Business & Technology Report
June 2021

Battery Energy Storage Procurement Framework and Best Practices

NRECA
America's Electric Cooperatives

Business & Technology Report
January 2021

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Prepared By:

AUTHORS

Jan Ahlen
Director, Energy Solutions
Business and Technology Strategies

Bob Gibson
Consultant & Technical Writer
Gibson Energy Insights
gibsonenergyinsights@gmail.com

Contact:

NRECA

Business and Technology Strategies
www.cooperative.com/bts

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Introduction

The foundation of a successful battery energy storage system (BESS) project begins with a sound procurement process. This report is intended for electric cooperatives which have limited experience with BESS deployment. It provides insights into the art of assessing the need for and value of BESS and presents a procurement framework. The guide is divided into three sections:

- Framing the BESS procurement with the project definition, key considerations and collection of relevant battery technology information.
- Development of a Request for Proposal (RFP) outlining the major considerations to address in an RFP, with procurement insights from the recent experience of electric cooperatives.
- The functional requirements for a successful RFP, including project concept, system conditions and appropriate technical specifications for the BESS.

Current Co-op Experience

The cooperative experience with BESS through early 2021 is generally at the 'working pilot' stage. Some co-ops such as North Carolina EMC[1] have a significant number of energy storage installations on their system, while others have recently deployed smaller pilot projects. Most installations are expected to address real needs and provide a solution to system issues, while serving as opportunities to gain experience and lay the groundwork for future investment. However, the majority of co-ops express strong interest in the technology but have yet to deploy a project.

BESS is a more complicated technology to procure than technologies such as solar PV. Some recent cooperative projects were developed with a procurement process limited by a lack of familiarity with market participants and product. In the case of small projects, cooperatives have been able to make reasonable purchasing decisions based on recommendations from third party partners or other utilities, as well as based on 'brand awareness' and market reputation.

Where RFPs were issued, sometimes preceded by a Request for Information (RFI) or other pre-bid screening process, the satisfaction in results as reported by the cooperatives was mixed. Cooperatives expressed disappointment in the number of bids received, in the responsiveness to what was sought in terms of system solutions, and in some cases, the price.

Future Co-op BESS Deployment

In 2021 and beyond, electric cooperative investment in battery storage will likely move from the pilot project stage to meeting rigorous cost-effectiveness standards for any investment in a cooperative's infrastructure. This evolution will depend upon several factors, including:

[1] The Value of Battery Energy Storage for Electric Cooperative: Five Emerging Use Cases. January 2021. Available at: https://www.cooperative.com/programs-services/bts/distributed-energy-resources/Pages/Battery-Energy-Storage-Use-Cases.aspx

- Building upon the experience of early co-op installations, shared by BESS adopters with the rest of the cooperative family.
- Aligning cooperative expectations for battery energy storage with a deeper understanding of the technical capabilities and limitations of the technology.
- Improved procurement process, which will evolve as cooperatives and the BESS suppliers develop a greater familiarity with their respective expectations and business practices.
- Affordable project pricing, influenced by lower battery hardware costs and reduced soft costs, including integration and installation.

Battery Energy Storage Procurement Framework

This section provides an overview of the steps required to procure and deploy a BESS project. It starts with guidance on developing a strategic assessment of the rationale for the BESS. This is followed by a look at the tactical approach to procurement, including a basic preparation checklist and suggested recommendations when developing an RFP).

Project Scoping: Why Battery Storage?

The first step in developing a battery storage project is to identify the purpose for a battery and how it will be used. Even if a project is undertaken as a "toe in the water" exercise to develop experience with battery storage as a utility asset, identifying the key application from the outset will lead to a better project design, more appropriate bids from vendors, and the likelihood that the battery system will deliver optimal value. This will lead to a more useful operational experience and a more accurate appraisal of the economics of additional deployments. The key questions in this process are "what issue on your system do you need addressed?" and "how does battery storage accomplish that?"

The primary configurations for battery energy storage include:

- **Stand-Alone Battery Systems**

  Stand-alone BESS are installed without additional generation sources and are designed for use cases such as demand reduction or ancillary services such as frequency regulation.

- **Solar-Plus-Battery Storage Systems**

  Installing a BESS along with a solar array is typically intended to extend the use of solar energy into the evening hours when it has more value than the middle of the day. Current federal tax policy also incentivizes this configuration because combining battery storage with a renewable resource qualifies the project for the Investment Tax Credit[2], while a stand-alone BESS does not. However, the battery must be charged only by the renewable generator.

- **Microgrid Battery Systems**

  Microgrids are designed to provide resilience as well as other benefits. A microgrid typically consists of distributed generation (such as solar) combined with additional local generators, batteries and active load management. A microgrid controller manages operation in the two basic modes – grid-interactive and islanded – and transitions between these modes. In order to maintain power to critical circuits within the designated microgrid for a period of time when the main power supply has been disrupted, batteries for this application are designed for long duration use.

Some of the early battery projects delivered useful lessons on how batteries can and should be used. For instance, much of the industry discussion focuses on utilizing the battery for multiple use cases, an idea

[2] Federal Tax Incentives for Energy Storage Systems. National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy18osti/70384.pdf

known as "value stacking." While it is possible to leverage a battery system to perform more than one task, it is recommended to focus on a primary application.[3] Some applications can be readily paired, such as using storage to maximize the value of solar and to reduce demand on the grid. However, a BESS should not be expected to both reduce demand and provide frequency regulation, for example. Changing how a battery is being used once it is in use (changing the depth and frequency of cycling, for example) can shorten battery life and violate product warranties and contract terms.

For more detail on recent electric cooperative experience in each of these applications, please see the NRECA report "The Value of Battery Energy Storage for Electric Cooperatives: Five Emerging Use Cases" (January 2021).

Designing A Project: Key Considerations

Elements of the procurement, construction, and commissioning of battery energy storage have much in common with traditional infrastructure and technology procurements. However, the maturing battery storage market creates unique considerations which electric cooperatives may want to take into account in the BESS procurement process. These include:

1. Create a project plan document which includes a description and rationale for the project, expected outcomes, the steps needed to achieve the outcomes, the project team, the potential barriers or risks of the project, and the budget.
2. Before sending out a Request for Proposals (RFP), gather system data, such as peak load, relevant to the proposed application.
3. Spend time becoming familiar with the technology that you intend to procure. In addition to general research from sources like NRECA, consider sending a Request for Information (RFI) to suppliers.
4. Write the RFP in a way that allows suppliers to exercise creativity in proposing a solution in order to receive more useful responses (particularly from the more experienced and highly thought of providers). RFPs that are overly-prescriptive – particularly in the case of a new technology where co-op experience is limited - may work against overall objectives.

The Value of the Request for Information

In some cases, the scope of the project and associated costs are defined enough to proceed directly to procurement. However, in many cases, it may be necessary or preferable to gather additional information before issuing a formal RFP. An RFI can help a co-op evaluate the state of the market for the products and services they are interested in acquiring. It can also help firm-up the budget and cost-benefit analyses and can be used to develop a short-list of recipients for the final RFP. RFIs can be especially useful in a technology market that is changing as rapidly as battery energy storage.

[3] When it Comes to Battery Storage Systems, Co-ops Should Focus on a Primary Application. February 8, 2017. NRECA. https://www.cooperative.com/programs-services/bts/Pages/TechSurveillance/battery-storage-systems-primary-application.aspx

In order to obtain these benefits and attract useful responses, the RFI should be simple and straightforward. It should include a description of what the cooperative hopes to accomplish with the addition of battery storage, including the configuration (stand-alone, solar-plus-storage or microgrid) and primary use case such as demand reduction, resiliency, or renewables integration. The RFI should provide basic information, if available, such as a proposed project location, a load profile and other electrical system details, technical and performance requirements, and other considerations that will help a provider outline possible solutions and an estimate of costs.

It is not advisable to be overly detailed on technical specifications or to limit responses to specific technologies (e.g. lithium ion batteries) or vendors in the RFI (or, for that matter an RFP). The RFI is an opportunity for gathering technical information and restrictive specifications may discourage innovative responses that might prove useful to the cooperative.

The cooperative should clearly state the degree of serious interest in investing in battery storage, and its intention to follow the RFI with a subsequent request for proposal. A strong statement of intent will help ensure useful responses from quality providers. The RFI should include an "intent to respond" section to gather initial information about potential suppliers.

Request for Information (RFI):
Success Comes When You Set Aside
'The Know-It-All Utility' Approach

Poudre Valley Rural Electric Association of Fort Collins, Colorado took a different approach to procurement when the purchase in question was a controller for batteries and other technologies that will form a microgrid.

"As a utility, we can spec down to the individual part what we want in a bucket truck, and we know everything we need in building a substation," says Milt Geiger, Energy Resources Director of Poudre Valley REA. But with a microgrid controller, the cooperative was breaking new ground. *"I'm proud of the fact that we owned up to the fact that this [technology] was all new to us, and we wrote an RFI that gave the vendors an opportunity to be creative, resisting the impulse to be the know-it-all utility."*

Geiger and a team at Poudre Valley REA focused on the need, not details of the solution. *"We said, 'here's what we want to do – what's the best way to do it? Give us your ideas.' By leaving the parameters of the project open – and not simply focusing on lowest price - we got great feedback from the vendors and eventually ended up with a great product."*

Developing A Request for Proposal

Responses to the RFI will likely dictate some changes in project scope, which will be critical in preparing an RFP. Additionally, the RFP should contain more details on both technical requirements (documentation, safety procedures, interconnection, general electrical requirements, etc.) and specific contractual and legal requirements.

The introduction of the RFP should include an overview of the proposed project, with details on the primary application, the needs and objectives that are important to the cooperative, in order to elicit competitive and responsive bids.

The RFP should also include a proposed scope of work and details on the technical specifications for the BESS. Companies undertaking construction projects often employ a consulting architect/engineering firm to assist in developing a scope of work and technical specifications to be used in an RFP. If a co-op does not have in-house engineering expertise with battery energy storage, – it may be advisable to obtain supporting expertise in the development of a battery energy storage RFP.

The technical detail on the BESS will include information such as the intended purpose of the battery, described in terms of expected capacity and number of annual battery cycles. If the project is designed to provide resiliency it should also include expectations for ability to “island,”where it could disconnect from the utility grid and operate independently. This would include “blinkness” transfer (e.g. within XX cycles) or a shutdown and blackstart transfer.The next section of this guide contains technical requirements which are applicable to a project that will be turned over to the co-op at the end of commissioning. These requirements are specific to a battery project, and will form part of the overall RFP, which will also need to incorporate a contract schedule and standard terms that the co-op uses for other projects.

Technical requirements for a solar-plus-storage system will include requirements for the PV array, the battery system and overall expectations for system behavior / performance. Technical requirements for a Power Purchase Agreement request will focus more on the annual and long-term performance requirements rather than detailed technical requirements. For example, rather than specifying the power and energy of the battery, the utility might describe the need (e.g., reduce peak demand during a certain period) and provide bidders with usage data that they will use to optimize a solution.

A formal system should be set up to manage questions submitted during the RFP. Possibilities include a webpage with anonymized questions and answers, email responses to all vendors who have replied to the notice of intent, and a webinar which will address both questions which have been submitted and new questions which might come up.

Ownership and Financing

Once the goal of the project has been established, a decision must be made on ownership, operation and financing of the equipment. There are three primary types:

- Ownership of the asset by the utility (which will typically require some sort of financing),

- Build-Own-Operate-Transfer (BOOT), where ownership and initial operation of the system by a third party with the eventual goal of turning ownership over to the utility (“lease-buyback” financing for solar arrays fits into this category), and
- Storage-as-a-service, which may include PPAs or agreements for the owner of the system to provide specific services (e.g. dispatch to reduce demand or transmission congestion charges). PPAs for solar have matured to the point where they are well understood. Energy-as-a-service contracts for the various types of energy storage systems are still evolving, so there is no template PPA that can be generally applied.

Each ownership option has advantages and disadvantages, and the final decision will vary depending on the overall goals of a particular utility. Co-ops can work with their traditional financing partners to develop solutions that best fit their needs.

Project Siting and Permitting

The project scoping step includes identification of a site for the project. Standalone BESS have a much smaller footprint than utility-scale PV systems, but they still occupy space. Should the BESS be near the co-op headquarters (particularly for R&D projects), or should it be located near a specific substation? Is there space available inside the substation perimeter, or will additional space be needed? If the purpose is renewable integration, does it need to be located at the same site as the PV array, or can control be affected through high-speed (fiber) communication?

The co-op should do research into permitting requirements, specifically the permitting that is the responsibility of the co-op (permitting may fall under the responsibilities of the vendor in a power purchase agreement, particularly for a larger project). Since battery energy storage is a new and rapidly developing technology, it may not be familiar to local permitting authorities (and local emergency response personnel), and the initial reaction may be to impose severe restrictions. Working with these agencies in advance of starting the project will help avoid unnecessary delays at a later stage.

Bid Acceptance

Once a final vendor is chosen, the co-op may choose to provide feedback to other vendors on why they were not chosen (especially if a short-list was used). The co-op will negotiate the final contract with the selected vendor and formalize a construction schedule, payment milestones and other contract details. Once everything is in place, the co-op will provide a “notice-to-proceed” to the selected vendor.

Installation / Commissioning

Primary responsibility generally lies with the engineering, procurement and construction (EPC) firm selected for the project, if the co-op has contracted with an EPC. Nevertheless, the co-op should assign a project manager to coordinate the installation and commissioning of the project. The project manager will monitor the schedule, approve payments, arrange for factory and site testing, interconnection, commissioning, as required.

Operation / Maintenance

The RFP should include an Operations and Maintenance plan. If the system is a PPA, the supplier will be responsible for operating and maintaining the system to meet specific performance goals. If the site will be owned by the co-op, there are a couple of choices – the co-op could sign an O&M contract with the supplier to provide for all maintenance, or the co-op could receive training in general operation and maintenance, with an option to access the supplier for non-standard situations. A hybrid option is to contract for O&M for the first year, with training included, then take over O&M after the co-op crew is trained.

End-of-Life Tasks

A battery energy storage system may have residual value at the end of life, depending on the types of materials used. It is good practice to have a reserve fund for removal of equipment at the end of its service life, especially if hazardous materials are involved. A requirement for recycling may also be useful in order to minimize adverse effects on the local environment. Recycling requirements are evolving rapidly and will be substantially different in the years when many current systems will reach end of life.

Working with BESS Providers and Project Developers

Feedback from the vendor community, through insights shared in industry forums and in remarks made directly to NRECA, can be instructive to co-ops working on BESS procurement. Given the competitive marketplace, top vendors gravitate to projects where the utility is able to provide clear and detailed system information and can describe its expectations for BESS performance in terms that the storage industry expects. In addition, because of the increasing demand for BESS top vendors are unlikely to directly bid on projects that are less than 1 MW.

In order to get responsive bids to a proposal, BESS experts and project developers suggest that co-ops avoid:

- An RFP that is overly prescriptive and/or limits responses in ways that prevents a respondent from presenting a compelling or appropriate solution.
- An RFP that demands conditions and/or submissions of information that are not reasonable or relevant to the stated goals and will require a level of effort not commensurate with the opportunity.
- Indications that contractual terms will require burdensome legal effort, risking taking profit.

Ways a cooperative can increase the likelihood of a successful procurement:

- Employ an engineer with expertise in energy storage as part of your team.
- Have a clear understanding of the advantages, responsibilities and risks of the cooperative owning and operating the BESS, or paying for performance under a power purchase agreement (PPA).

Cooperative Perspectives on Procuring Battery Storage

Several co-ops have found the community of vendors of products and services to be difficult to access, right down to the question of "who do you call?" That was the question that Milt Geiger at Poudre Valley REA in Colorado had when his cooperative sought to purchase a battery for a microgrid project. "When you want to buy a pick-up truck, you don't call the Ford Motor Company – you go to a local dealership," he says. But, he and his team wondered, what is the equivalent of an auto dealership in the utility-scale battery market?

An informal survey by NRECA of cooperatives that recently deployed BESS projects found that many cooperatives have basic questions about procuring and deploying the technology – even after a project is up and running. Cooperatives assessing acquisition of battery energy storage may benefit from keeping these questions in mind – and asking these questions, as relevant – as they work through the process. Also included are points of advice that may apply to future co-op projects.

<u>General questions:</u>

- Is there an industry leading supplier? How is "leading" defined?
- What questions should you ask a supplier during the procurement process?
- Do different applications require different battery products?
- Is a co-op advised to engage a consultant to lead the acquisition and subsequent implementation of battery storage?
- What is the anticipated ownership structure, post-construction?
- Under a Power Purchase Agreement (PPA), what are the terms covering non-performance? In the event of non-performance, how will the utility be made whole?

<u>Questions relevant to a direct battery purchase by a co-op:</u>

- In transporting the battery to the co-op site, when and where does the co-op take ownership, and which party holds liability during the process?
- What are the warranty terms? Is it more important to ask for a battery that maintains capacity throughout its life or whether to ask for a guaranteed degradation rate?
- Who is responsible for monitoring the health of the BESS?
- Who is responsible for preventative maintenance?
- If the manufacturer requires remote access to the battery, who is responsible for the communications path, and how are potential cybersecurity issues addressed?
- What training is available from the vendor for commissioning and operation?

<u>General advice to co-ops taking on their first project:</u>

- Be very clear ahead of time about your expectations for the battery project – do you need islanded capability? Peak demand reduction? Arbitrage?

- Obtain a clear understanding of the experience of a given developer in designing and constructing battery storage systems.
- What is the information technology and communications infrastructure required for the project – and which party is responsible?
- Understand what it will cost to operate and maintain the system – whether by utility staff or a third party.
- If you are using a PPA, make sure the terms are clear and fully understood for what happens if the owner/developer goes bankrupt.
- If a co-op is building a microgrid project, give strong consideration to hiring an EPC contractor to take responsibility for the inevitable issues that arise when harmonizing the various components of the microgrid. Contracting with the EPC for project maintenance following commissioning also should be considered.
- Related to the point above, the complexity of controlling all the operating parameters (voltage, frequency, etc.) of all the devices (solar and battery inverters, batteries and reclosers) demands critical support.

Keys to Success in Procurement: The NCEMC Experience

North Carolina Electric Membership Corporation (NCEMC) and several of its member distribution cooperatives are gaining extensive experience in the deployment of battery energy storage systems (BESS), with the technology featured in five microgrid projects and ten solar plus storage installations.

NRECA spoke with John Lemire, director of grid management, and Kagen Del Rio, manager of project development and engineering, to discuss what they have learned to date from procuring, building, and operating BESS.

Define your goals as the first step in your project.

Lemire says that "success comes down to having a clearly defined objective of what you want the [BESS] to accomplish." NCEMC has used each project as an opportunity to refine its approach by measuring the results in each project against the original goals and expectations.

Own and operate in-house or through a third party.

Del Rio observes that the path the cooperative takes "is a balance between a co-op's capability and resources. If you have the capability in-house you'll be well-positioned to maintain the assets more efficiently over time." Microgrid control system design and deployment require a significant amount of engineering labor hours. "You can buy quality assets without too much trouble, but making them all dance together as a microgrid is another story."

Continued…

A cooperative can access the benefits of a BESS or microgrid through a third-party contract. Lemire says that "if a co-op wants a microgrid to do X, Y, and Z, a third party can build it and manage the O&M. It is autonomous and hands-off - all the co-op needs to do is push a button for power." NCEMC, however, has chosen the ownership path. "We're trying to build out our skillset [in managing distributed energy resources], to develop the skills internally, to be involved in the architecture of our use cases, and in designing how these systems operate."

The path NCEMC is taking is complex. Each battery project has been executed a little differently. It has used EPCs in some projects, while in others, the cooperatives have managed or directly carried out the construction. NCEMC has utilized RFPs for most of its procurement, but it will leverage the previous supplier to create standardization and increase efficiency in some cases. Ownership of assets is mixed. In the microgrids, some of the energy resources, and in one case, the battery system is owned by project partners, including cooperative members, not NCEMC. The operation of the microgrids is a joint effort between the G&T and the distribution cooperatives.

Standardizing the process.

Even after several projects, NCEMC says that it has not developed a standard RFP. "We haven't found the winning formula for an RFP," says Lemire, "but we have refined our technical specifications, and we find those incredibly useful, particularly in setting out the terms in a contract. So if an issue arises, we have a basis to be able to say, no, this isn't a change, this is what we asked for."

NCEMC has found that it can successfully use a mix of technologies and different vendors, but it is important to focus on a standardized design, especially in the site controller. Overall, Del Rio says, "we're evolving in our understanding of standardizing – we've been somewhat successful, but there are a lot of areas for improvement. Part of that is better understanding the technology, understanding the vendors, and adjusting our requirements. As our requirements evolve, we are relaxing on some things that we thought were going to be standardized and enforcing other things we know have to be standardized in order to be efficient."

Del Rio suggests that all cooperatives should "do your due diligence and develop a solid technical understanding of what you are asking for in an RFP and a contract." Each project, he adds, "provides lessons learned and helps drive more successful projects in the future."

Functional Requirements for Battery Energy Storage RFP

The following section provides an example of a hypothetical RFP. The exact information included should be modified to conform with the specific co-op battery project. Some of the example text only relates to a microgrid RFP while the rest relates to all battery storage projects.

1 Project Description

1.1 Project Goals

The goal of this project is to install a functional energy storage system at [Co-op name here].

The system will have a useable rating of XX MW-AC and XXX MWh-AC and shall be designed for a service life of XX years with degradation no more than XX% of initial capacity per year.

The equipment will be designed to provide the following services (examples only – the actual list may consist of a single use case or multiple use cases):

1) The system will be discharged to reduce co-utility power consumption during peak periods, which occurs between 3pm and 7 pm on weekdays during the summer and between 6am and 9 am on weekdays during the winter. It is anticipated that the battery will be dispatched no more than 8 times per month. Dispatch will be controlled by the utility. Recharge will occur between 11pm and 6 am.
2) The system will be designed to limit up and down ramping of [specify existing PV array] to no more than 10% per minute
3) The system will be designed to provide frequency regulation services to the [specify market] during weekdays from XX:XX to XX:XX
4) The system will be designed to limit load on XX feeder to XX MW for a period of XX years, assuming load profile supplied in the appendix and a growth of no more than 2% per year.
5) The system will be designed to discharge daily during weekday peak hours (from 3pm to 7 pm) and to recharge daily using low cost energy during the evening and night (9pm to 6 am).
6) In the event of an outage, the system will be designed to isolate itself from the grid and provide power to [describe load] for a period of XX hours. If the outage ends while there is still energy in the battery, the system will reconnect automatically per IEEE 1547 standards and will recharge based on the following schedule: [schedule may vary]

1.2 Site

1.2.1 The system will be installed [description of install location] and connected to [co-op's] XX.X kV distribution system at [interconnection substation / other point] as shown in drawing XXX

1.2.2 Minimum ambient temperature: -20 degF [modify as needed]

1.2.3 Maximum ambient temperature: 101 degF [modify as needed]

1.2.4 Humidity (describe)

1.2.5 Elevation – 4,000 ft above sea level [modify as needed][4]

1.2.6 Access to site – [Describe]

1.3 Proposal Documentation

1.3.1 Complete design package, BOM and calculations issued for co-op review and construction

1.3.2 Network diagram of the ESS system and SCADA points list

1.3.3 Complete commissioning plan including test and startup procedures for [insert utility] review

1.4 Construction

1.4.1 The winning bidder will be responsible for providing details related to construction services including management, engineering advisory, construction equipment and materials, labor, and supervision.

1.4.2 The winning bidder will provide construction plans that will include milestone schedule, hours of operation, utility and site access needs, and emergency SOPs.

1.5 Communications Integration

1.5.1 The winning bidder will be responsible for providing a plan on how to integrate the ESS into the existing communication backbone.

1.6 Final Project Documentation

1.6.1 Complete set of as built drawings post construction

1.6.2 Complete set of test results package for record

1.6.3 Statement of completion

1.6.4 Installation manuals, instruction manuals and operation guides for all equipment and subsystems. Specific instruction manuals for operation of the BESS controller is required.

1.6.5 Other project documentation that would reasonable be required for [insert utility] to document the construction of the ESS and operate the ESS in the future.

1.6.6 ESS Control and protective settings

1.6.7 Final software

1.6.8 As-built drawing and documentation upon final Project acceptance

[4] Note that requirements above 3,000 meters (approximately 10,000 ft) altitude will require special derating due to both lessened cooling capacity and changes in the electrostatic capacity of the air.

1.7 Training [modify as needed]

1.7.1 The winning bidder will be responsible for the provision of classroom/on-site training prior to the commissioning of the system. The training could include, but is not limited to the following areas:

- *System/Network Administration Training;*
- *Hardware Training;*
- *Software/Application Training;*
- *End-user Training (Train the trainer);*
- *Operation and Maintenance training;*
- *Incident Response Procedures (e.g. Fire, Spillage, Errors/Warnings etc.);*

1.8 Warranty Requirements [modify as needed]

1.8.1 The system shall have a minimum parts and workmanship warranty of one year

1.8.2 The BESS shall shave a performance guarantee as specified

1.9 Commissioning, Start-Up and Hand-Over

1.9.1 The proposer will be responsible for providing the commissioning plan overview prior to the start of the project. The proposer will also be responsible for the start-up, testing, initial operation and performance verification of the project, prior to the handover to [insert utility]

2 Battery Energy Storage System (BESS) Technical Requirements

2.1 Ratings

2.1.1 The BESS shall have an operational life of at least ten years.

2.1.2 The BESS shall be capable of providing continuous power of **XX** MVA during battery discharge (subject to energy reserve of the battery)

2.1.3 The system shall be capable of operating at +/- 0.8 power factor

2.1.4 AC connection to the battery shall be 480V, three phase wye, 60Hz AC

2.1.5 The AC systems shall have a Basic Insulation level of 105 kV and otherwise comply with UL 1741 or ANSI C62.41.2 Standards.

2.1.6 BESS inverter shall meet IEEE 1547-2018 standards for grid-tied operation.

Sample information from a recent RFP:

Entire BESS must be listed to UL 9540.

In addition, the following standards apply to equipment supplied for this project:

- NERC Standard PRC-024-2 – Generator Frequency and Voltage Protective Relay Settings

- UL 1741 – Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 1741SA – Supplemental testing for advanced grid inverters
- IEEE 1547-2018 – Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
- IEEE 519 – Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
- NFPA 1 – Fire Code
- NFPA 70 – National Electric Code
- NFPA 855 – Standard for the Installation of Stationary Energy Storage Systems, 2020 edition
- ANSI C84.1 – Electric Power Systems and Equipment – Voltage Ranges

2.1.7 The BESS shall provide **XX** MWh at rated full power discharge.

2.1.8 The system shall be capable of charging from 0% to 100% useable SOC and discharging from 100% to 0% useable SOC (its rated energy) for a minimum of duration as stated in the Product Specifications.

2.1.9 Systems shall be rated in terms of net delivered power and energy to the Point(s) of Interconnection. All system loads and losses, including wiring losses, losses through the contactor/static switch, power conversion losses, auxiliary loads, and chemical/ionic losses are considered internal to the system and ratings are net of these loads and losses as measured (or calculated if not measured) to the Point(s) of Interconnection.

2.1.10 The BESS shall have an average degradation of energy storage of no more than 3% of initial design capacity per year, with a useful capacity of no less than 70% of original design at the end of ten years of life. [modify as needed]
{Alternate Requirement]

The BESS shall provide no less than 90% of rated capacity over its service life. This can be accomplished by oversizing the initial system, or by replacing battery modules as necessary. Capacity testing shall be done on an annual basis using the full rated power of the system.

2.1.11 The BESS shall be rated to provide a minimum of 200 cycles to 100% rated depth of discharge per year under the conditions described in the "Operations" specification.

2.1.12 The BESS shall have an AC-to-AC round trip efficiency of at least 85% for Lithium-based chemistry or 75% for flow batteries. This must be measured at full power discharge and recommended full-power recharge.

2.1.13 The supplier shall provide information on expected degradation of ACRTE over the projected life of the BESS.

2.1.14 The BESS shall respond to control signals from an external controller / communications channel within 0.05 seconds

2.1.15 The BESS shall be capable of switching from full discharge to full recharge and vice versa within 10 seconds. [modify as needed]

2.1.16 Bidder shall specify the auxiliary (tare) loads of the BESS, including HVAC, idling losses from power electronics, and controller loads.

2.2 Operation [modify depending on configuration of battery]

2.2.1 The BESS shall be configured to be capable of operating in grid-connected (“load following”) mode when connected to the main grid (option -- or in islanded (“load forming”) mode when islanded).

2.2.2 In load following mode, the BESS shall be capable of discharging or recharging up to full power capacity (subject to battery state of charge).

2.2.3 Typical system operation is expected to include XX full discharges over the course of each month. [more details as appropriate]

2.2.4 The maximum sound levels, outside and adjacent to any equipment shall be limited to the levels specified by local ordinances.

2.2.5 The maximum noise level inside containers and control rooms will be 80 dBA.

2.2.6 Compliance measurements shall be made during commissioning at a minimum of three location outside containers using a Type 1 sound level meter that complies with the requirements of ANSI S 1.4-1983.

2.3 Electrical

2.3.1 System shall connect to the [co-op] at the point of common coupling (PCC) defined in the attached drawing

2.3.2 System shall include step-up transformer to XX.X kV delta connection

2.3.3 [protection requirements here]

2.3.4 [Metering requirement here – utility provide revenue meter?]

2.3.5 Grounding – system shall be grounded at the neutral of the LV three-phase wye AC output

2.3.6 The Contractor shall take necessary precautionary measures to ensure that there will be no mis-operation, damage or danger to any equipment or system due to broadband interference and effects. The Contractor shall ensure that there are no discharge sources from the Project and related equipment that could cause interference with radio and television reception, wireless communication systems, or microwave communication systems. The Contractor shall propose any necessary mitigation to ensure that communication is not adversely affected.

2.3.7 The Contractor shall make measurements before, (or with all equipment de-energized), and after commissioning of the Project for the purpose of verifying compliance with the broadband interference requirements.

2.3.8 All broadcast signals, radio noise, television interference and broadband interference measurements shall be made with instruments that comply with the latest revision of ANSI C63.2, “American National Standard for Electromagnetic Noise and Field Strength

Instrumentation, 10 Hz to 40 GHz - Specification." IEEE Standard 430, "IEEE Standard Procedures for the Measurement of Radio Noise from Overhead Power Lines and Substations" defines the measurement procedures that shall be used.

2.3.9 The PCS shall not produce Electromagnetic Interference (EMI) that will cause mis-operation of instrumentation, communication, or similar electronic equipment within the Project or on Owner's system. The PCS shall be designed in accordance with the applicable IEEE standards to suppress EMI effects.

2.3.10 The Project must meet the harmonic specifications of IEEE 1547. Harmonic suppression may be included with the PCS or at the Project AC system level. However, the Contractor shall design the Project electrical system to preclude unacceptable harmonic levels in the Project auxiliary power system.

2.3.11 [Additional requirements here – undergrounding, etc]

2.4 Safety

2.4.1 BESS will include a complete fire protection/alarm system as required by the appropriate permitting agency.

2.4.2 Systems must be designed to be in compliance with applicable safety standards with regard to construction and potential exposure to chemicals and with regard to module or enclosure resistance to hazards such as ruptures and exposure to fire.

2.4.3 [Optional] Systems must be seismically qualified in accordance with IEEE 693, High Seismic qualification level.

2.5 Monitoring / Communications

2.5.1 The BESS shall include a monitoring and data acquisitionsystem which allows monitoring of

- AC voltage and current per phase – real time
- Overall real power, power factor and frequency – real time
- System status – charge, discharge, idle
- System mode – grid-tied, islanded, islanded with diesel, offline
- Battery state of charge (BSOC)
- Energy / time remaining at current discharge rate
- Energy / time remaining at full rated discharge rate
- Time until full charge at current recharge rate
- Logging of energy data on a [one minute, five minute, 15 minute] interval, with up to 30 days of local storage
- Sufficient data to allow calculation of BESS AC round-tip efficiency

2.5.2 The BESS shall be capable of communications with an external controller (such as a microgrid controller) via MODBUS over TCP/IP [depending on application and co-op].

2.5.3 All communications shall be encrypted to meet cyber security standards

2.5.4 BESS shall report status and logged data to the [SCADA system, third party monitoring with access by utility?]

2.5.5 BESS shall be able to accept system commands from an external controller[5], including

- Charge power
- Discharge power
- Mode (grid-tied, islanded, islanded with external generators)
- Note that these mode changes may require different sets of synchronization / protection setpoints

2.5.6 Individual BESS synchronization / protection setpoints shall be adjustable via an external controller.

2.6 Installation / Commissioning

2.6.1 Location – system shall be installed in weatherproof enclosures[6] [describe install site, including any necessary site work required] as indicated on drawing XXX

2.6.2 Fencing shall be provided per the following specification: [answer will be co-op specific]

2.6.3 [the utility] will work with the successful bidder to develop the installation and operation safety plan. The safety plan, prepared primarily by the contractor, will be approved by [the utility]. The contractor will be required to follow this plan. This plan must document the ES&H training of any personnel who will be needed to perform work at the site, along with the step-by step procedure for their work and foreseeable contingencies.

2.6.4 Spill Containment -- The ESS design shall mitigate against electrolyte spills that are credible for the types of cells used. The design shall include features that contain electrolyte spills (to be emptied by contracted chemical disposal company in the event of a spill) and prevent discharge to surrounding site soils.

2.6.5 Personnel safety -- The ESS shall include eyewash stations in the battery area as applicable. The ESS shall be designed with personnel safety as the top priority.

2.6.6 Fire Containment -- The vendor shall design and install a fire protection system that conforms to national and local codes. The fire protection system design and associated alarms shall take into account that the ESS will be unattended at most times. In the event codes do not exists for the proposed ESS, current industry accepted best practices shall be employed.

2.6.7 Commissioning -- The Contractor shall, within 30 days prior to any on-site testing, submit a Master Test Plan and Procedures indicating the order in which the tests will be

[5] This assumes an external controller such as a SCADA system or a microgrid controller. For building specific BESS applications, the microgrid may simply be the battery, so the controller must be included, and must be programmable (schedules, power levels, etc) from an external source.

[6] The RFP should specify a specific NEMA rating depending on the application. Typical Nema Ratings are 3, 3R, 4, 4X, 12.

conducted, and the test method being used along with required instrumentation for Owner's approval.

2.6.8 The Contractor shall furnish, at the Contractor's own expense, necessary facilities and test equipment for the required tests.

2.6.9 Certified reports of all tests shall be furnished to Owner's in digital and print formats for review. Owner's will inform the Contractor within one (1) week after the receipt of the certified test reports either that there are no exceptions noted or that the test results show noncompliance with the Specification. In addition to written test reports required for each piece of electrical equipment tested, Contractor shall also provide the electronic files produced by the test equipment.

2.7 Maintenance

2.7.1 Contractor shall provide all required ongoing maintenance for **XX** years, including semi-annual inspections.

2.7.2 Contractor shall provide training for co-op personnel in basic aspects of system operation and maintenance.

2.8 [Optional] End-of-Life Removal / Recycling

2.8.1 Contractor shall make provision for removal and recycling of the battery and other BESS components at the end of life.

Additional Resources

- The Value of Battery Energy Storage for Electric Cooperatives: Five Emerging Use Cases
- DOE/EPRI Electricity Storage Handbook in Collaboration with NRECA- https://www.sandia.gov/ess-ssl/publications/SAND2015-1002.pdf
- When It Comes to Battery Storage Systems, Co-ops Should Focus on a Primary Application
- PNNL materials - https://availabletechnologies.pnnl.gov/technology.asp?id=413
- Sandia Model -- https://www.sandia.gov/ess-ssl/docs/pr_conferences/2015/EESAT%202%20Wednesday/Balducci.pdf
- DNV list of tools -- https://blogs.dnvgl.com/energy/five-key-tools-for-energy-storage
- EPRI Tool https://www.epri.com/#/pages/product/000000003002000312/?lang=en-US
- HOMER - https://www.homerenergy.com/products/pro/modules/advanced-storage.html