level power system study and site-level SoO to ensure there are no loads that could overload the BESS on startup or when energized, like large transformers.)
3. Demand control scenario: The Contractor shall integrate the BESS to provide grid electricity usage and demand control/peak shaving to limit demand (kW) to programmed setting. Current site monthly peak demand is [insert monthly peak kW demand here], and average load is [insert average demand in kW here]. Limit grid demand by [specify the required demand reduction in kW here]. (The calculation of your utility billing demand can vary dramatically depending on your serving utility. Carefully review your utility tariff to understand how your billing demand is established. Common clauses that could impact savings include contractual minimum billing demand, billing ratchets/lookbacks [e.g., 80% of highest annual demand], and standby service charges.) The BESS shall have a method for forecasting the peak load and automatically dispatching the battery or scheduling the charge/discharge in advance. (A site-level EMS may also be used for this function.)
   1. Time-of-Use Charge Reduction: The Contractor shall integrate the BESS to discharge during on-peak hours in accordance with the site’s rate tariff.
   2. A BESS-level control system shall be provided to control the charging and discharging of the equipment. The BESS control system shall be field programmable by connecting with a laptop and viewing/editing on a locally hosted web browser. (Remote sites without internet access may not wish to require remotely programmable capability.) Programming instructions and set points shall be shared with Agency staff.
   3. BESS shall maintain a round-trip efficiency greater than 70% AC-in to AC-out (confirmable by operation over a single round-trip cycle from 0% SOC to 100%, and back to 0% at standard conditions specified by the manufacturer), including thermal losses and auxiliary loads, over 10 years.
   4. The Contractor shall guarantee annual BESS savings as established in the proposal. (Potential language: Savings will be generated by discharging the battery during on-peak periods, as well as during peak billing demand periods. The Contractor shall propose a methodology to calculate optimal savings, subject to review by the Agency, and guarantee [define percentage] of optimal savings.)
4. Solar-plus-Storage (optional language)
   1. (If the solar-plus storage will be privately owned: The awarded Contractor may be eligible for tax incentives associated with the PV and BESS. Due diligence to determine tax incentive eligibility is the responsibility of the Contractor, not the Agency.)
5. (Grid support applications [optional language] as per IEEE 1547.
   1. Volt/Var: voltage regulation by absorption and production of reactive power.
   2. Hz/Watt: frequency regulation by changing active power.)

## Thermal Management

The Contractor shall provide all components to operate the BESS within acceptable operating temperatures, as well as any thermal management systems and operating strategies required to maintain the BESS and inverter temperatures within manufacturer’s recommendations at all times, including during shipment and prior to commissioning.

## Arc Flash and Coordination Studies

The Contractor will perform arc flash and coordination studies of the system to ensure safety during operation in parallel with the grid. (If pursuing an islandable system, add the following: The Contractor will also perform arc flash and coordination studies of the system during islanded operations.)

## Professional Engineer and Licensed Design Professionals

All architectural and engineering (A-E) services shall be performed by design professionals licensed in the state in which the project is being built with responsible control for each respective design discipline. Where required by NFPA 855 and/or the IFC, safety basis documents shall be prepared by a registered design professional.

## Registration Seals

Each submitted final design drawing, calculation document, and specification manual shall be signed and dated by, bear the seal of, and show the State Certificate Number of the Architect or Engineer who prepared the document and is responsible for its preparation.

## Coordination of Professional Services

The Contractor shall be responsible for the professional quality, technical accuracy, and coordination of all investigations, evaluations, drawings, testing, cost estimates, submittals, written reports, construction, operations, and all deliverables, as required by this document or as required to complete the work of this contract.

## Coordination of Subcontractors’ Credentials

The Contractor shall ultimately be responsible for the completeness, accuracy, coordination, and submission of all submittals described previously. The Contractor may delegate the preparation of submittals to subcontractors or suppliers as long as the specifications in Sections 2.5, 2.6, and 2.7 are met.

## Modifications and Alterations of Government Property

Modifications, alterations, and/or additions to existing facilities shall be designed and certified to satisfy applicable requirements of this Statement of Work (SOW) document and the governing codes and standards referenced in this SOW document. The Agency shall coordinate with building occupants and approve all modifications, alterations, and/or additions prior to the completion of the design.

## Grounding System

A suitable equipment grounding system shall be designed and installed for the BESS. The grounding system shall provide personnel protection for step and touch potential in accordance with IEEE 80. The system also shall be adequate for the detection and clearing of ground faults within the BESS. The system shall be grounded in [list all anticipated operating modes, e.g., grid-tied and islanded] operating modes.

## Structural Components

The vendor shall furnish the design for the structural components of the BESS, concrete pads/foundations as required, and conduit required for the complete BESS. All final (Issued for Construction) drawings, specifications, and calculations shall be stamped by a state-licensed Civil/Structural Professional Engineer. The vendor is responsible for geotechnical surveying if required.

## Conduit and Preventing Water Intrusion

Outdoor containers shall be suitably rated to prevent water intrusion and minimize condensation. Conduit routing and fittings must be selected to prevent water intrusion into inverter enclosures, combiner boxes, switchgear, and transformers. Conduits are to provide fittings to allow water to drain prior to entering the electrical enclosure. Any exterior PVC conduit must be Schedule 80.

## Locating Equipment

Major electrical components, including the inverter, isolation transformer, and metering, shall be installed in code-compliant enclosures. BESS location shall be above the [insert year] flood plain and surge levels and shall be elevated higher than any pull vaults and conduit not sloped toward any BESS electrical component to prevent equipment flooding. BESS shall include a thermally conditioned enclosure. Site design shall include egress for staff or other people on site and access for emergency responders.

## Expected Service Life

Unless noted otherwise, all materials furnished for the project shall have an expected service life of at least 10 years.

## Site Service Conditions

Materials shall be designed to withstand the year-round temperatures and conditions to which they are exposed (e.g., sunlight, heat, humidity, rain, wind, sand/dust, seismic activity, salty air, fog, marine corrosiveness). (The Agency can specify the wind rating and any other site conditions here.)

## New Equipment

The Agency shall not accept used, reconditioned, after-market, or grey-market products or equipment. Any offeror supplying used, reconditioned, after-market, or grey-market products may be held responsible for damages to the Agency.

## Markings (Labeling)

Strict conformance to system marking requirements of BESS and their components is crucial for the safety of operators, service personnel, emergency responders, and others. Include all required and desired labeling language in the design drawings for Agency review. Provide all required markings per UL 9540, NFPA 70, NFPA 855, and the IFC, including, but not limited to:

1. Electrical equipment and components used in BESS shall have markings that identify the manufacturer, size, type, ratings, hazard warnings, and other specifications.
2. Labeling shall include posted instructions for tasks that site staff may need to perform, such as system shutdown during an emergency.
3. All disconnects shall be clearly labeled, indicating operating system voltage, current, and system rating.
4. Equipment markings shall never be removed and shall be able to withstand the environmental conditions in which the equipment is installed (e.g., “UV rated” for outdoor labels, or on an embossed steel placard, designed for outdoor use and fastened with adhesive and rivets).
5. Markings shall be visible or easily accessible during and after installation. The Contractor shall be responsible for all field-applied markings as required by local, state, and federal codes.

## Battery Warranties

The Contractor shall provide the following limited and performance warranties:

* 1. Battery pack performance shall have a warranty for at least 10 years after the date of successful completion of commissioning. A battery pack shall retain at least 70% of nominal energy capacity for the earlier of either 10 years after commissioning or after a minimum energy throughput of [insert cumulative throughput] kWh energy.
  2. Power conversion system shall have a warranty of at least 10 years from successful completion of the commissioning.
  3. Full turnkey system shall have a warranty for 1 year from successful completion of the commissioning. The Contractor shall respond within 3 days if maintenance is required. (The Agency shall specify: [1] definition of Contractor response, [2] minimum system availability, [3] allowable outage hours/year for preventive maintenance, and [4] penalties for nonperformance.)

## Operations and Maintenance

[The Contractor or designated O&M provider] shall conduct annual O&M and continuous monitoring to verify the BESS is performing as intended per the proposed battery storage strategy and manufacturer recommendations and submit an annual report to the Agency. The Contractor shall perform all required maintenance to the BESS to ensure the system is performing as expected. Additionally, the Contractor shall:

1. Provide O&M training and supporting manuals to Agency personnel.
2. Perform updates to the BESS control system dispatch strategy if required because of rate tariff or major site load profile changes.
3. Ensure all system firmware is up to date and meets Agency cybersecurity requirements.
   * 1. Provide an annual O&M report, including use case performance, battery outages with root cause summaries and start and end time periods, summaries of all O&M operations, repairs, and replacements, and summaries of safety incidents, causes, and resolutions.

## Data Acquisition Monitoring

The Contractor shall provide a turnkey data acquisition and display system that allows the Agency to monitor, diagnose, and track the charging, discharging, and operating data of the BESS. A minimum requirement is the provision of a web-based monitoring and tracking system. The Contractor shall provide an internet connection to the BESS, distinct from Agency internet. (Agency requirements may vary; ensure the data acquisition and monitoring solution is compliant with agency cybersecurity requirements. Remote sites without internet access may not wish to require remotely programmable capability.) Monitoring and tracking systems shall include a historical database and real-time data portal capturing the data in 15-minute intervals. A minimum of 36 months of data shall be stored by the Contractor and be made available for Agency download via the web portal. (The Agency may consider requiring machine-learning predictive maintenance based on installed data collection and retention components, as well as the incorporation of control algorithms that minimize overcharging and aggressive cycling.) The data shall, at a minimum, comprise the following information and frequency of collection:

1. Date and time.
2. Apparent power (in kilovolt-amperes, [kVA])/phase, real power (kW), power factor, and volts on each phase; recorded in 15-minute intervals.
3. BESS SOC, with minimum and maximum operating requirements identified in accordance with manufacturer recommendations about how SOC will be measured.
4. BESS temperature, hourly average at hourly intervals.
5. Internal communication architecture with status.
6. Actual system performance, an estimate of expected performance, and updated cycle life.
7. Visual and audible alarm, if potential safety hazard exists.
8. Notification when preventive maintenance is needed.
9. System level alerts.
10. [Wind speed at the BESS, at hourly intervals.] (This is optional, not required, for performance assessment.)

The system shall allow the Contractor to interact with the BESS control system to update settings and modify set points. Updates shall be incorporated into the monitoring system throughout the contract term. The system shall be described in the offeror’s proposal.

## BESS Safety

The BESS shall comply with various measures to support safety in design, installation, and operation. These safety measures shall include the following:

1. Installation of the BESS shall comply with the locally adopted edition of NFPA 855 and/or IFC.
2. The BESS shall contain protective relays, circuit breakers, or fuses that self-protect the BESS in the case of internal electrical faults.Set and adjust circuit protection devices according to a short circuit and coordination study.
3. A detailed plan surrounding battery cell failure modes, preventative barriers to failure, and mitigation measures will be included in the submittal process. This shall be documented in an NFPA 855 and/or IFC compliant HMA, prepared by a registered design professional. The HMA shall be evaluated at the product and site-specific levels. The AHJ shall have final approval authority over the HMA. (The Agency shall ensure all code-required safety systems are provided, including but not limited to fire detection, explosion control systems, and battery management systems. Gas detectors or early thermal runaway detection specific to the cell type are recommended for insight into the presence of flammable gases inside BESS, if not provided by the explosion control system.)
4. A visible disconnect will be installed that isolates BESS in accordance with utility interconnection requirements.
5. All electrical equipment, enclosures, disconnects, and overcurrent devices shall be clearly marked and identified. Markings shall reference the same designations called out in the final design drawings.
6. Develop an emergency operations plan in accordance with NFPA 855 and/or the IFC. Post the plan at a location approved by the fire department.
7. Ensure site design is informed by an emergency preparedness strategy coordinated with local emergency management officials. (Consider incorporating site emergency preparedness officials into the site design approval chain. Also, consider including contract language regarding Contractor-led training and coordination exercises for battery system operators, supervisors, and emergency responders.)
8. The Contractor shall perform a safety risk assessment to include inverters, battery management systems, and energy management systems. This risk assessment shall include guides for ventilation and thermal management; for installation, maintenance, and operations; and for managing electrical, fire, and shock hazards.

## Severe Weather

(The appropriate clauses shall be included based on site location and extreme weather risks.)

1. **Earthquake Mitigation—**The Contractor shall comply with Unified Facilities Criteria (UFC) 3-301-01 for requirements related to the foundation, soil stability, and seismic analysis.
2. **Flooding/Other Water Intrusion Considerations**
   1. The Contractor shall use NEMA 3R-rated or better enclosures. (In severe weather locations, NEMA 4 ratings are recommended. In coastal areas with severe weather, NEMA 4X shall be considered if funding is available to support the additional cost.)
   2. The Contractor shall develop a comprehensive site stormwater management and drainage plan that encompasses location of BESS out of the path of stormwater flows.
   3. Along with code requirement compliance, the Contractor shall design the system to prevent scouring of soils in and around the BESS to prevent loss of foundation integrity.
3. **Wildfire—**The Contractor is responsible for removing any vegetation adjacent to the BESS. Areas within 10 ft (3 m) on each side of an outdoor BESS shall be cleared of combustible vegetation and combustible growth. To limit the risk of wildfire damage, ensure the system is set back from flammable objects (e.g., trees, buildings) and ensure a fire defensible perimeter is maintained. Coordinate vegetation management plan and defensible perimeter with the local AHJ to ensure adequate setbacks and mitigate fire risk.

# Inspections and Commissioning

## Factory Acceptance Testing

The Contractor shall plan for factory acceptance testing (FAT) before shipping the BESS. FAT shall cover testing of the individual key components and also as integrated BESS. FAT shall also include functional testing for both grid-connected (and islanding) modes for all the key functional use cases and modes. The Contractor shall provide FAT specifications to the Agency technical team for review and potential feedback. FAT may be witnessed by the Agency technical team along with relevant project stakeholders. If the project interfaces with a microgrid control system, this may also be tested as microgrid control system integration within the FAT.

## Commissioning

The Contractor shall coordinate with a third-party Commissioning Agent on the following tasks. (The Federal Emergency Management Program strongly recommends the use of a third-party Commissioning Agent to support the project from design through final acceptance. The Commissioning Agent shall be involved throughout the project, from the design and programming phase through the acceptance phase. If an Agency is unable to procure a third-party Commissioning Agent, the section below may be modified to place commissioning responsibility upon the Contractor. All documents shall be provided from the Contractor to the Agency and the third-party Commissioning Agent.) A commissioning plan, along with checklist and related documents, shall be provided by the Contractor and approved by the Agency before proceeding with inspection and commissioning:

1. After the Agency’s electric utility provides permission (interim for testing) to operate in parallel with the grid, the Contractor shall complete commissioning in accordance with Agency safety and the Commissioning Agent’s commissioning plans, its own quality control plan, manufacturer's recommendations, and franchise utility interconnection requirements. The Contractor shall work with the Commissioning Agent to document all performance measurements.
2. The Contractor shall perform all work required for testing, startup, and commissioning, under Commissioning Agent review and supervision.
3. The BESS shall be commissioned per the Electric Power Research Institute (EPRI) “ESIC Energy Storage Commissioning Guide,” or by a similar standard reviewed and approved by the Agency.
4. The Contractor shall give the Agency and Commissioning Agent 10 business days’ advance notice prior to the start of commissioning. An Agency manager or representative may request to be present during any or all phases of the startup, commissioning, and testing activities. (It is strongly recommended that an Agency representative witness all startup, commissioning, and testing activities.)
5. All subsystems and components shall undergo commissioning tests, function tests, and performance tests to demonstrate correct installation and operation.
6. The system shall be started up and tested in accordance with the regulations of the applicable interconnection standards. All anticipated modes of operation shall be tested.
7. The Contractor shall request and coordinate system acceptance testing with the utility and Agency for acceptance and certification of the BESS and permission to operate, after commissioning and final inspections are complete.
8. Commissioning shall include the Contractor’s data acquisition system, fire alarm system testing, gas detection/ventilation system testing, testing any system interconnections, and enclosure thermal conditioning system testing (e.g., HVAC, liquid cooling).
9. Commissioning of safety systems shall be performed in accordance with the applicable standards associated with the respective systems: for example, NFPA 855, NFPA 72 (*National Fire Alarm and Signaling Code*), and NFPA 69 (*Standard on Explosion Prevention Systems*). Testing shall be performed in an integrated manner consistent with NFPA 3 (*Standard for Commissioning of Fire Protection and Life Safety Systems*) and NFPA 4 (*Standard for Integrated Fire Protection and Life Safety System Testing*).
10. A commissioning report shall be provided to the Agency and AHJ prior to final inspection and approval.

## Inspections

1. The third-party Commissioning Agent is responsible for verifying the BESS is installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent and local codes and regulations. The Contracting Officer or the delegated Contracting Officer’s Representative may inspect the systems at any time during construction or after the systems have been put in operation. The Contractor may be ordered to stop work or shut the systems down if unsafe conditions or code violations are noted.
2. An initial inspection for Substantial Completion will be made when the work is complete to the point the Commissioning Agent is ready to begin starting, testing, and commissioning the system. Following this inspection, the Agency shall provide the Contractor with a punch list describing any incomplete work that must be completed before the Contractor’s request for final inspection.
3. The Contractor shall give the Contracting Officer 10 business days’ advance notice, in writing, of the date the work will be ready for initial inspection.
4. A final inspection of all systems shall be made only when all construction is complete in accordance with the terms and conditions set forth in the contract and all punch list items identified in the initial inspection are complete. If, upon examination by the Contracting Officer and/or Agency inspection personnel, the project is determined not sufficiently completed to have warranted a final inspection, the Contractor may be charged for any additional cost of re-inspection.
5. The Contractor shall give the Contracting Officer 10 business days’ advance notice, in writing, of the date the work will be fully completed and ready for final inspection.
6. The Contractor’s request for final inspection will not be approved unless the following documentation, at a minimum, has been provided to, and accepted by, the Contracting Officer, in addition to all other contract requirements:
7. Final as‑built drawings (record drawings), meeting as-built requirements.
8. Preventive maintenance work schedules and procedures.
9. O&M manuals (electronic and hard copy).
10. Training manuals (electronic and hard copy).
11. Equipment documentation and spare parts lists.
12. Certificates of AHJ inspections.
13. After commissioning is complete, the Contractor shall instruct and train Agency-designated personnel on normal system operation and how to shut down the system in the event of an emergency. The Agency may reasonably request additional training, and the Contractor shall conduct such training at the Contractor’s expense. Training may take place over multiple sessions to accommodate the Agency’s staff availability. The training session(s) may be recorded.
14. As soon as practicable, following final inspection, the Contracting Officer will inform the Contractor, in writing, of any discrepancies and/or omissions noted at the final inspection. The Contracting Officer shall also state the time allowable for replacement of material and performance or re-performance of any unsatisfactory work necessary before written notification of system acceptance testing.
15. Upon written notification that all deficiencies identified during the final inspection have been corrected, the Contracting Officer may schedule a follow-up inspection to confirm all corrected work is acceptable. The Contractor shall then coordinate with the Commissioning Agent, utility, Agency, and AHJ to schedule system acceptance testing.

## Summary of Process

In summary, inspections and commissioning will follow the following sequence:

1. Factory acceptance testing.
2. Initial inspection for substantial completion of construction.
3. Pending successful initial inspection, commissioning may begin.
4. Final inspection may be scheduled following completion of commissioning and approval of all documents shown in Section 3.2(6) of this specification.
5. The Contractor will be responsible for completing any re-work identified in the final inspection before scheduling system acceptance testing.

# Final Acceptance

1. The Contractor shall notify the Commissioning Agent and Agency within no less than 10 business days prior to the anticipated date of system acceptance testing. The Agency shall have the right, but not the obligation, to be present at and observe the system acceptance testing, at the Agency’s sole cost. (It is strongly recommended that an Agency representative witness all testing activities.)
2. The system acceptance testing shall be witnessed by the electric utility if required for interconnection approval, and the Contractor shall meet the utility’s test notification requirements.
3. In addition to utility and Agency system acceptance test standards, the test shall include, at a minimum, the following tasks:
   1. While connected to grid power, start up the BESS until it achieves the minimum specified performance requirements. The acceptable productive power output will be measured in kW (AC) at the building electrical interconnection point and must be consistent with the specifications for the system.
   2. Demonstrate the operation of one full charge/discharge cycle of the BESS and report on system performance.
   3. Ensure all subsystems and components work under foreseeable operating conditions.
   4. Provide a complete record of all pre-functional tests, equipment startups, and functional performance verification tests.
4. Approvals as required by the local AHJ and local electric utility will be a prerequisite for acceptance and for authorization to energize the system(s).

Upon successful completion of system acceptance testing, the Contractor shall send a Completion Notice and a copy of the system acceptance test report to the Contracting Officer so that the Agency can complete their final acceptance. The Agency and Commissioning Agent shall have 10 business days after receipt of the Completion Notice to review the system acceptance testing results and verify the system installation is complete, safe, aesthetically acceptable, functional, and constructed to all code requirements; does not interfere with Agency or tenant operations; and otherwise meets all other requirements. The Contracting Officer will notify the Contractor in writing of final acceptance.

If any of these requirements are not met, the Agency shall provide the Contractor with a detailed notice of such failure (a Rejection Notice) within the 10-business-day period, with details regarding the required remedy (including repetition of either partial or full system acceptance testing, if appropriate, at the discretion of the Contracting Officer or Contracting Officer’s Representative, and the time allowed to complete remedy). The Contractor shall promptly remedy, at the Contractor’s cost, the items identified in the Rejection Notice and conduct any additionally required system acceptance testing (if required by the Rejection Notice) until the system acceptance testing indicates the system meets the contract requirements. In each such case, the Contractor shall send a new Completion Notice to the Agency with a copy of the results of the new system acceptance testing as provided previously, and the foregoing procedures shall be repeated.

Written acceptance shall be final and conclusive except regarding latent defects, fraud, or such gross mistakes as may amount to fraud, or regarding the Agency’s right under any warranty or guarantee, subject to the system performance warranty.

In summary, the following requirements must be fulfilled before final acceptance:

1. Completed system acceptance testing, with the system and all subsystems and components having operated at specified performance for one full charge/discharge cycle with power production levels consistent with the proposed system’s estimated production with 100% system availability, measured with applicable instruments and meters.
2. System approval for interconnected operation by the electric utility (with signed interconnection agreement).
3. Submission of as-built drawings and all documents required prior to final inspection as described in Section 3.2 of this specification. (Agency to add any additional documentation as required.)
4. Training fulfillment documentation.
5. Commissioning report provided to the Agency.