# Battery Energy Storage System Procurement Checklist

This checklist provides federal agencies with a standard set of tasks, questions, and reference points to assist in the early stages of battery energy storage systems (BESS) project development. The checklist items contained within are intended for use in procurement of commercial scale lithium-ion BESS, although they may be used more generally for other BESS technologies. During the more technical portions of BESS project development, agencies are encouraged to utilize FEMP’s [BESS Technical Specifications](https://www.energy.gov/eere/femp/articles/lithium-ion-battery-storage-technical-specifications) and [Distributed Energy Interconnection Checklist](https://www.energy.gov/eere/femp/articles/distributed-energy-interconnection-checklist).

## Abbreviations and Acronyms

AC alternating current

AHJ Authority Having Jurisdiction

ANSI American National Standards Institute

BESS battery energy storage system

BMS battery management system

FEMP Federal Energy Management Program

IEEE Institute of Electrical and Electronics Engineers

kW kilowatt

kWh kilowatt-hour

NEC National Electrical Code

NEPA National Environmental Policy Act

UL Underwriters Laboratories

## General BESS Requirements

### Ensure site staff and agency leadership buy-in

Early-and-often coordination with the site energy manager, agency leadership, all relevant stakeholders, and decision-makers, and any authorities having jurisdiction (AHJs) is necessary to ensure there are no unknown barriers that may prevent the project from being successful. All parties should be made aware of the project, the proposed financing method(s), and any impacts the project may have on the site (i.e., reduced utility costs, added site resilience, required land use commitments, etc.).

### Confirm intended BESS use cases and site electricity requirements

BESS can be used in a variety of ways. Most commonly, BESS are used in grid electricity use time shifting, peak electrical load shaving, emergency backup power, power quality improvements, and frequency or voltage regulation (sometimes in conjunction with wind or solar photovoltaic generation). BESS can be designed for operation in two modes: (1) grid tied, and (2) islanded mode during grid power outages. When planning BESS use cases and operational modes, staff should understand the site’s electricity requirements such as:

* Typical load profile including peak and average demand
* Expected load for BESS to carry
* Minimum timeframe BESS must carry load
* Voltage and frequency of electricity supplied by BESS

This information will assist the project development team in designing the system and determining the appropriate battery power, energy capacity, and storage duration.

### Compile all existing feasibility studies, engineering studies, and facility condition reports and prepare them for contractor use

If available, existing site utility and facility information can help expedite the project development phase. The contractor’s project development and design team will likely request documents such as as-built drawings, site one-line diagrams, utility maps, and previous energy audits. Ensure all documents provided to contractors are free of classified information. All information provided within these reports should be independently verified by the installing contractor.

### Confirm BESS physical location and interconnection point

When locating a BESS, consider the utility interconnection point, site ownership, land availability and expected future uses (any site requirements for the space), site access requirements, and National Environmental Policy Act (NEPA) evaluations.

* Coordinate with the local fire marshal for other fire safety considerations
* It is typically not feasible to place lithium-ion BESS on roofs or in buildings
* Consider the site’s 100-year flood plain and surge levels.

### Identify all codes, standards, and regulations required by the agency, site, and local authority having jurisdiction

BESS components must comply with all codes and standards relevant to the installation and operation of energy storage equipment. All installed equipment must be tested and approved by the UL or other nationally recognized testing facility. Batteries, enclosures, inverters, and balance of system components must be certified to comply with the latest version of the following:

* National Electric Code (NEC), including, but not limited to NFPA 855, “Standard for the Installation of Stationary Energy Storage Systems.”
* Battery Cell:
  + UL 1642 “Standard for Lithium Batteries.”
* Battery Module:
  + UL 1973 “Batteries for Use in Light Electric Rail Applications and Stationary Applications.”
* Battery System:
  + UL 9540 “Energy Storage Systems and Equipment”
  + UL 9540A “Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.”
* Grid Interconnection standards, as applicable to the project as a whole:
  + IEEE 1547-2018 “Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces”
  + UL 1741, “Standard for Static Inverters and Charge, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources”
  + UL 62109-1 “Safety of power converters for use in photovoltaic power systems – Part 1: General requirements.”

Other codes and standards that may apply include:

* UN 38.3 “Certification for Lithium Batteries” (transportation)
* ANSI C12.1 (electricity metering)
* IEEE 2030.2, Guide for the Interoperability of Energy Storage Systems Integrated with the Electric Power Infrastructure.

### Define permitting and licensing requirements for which the contractor will be responsible

The installing contractor is responsible for preparing all permits and licenses for the project, paying all fees associated with those permits and licenses, providing any supporting documentation needed to obtain those permits and licenses, and acting as the primary liaison with local permitting and licensing agencies. Site personnel are responsible for communicating to the contractor which permits and licenses are required to do the required work on-site, such as local electrical permits, building permits, trade licenses, etc.

### Confirm agency/site equipment warranty requirements

Expected service life of BESS and associated equipment is 10 years. FEMP recommends requiring a battery pack performance warranty of at least 10 years after commissioning, where the battery must retain at least 70% of its nominal energy capacity. FEMP also recommends requiring a full turnkey system warranty of at least 1 year, including a contractor maximum warranty claim response time of 3 days.

### Investigate federal and local rebate and incentive programs, and third-party owned tax incentives

Local and federal rebates and incentives may be available for a BESS project. Consult with your local utility, potential installing contractors and the [Database of State Incentives for Renewables & Efficiency (DSIRE)](https://www.dsireusa.org/). The contractor is responsible for completing and submitting all documentation required to qualify for any available rebate or incentive program.

Depending on procurement method, if the equipment is owned by the installing contractor, there may [tax incentives](https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses) available. The cost savings generated by these tax incentives are often passed on to the customer, making the project more economically attractive.

## Engineering and Construction Considerations

### Ensure that the request for proposals includes thermal management systems for the enclosure housing the BESS as well the battery modules and rack

Consider the thermal management systems and operational strategies required to ensure that BESS and inverter temperatures stay within the manufacturer’s specified limits.

### Specify grounding, structural, and water intrusion requirements

The system must be adequate for ground fault detection and clearing. Mount BESS and equipment on appropriate concrete pads/foundations. Other considerations include geotechnical requirements, conduit specifications, and prevention of water intrusion.

### Ensure that BESS includes data acquisition and monitoring capabilities

Ensure that the BESS has a web-based monitoring system that reports on actual system performance and estimated future performance. Key metrics include apparent power (kVA) per phase, real power (kW), and voltage per phase, BESS state of charge, and ambient temperature. The system should include a Human-Machine Interface to allow users to interact with the BMS.

### Review and understand BESS safety concerns and risk mitigation methods

Data acquisition system alarms should include visible and audible on-site alarms when potential safety hazards are identified, notification when preventive maintenance is required, and system-level alerts. Consider performing arc flash and coordination studies to ensure system safety during all modes of operation.

### Review fire safety standards and ensure appropriate fire marshal coordination

Fire detection and suppression system submittals must be reviewed and approved by the local fire marshal and installed in accordance with national and local fire safety codes. Early coordination with the local fire marshal can help ensure that the installing contractor is aware of all site fire safety requirements and develops the project accordingly.

### Consider agency cybersecurity requirements (Risk Management Framework process, Authority to Connect, Authority to Operate, etc.)

BESS must be designed, installed, and operated in compliance with all agency cybersecurity standards. FEMP recommends that site personnel fully understand all cybersecurity requirements for networked and utility interconnected systems and include detailed descriptions of those requirements in the project request for proposal.

## Inspections and Commissioning Considerations

### Develop plan to monitor and support the project throughout the construction process

Ensure site personnel assigned to the project have adequate time to oversee and inspect the construction process. Typically, these projects include regular construction period update meetings, work site inspections, operational requests, and document reviews that need to be handled by site personnel. Lack of on-site support through the construction period may cause project delays attributable to the agency.

### Ensure all equipment has appropriate labels and markings

NFPA 855, NFPA 70, and the International Fire Code all describe BESS labels and markings. The site, in coordination with the local fire marshal, should include detailed requirements from these references within the project specifications.

### Typical inspection sequence

1. Regular construction period inspections
2. Subsystem start up inspections
3. Substantial completion inspection
4. Punch list remediation confirmation inspection
5. Final completion inspection
6. System acceptance testing with witnessing and approval by electric utility and fire marshal as needed.

### Commissioning requirements

* Commissioning workshop (pre-commissioning coordination meeting)
* Agency witnessing
* Utility/fire marshal/other AHJ coordination
* Commissioning standards as described in Section 3.1 FEMP’s [BESS Technical Specifications](https://www.energy.gov/eere/femp/articles/lithium-ion-battery-storage-technical-specifications)
* Subsystem startup checklists
* System acceptance test and field performance test checklists
* Commissioning report confirming system functions as designed.

## BESS Interconnection

For detailed interconnection requirements, tasks, and considerations, see FEMP’s [Distributed Energy Interconnection Checklist](https://www.energy.gov/eere/femp/articles/distributed-energy-interconnection-checklist). FEMP recommends coordinating with your site’s serving utility as early as possible.

### Identify and communicate with the owner of the on-site electrical distribution system

On-site electrical distribution systems may be owned by the serving utility, the agency, or a private third party (typically referred to as utility privatization). There are unique interconnection considerations for each ownership model, and communication with the system owner is crucial to understanding their specific requirements and maintaining the project schedule.

## Ownership, Operations, and Maintenance Considerations

### Clearly define operations and maintenance responsibilities

Assess site operations and maintenance capabilities. The site should not accept responsibility for any operations and maintenance tasks it is not prepared to fulfill. Depending on procurement method, like in an Energy Savings Performance Contract, it may be allowable to include long-term operations and maintenance in the initial contract award.

### Ensure request for proposals includes augmentation/capacity maintenance

BESS capacity performance requirements should be included in the request for proposals and maintenance should be provided to ensure that performance is sustained throughout the life of the equipment/contract term.

### Ensure request for proposals includes requirement for regular firmware/software updates

The site should ensure that all firmware updates are received throughout the expected life of the equipment. Updates should include security patches, updates to BMS antivirus software updates, and anything required to ensure the system functions properly.Ensure all updates are in compliance with agency cybersecurity standards.

## What To Look for in BESS Submittals

### Confirm BESS submittals include at least the following:

* Equipment manufacturer and product names:
  + Including the battery itself, inverters, transformers, control equipment, protection devices, enclosures, etc.
* BMS provider
* A site plan showing the BESS footprint
* Electrical schematic diagrams (interconnection, system one-line diagrams)
* Useable energy storage capacity (kWh)
* Rated power (kW AC)
* AC:AC efficiency (including auxiliary loads)
* Cycle life
* Annual degradation factor
* Ambient temperature control system
* Fire protection/suppression system description as required by code
* Maintenance requirements
* Confirmation that the proposed system can integrate with existing solar photovoltaics, if applicable
* BESS-specific sequences of operation should be included for all modes of operation and use cases.

### Standards for BESS submittals

All submittals should include a statement from the engineer of record confirming that the contents of the submittal adhere to the project requirements in the contract and project specifications. Additionally, all final design drawings, calculations, and specifications should be signed, dated, and bear the seal (stamp) of the engineer or architect responsible for its preparation. The site should not accept any engineering or architectural services from personnel not professionally licensed in the location of the project.