RFP Appendix A.X

Battery Energy Storage System Technical Specification

Draft

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PACIFICORP
BATTERY ENERGY STORAGE SYSTEM
TECHNICAL SPECIFICATION

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1.0 OUTLINE OF WORK

1.1 General

Owner desires a qualified firm (Seller) to provide a Battery Energy Storage System (BESS) and the Large Generator Interconnection Agreement (LGIA) requirements to be used for grid support applications on Transmission Provider electric utility grid under a Build Transfer Agreement (BTA) basis at Seller proposed location. The entire BESS facility shall be controlled by the BESS Supervisory Control and Data Acquisition (SCADA) System and Controller as described below in this Technical Specification. The Project includes all the necessary design, engineering, procurement, manufacture, build, construction, commissioning, start-up, testing, performance verification, and Owner personnel training. The Project shall be engineered and constructed according to Industry Standards using prudent utility practices.

1.2 Definitions and Abbreviations

ºC	Celsius
°F	Fahrenheit
A	Ampere, unit of Electrical Current
AC	Alternating Current
AGC	Automatic Generation Control
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BESS	Battery Energy Storage System
BOL	Beginning of Life
BTA	Build Transfer Agreement
Change of Ownership	As defined in the LGIA
Seller	Qualified integration firm and/or OEM vendor
CPT	Control power transformer
dBA	A-weighted decibels
DC	Direct Current
DOD	Depth of Discharge
Down Reserve	The capability of the BESS to inject AC power to the grid at the point of interconnection (POI) in response to remote commands, and/or frequency response
DR	Distributed Resources
EL	Electroluminescence
EN	European Standard
EOL	End of Life
EPC	Engineer-Procure-Construct as the primary or general Contractor
EPS	Electric Power System

Frequency Response	The capability of the BESS to provide response for frequency deviations above and below the frequency set point (or dead band) of the BESS, within the ramp rate limits for the Project
FRT	Frequency Ride-Through
GHS	Global Harmonized System
GHz	GigaHertz
HMI	Human Machine Interface
HV	High Voltage
HV_{AC}	High voltage alternating current
HVAC	Heating, Ventilation & Air Conditioning
Hz	Hertz, unit of electrical frequency
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
Inverter	All inverters in this specification refer to Four-Quadrant, Bidirectional, Smart Inverters.
ISO	Independent System Operator
kHz	kiloHertz
kW	kiloWatt
kWh	kiloWatt-hour
kV	kiloVolt
LGIA	Large Generation Interconnection Agreement
LHFRT	Low and high frequency ride through
LHVRT	Low and high voltage ride through
Load Following	The ability of the BESS to provide real power response to a specific, metered electrical location (i.e., the point of interconnection (POI)) based on the variations of real power demand at the specified location
LPS	Lightning protection system
LV	Low Voltage
MHz	MegaHertz
mil	Unit of measurement for length (thousandth of an inch)
MPT	Main Power Transformer
ms	milliseconds
MV	Medium Voltage
MVT	Medium Voltage Transformer
MVA	Mega Volt Amp
MW	MegaWatt
MW_{AC}	MegaWatt alternating current
MWh	MegaWatt hours
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association

NFPA	National Fire Protection Association
NVR	Network Video Recorder
O&M	Operation and maintenance
OEM	Original Equipment Manufacturer
Output Frequency Range	The range of frequency under which the Project will operate according to its specification
Output Voltage Range	The range of AC grid voltage under which the Project will operate according to its specification
Owner	PacifiCorp
P/T/Z	Pan/tilt/zoom
PCB	Polychlorinated biphenyl
PCC	Point of Common Coupling
PCS	Power Conversion System
Peak Shaving	The ability of the system to provide power to the grid above a threshold power demand level during peak demand periods to maintain net power demand at the substation below the threshold level.
PID	Proportional Integral Derivative loop control
PLC	Programmable Logic Controllers integrated with the BESS and SCADA System
POI	Point of Interconnection, which shall be where system ties in to the existing Transmission or Distribution Network
Project	BESS for grid support applications
pu	per unit
PV	Photovoltaic
PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
QP	quasi-peak
Ramp Rate	The rate, expressed in megaWatts per minute, that a generator changes its power output.
RAS	Remedial Actions Scheme
Rated Apparent Power	The real or reactive power (leading/lagging) that the BESS can provide at the POI continuously without exceeding the operating limits of the BESS
Rated Continuous Charge Power	The rate at which the BESS can capture energy for the entire SOC range of the BESS
Rated Continuous Discharge Power	The rate at which the BESS can continuously deliver energy for the entire specified SOC range of the BESS
Rated Discharge Energy	Total energy the fully-charged BESS can deliver to the POI at the rated continuous discharge power without recharging.

Revenue Metering Point	There are three Revenue Metering Points: Project Totalizing meter at the POI; the Project BESS (low side of the transformer); and the Project PV (low side of the transformer).
rms	root mean square
SCADA	Supervisory Control and Data Acquisition
SCCR	Short-circuit current rating
SGIA	Small Generator Interconnect Agreement
SOC	State of Charge, measured in % relative to the maximum possible amount of energy that can be stored by the system, with fully charged being 100% and fully discharged being 0%.
SPCC	Spill Prevention Control and Countermeasures
SPD	Surge protection devices
Standby mode	BESS standby mode means that the battery is charged to the specified level and is not providing or receiving power from the grid
SWPPP	Storm Water Pollution Prevention Plan
System Round-Trip Efficiency	The ratio of the delivered output energy of the BESS to the absorbed input energy required to restore it to the initial SOC under specified conditions through the Design Life.
Total Response Time	Starting when the command is received at the BESS boundary and continuing until the BESS discharge power output reaches 100 +/- 2% of its rated power, measured at the POI
Transmission Provider	Rocky Mountain Power
TÜV	Technischer Überwachungsverein (third party factory audit or testing score)
DOT	Department of Transportation
UL	Underwriters Laboratories, Inc.
Up Reserve	The capability of the BESS to absorb AC power from the POI in response to remote commands, and/or frequency response
UPS	Uninterruptible Power Supply
µV/m	microVolts per meter
V	Volt, unit of Voltage (Electric Potential)
VA	Volt-Ampere, unit of Apparent Power
V_{AC}	Volts alternating current
VAR	Volt-Ampere Reactive, unit of Reactive Power
V_{DC}	Volts direct current
VDE	Association for electrical, electronic, and information technologies

VESDA	Very Early Smoke Detection Apparatus
V_{OC}	Open Circuit Voltage
VRT	Voltage Ride-Through
W	Watt, unit of Real Power

2.0 KEY PROJECT TECHNICAL AND OPERATING REQUIREMENTS

Seller has the ultimate flexibility to determine the size and main operational parameters of the proposed BESS system, whether as a standalone system or as a compliment to a wind or solar generating asset, in order to deliver the most value to the Owner. However, the following guidelines are offered to aid in narrowing down the range of available options related to BESS sizing, controls and capabilities to support the Seller in the proposal development process. Further technical details can be found in section 5.1.1, Table 1.

2.1 System Sizing and General Requirements

- For solar paired assets, the BESS AC power capacity base case is 25% of Solar AC rated generating capacity; Seller is free to offer additional options or variations from this base case.
- Standalone utility scale energy storage is typically a minimum of 10MW peak power and can be substantially larger. Seller to offer optimized project size.
- The base case duration is assumed to be 4-hours for all BESS systems, and they will perform energy time shifting and renewable capacity firming functions, but as elaborated below, systems will be evaluated on their flexibility to perform additional services when desired by the Owner;
- Seller can assume that the BESS will typically be cycled to a depth of discharge of 80% of the system rated dischargeable energy capacity;
- Systems should be capable of charging in various modes including constant-current, constant-voltage and constant-power;
- Systems should be capable of achieving a full state of charge at a constant power charge rate of 1.0 (CP of 1);
- For PPAs, Seller can assume that the BESS will be cycled annually at least 200 full DoD cycles. In addition, the system should be capable of not cycling or of cycling up and down continuously over a 24-hour period if called upon by the Owner.
- Although grid charging of solar paired BESS is not expected to be used during the first 5 years of operation to preserve the ITC benefit, Owner expects all BESS systems whether stand-alone or renewable energy paired storage systems to have the capability to charge from the grid.
- Typical discharge cycle:
    - June through September: 3.5-4.0 hours every evening
    - All other months: 2.5 hours in the evening ramp and 1 hour in the morning

2.2 Operating Strategy & Use Cases

- Primary:
    - The BESS should be capable of ramping toward a charge or discharge target updated every four (4) seconds by the Owner's dispatch signal. BESS shall charge and discharge when load following while also maintaining positive power flow to the POI unless explicitly directed.

  - Typical storage discharge will be used to economically balance external grid load and resources, for instance during evening (and morning) net load ramp(s). Individual batteries and subsystems will be consolidated and managed via a Battery Management System (BMS) for each generating asset. Each BESS will have a SCADA System and Controller that receives signals from the Owner's AGC. In addition, CAISO feeds into Owner's AGC. Whether any individual generating resource is following one or both (AGC/CAISO) depends on the mode / scheduling strategy. In general, Owner wants the generating asset to have the capability to follow either; however, there will be conditions where the resource will not be dispatched in AGC.
- Secondary:
  - The Owner's four-second dispatch signals may reflect five-minute market dispatch signals from CAISO Western Energy Imbalance Market (EIM).
  - The system operator may call for up to maximum discharge for 60 minutes for contingency reserve events [several times per week] or until a battery state of charge limit has been reached [rare].
  - The BESS should respond to significant system frequency deviations with up to maximum discharge for approximately 1 minute [several times per month].
  - The system operator may call for reactive power to provide voltage support. The reactive power capabilities of PCS equipment currently on the market is sufficient to meet the anticipated need for reactive power by supporting +/- 0.95 power factor at the POI, and larger ranges may be required under certain project conditions. Reactive power studies are required to meet the LGIA requirements and project specific details will be addressed

2.3 Augmentation

- Owner will manage augmentation needs and Seller should prepare their cost proposals exclusive of the cost of future augmentation.
  - However, design and pricing must allow for the possibility of future augmentations in proposed site layouts and electrical designs for purposes of developing firm cost proposals. This means allowing for additional site area that may be required and allowing for additional MV circuits to be connected into the substation switchgear as examples. Seller can assume that up to 30% of BOL BESS capacity may be needed over the course of a project lifetime and cost proposals should be inclusive of this supporting infrastructure.
  - Owner will consider additional optional pricing from Seller that includes augmentation.

2.4 Flexible Warranties

Seller is encouraged to provide a long-term performance guarantee. Owner will require a significant amount of flexibility to operate the BESS in a manner that maximizes overall value for the company, and which may be location specific and change from year to year. Therefore, the Owner will require Seller to offer performance warranties that are flexible and allow for a variation in operating parameters. It is expected that during the RFP process, the parties will be able to develop a formula to forecast the guaranteed degradation rate for the remainder of the contract term based on actual averages and ranges (min, max) of key operational parameters. These may include:

- Constant power charge and range (e.g. CP from 0.9 to 1.1)
- Discharge rate and range (e.g. CP from 0.5 to 1.2)
- Operating temperature
- Annual number of cycles and depth of discharge

- Calendar (degradation)

2.5 Seller Responsibilities

Seller shall provide all required services and materials for the Project to achieve final completion and pass all necessary tests. Seller's responsibilities shall include all permits normally and customarily provided by Seller, design, engineering, equipment procurement, Site preparation work, foundations, installation of all equipment, bulk material and commodities supply, and Site finishing work. Seller also shall deliver project management, construction management, commissioning and startup, and testing of work, all as described herein, including all referenced appendices and standards, which will subsequently become a part of the build transfer agreement.

Seller shall construct all roads, foundations, electrical systems, control systems, monitoring systems, communications, ancillary structures, storage facilities, security systems, and fencing. Seller shall also erect and commission the BESS in the locations and orientations set forth in a proposed site plan and site layout drawing and in accordance with this specification, and all related specifications that relate thereto.

2.6 Conditions of Services

The BESS consists of all the direct current (DC) components from the BESS modules through the PCS plus the MVT. The BESS shall be "Utility Grade" (defined later in this Technical Specification). The balance of the Project (from the output of the PCS to the point of interconnection as defined in the LGIA shall comply with this Technical Specification and be compatible with applicable Owner standards and LGIA requirements. The balance of plant items include but are not limited to:

- Wiring, conduit, trenches and grounding
- Switchgear and current limiters
- Metering, as shown in the LGIA.
- Transformers
- Power poles
- Equipment pads
- Communications to Owner equipment.

The Project shall be designed to maintain the guaranteed performance metrics presented in this Technical Specification. The Project is limited to the use of electrochemical energy storage and PV technologies that have demonstrated appropriate technical and commercial maturity. The Project should include BESS equipment capable of exceeding the technical and operating needs of Owner.

The Project shall include full provisions for training, operation and maintenance of the Project and all associated equipment.

2.7 Preferred Main Supplier List

This section contains a list of preferred materials and equipment suppliers. In the event that Seller is considering the selection of a material or equipment supplier, that is not listed herein, Seller shall request approval from Owner prior to executing any contract for the procurement of such material or with such

equipment supplier. Equipment catalog cut sheets shall be submitted for Owner review and approval prior to procurement.

2.7.1 Preferred cable suppliers:

- Prysmian.
- Southwire.

2.7.2 Preferred junction box suppliers:

- Hubbell (Trinetics).
- SolarBos.

2.7.3 Preferred pad-mount transformer suppliers:

- Cooper-Eaton.
- General Electric.
- Howard.
- Virginia Transformer.

2.7.4 Preferred 34.5-kV disconnect switch suppliers:

- Cleveland / Price.
- Morpac.
- Royal.
- Southern States.
- USCO.

2.7.5 Preferred 34.5-kV circuit breaker suppliers:

- ABB (with spring/hydraulic mechanism).
- Siemens.

2.7.6 Preferred grounding rod suppliers:

- Blackburn.
- Weaver.

2.7.7 Preferred cable splice suppliers:

- 3M.
- Kanusa.

2.7.8 Preferred fault indicator suppliers:

- Cooper.
- Power Delivery Products.
- Schweitzer.

2.7.9 Preferred compression connection suppliers:

- Burndy.
- CMC.
- Polaris Connectors.

2.7.10 Preferred Power Conversion System suppliers:

- Sungrow.
- SMA.
- TMEIC.
- Power Electronics.
- Parker.

2.7.11 Preferred Battery Suppliers

- LG Chem.
- Samsung.
- Tesla.
- CATL.
- Toshiba.
- BYD.
- Panasonic.

3.0 STUDIES

3.1 Grounding System Study

Seller shall perform studies to determine the parameters for the Project's grounding system in WinIGS, CDEGS or equivalent. Acceptable solutions shall conform to Owner's Standard #10. In addition, Seller shall meet all safety requirements for step and touch potential plus all requirements from the LGIA.

3.2 Electrical System Studies

Seller shall prepare electrical system studies as required to configure the Project and to determine control response and settings. Seller shall develop a positive sequence power flow model and a dynamic model in the latest version of PSSE or equivalent software as required by the grid operator at the point of interconnect. The short circuit and arc flash models and reports will be made in SKM and be made available for Owner's use. Seller shall include in their harmonic study, the harmonic profile of the project in the interconnection requirements. Electromagnetic Transient modeling shall be performed in PSCAD. Studies shall be provided in sufficient detail to demonstrate the functionality as described in this Technical Specification and shall be completed prior to the commencement of detailed design and identified in the project schedule. These system studies shall be updated/as-built with final system design changes and provided to Owner at the end of the Project. These studies, at a minimum, shall address and solve the following concerns:

- Harmonic analysis of the proposed system.
- Minimum system requirements and configuration for proper operation of the BESS (i.e., requirements to stabilize a self-commutated power conversion system [PCS]).
- Minimum spacing requirements between equipment to maintain safe energization and maintenance conditions.
- Battery degradation and expected power output at end of life of the BESS.
- Charge and discharge curves of the project for potential tie into other renewable systems
- Requirements for Volt-Ampere Reactive (VAR) support, peak shaving, battery charging and other support services as described in this Technical Specification.
- Safety requirements for operation compliance with applicable codes and standards.

3.3 Required Dynamic Models

3.3.1 Frequency Models

- Seller shall prepare individual models of the fundamental positive sequence behavior of the BESS.
- Owner shall be provided PSSE models in the version required by the interconnection authority that accurately represent the control characteristics and dynamic behavior of the BESS in response to balanced voltage and frequency disturbances. This model shall be provided with all available information once the 60% design is complete and refined to reflect the final design configuration at IFC.
- Fully detailed equivalent models are required; generic models from the WECC approved model library are preferred if they can accurately model the BESS behavior in response to voltage disturbances and system frequency disturbances.
- The PSSE models shall be validated for accurate representation of disturbances that are within the model's appropriate range of application, using a validated electromagnetic transient model or full-scale testing.
- The PSSE models shall be fully documented.
- The PSSE models must be non-proprietary and shall be accessible to other utilities, system operators, asset owners, and other entities associated with the interconnection.
- The PSSE models shall be updated by Seller prior to any change to the inverter controls or control parameters that affect the dynamic performance.
- Seller shall ensure compatibility of the provided PSSE models with the version of PSSE that Owner utilizes at the start of commercial operation. Upgrades and modification of the models to maintain compatibility with ongoing PSSE versions shall be the responsibility of Seller over the lifetime of system performance.

3.3.2 Model Inputs

The PSSE model should reflect the current design of the power plant and a general network equivalent or detailed network, depending upon interconnection study requirements.

3.4 Electrical Design Parameters

For design purposes, the power system characteristics, at the Project location, and for which the BESS will be required to provide rated output, shall be considered are as follows:

- The nominal power at the POI will be defined by the Seller and duration for the base case is planned at four (4) hours
- Maintain frequency and voltage within the utility set limits
- Supply required real and reactive power at a power factor range set by the utility

In addition, the BESS will be required to operate, without damage, with voltage and frequency ride through characteristics as specified in the LGIA.

3.4.1 Grounding

A suitable equipment grounding system shall be designed and installed for the Project. Seller will be responsible for providing an effective grounding mechanism. Seller shall provide detailed information (such as ground-grid drawings and calculations) for all Project grounding. Seller is responsible for designing and providing the Project system grounding and equipment grounding. The Project grounding system shall provide personnel protection for step and touch potential in accordance with Institute of Electrical and Electronics Engineers (IEEE) 80. Equipment and systems not covered by IEEE 80 shall comply with grounding requirements of National Electrical Code (NEC) 2017. The system also shall be adequate for the detection and clearing of ground faults. The Project grounding system shall be reviewed and approved by Owner.

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

All ground conductors shall be stranded copper and may be bare if exposed. Ground conductors in conduits shall be green-insulated. Ground lugs shall be mechanical and rated aluminum to copper. All below grade connections shall be exothermic welds. Step-up transformers and inverters and the Project switchgear shall be bonded to the ground ring at opposing corners of the equipment. Mounting structures shall be grounded in a manner that is sized for maximum available short-circuit current and lightning current (if required).

Seller shall submit to Owner grounding and lightning calculations for assurance of safe step and touch potentials on the Site, in accordance with Owner's standards. Seller shall conduct a ground resistivity test to verify that the grounding system meets minimum requirements for the overall grounding scheme. Interior fencing (including without limitation internal fences around interconnection equipment and inverters) shall be installed and grounded and substation grounding shall be done in accordance with Owner's Standards and Specification, Appendix A-4. Fencing around the perimeter of the overall Project Site shall not need to meet the aforementioned Handbook standards but shall be grounded in accordance with local codes. Perimeter fences shall be at least 30 feet from the fence around the interconnection equipment. A ground grid meeting the requirements of IEEE 80 shall be installed in the area of the interconnection equipment.

3.4.2 Control and Instrumentation Cabling

All cabling shall be new and continuous for each run; splices are generally not acceptable. On a case by case basis, splicing may be reviewed and approved by Owner. All conductors shall be copper. All cabling, which may be exposed to mechanical damage shall be placed in conduits, wireways, overhead trays, or other enclosures suitable to Owner. All below grade runs shall be in buried conduit unless proximity to a roadway requires concrete duct bank. Alternating Current (AC) and DC circuits shall be installed in separate conduits. Wires shall have identifying labels or markings on both ends. The labels shall identify the opposite end destination.

Control and instrumentation wiring shall be separated from power and high voltage wiring by use of separate compartments or enclosures or by use of separate wireways and appropriate barrier strips within a common enclosure according to the National Electric Code (NEC) or governing standard.

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

The instrumentation and control cable shields, where applicable, shall be multi-point grounded.

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

Raceway and cable systems shall not block access to equipment by personnel.

3.5 Permitting

Seller shall apply for and obtain all permits and authorizations necessary for construction of the Project. Copies of all applicable permits shall be provided to Owner within five business days after they are obtained or completed. Seller shall provide a permit matrix to Owner for approval.

3.6 Audible Noise

The maximum sound level generated from the BESS and any associated equipment supplied by Seller under any output level within the Project operating range, shall be limited to the maximum allowed dBA level in any direction from the facility fence or building exterior or as required by local or State ordinances. Seller shall comply with all ordinances and regulations that may apply to the BESS installation as determined by the local building codes. Results of noise studies shall be provided for major equipment such as HVAC and PCS units.

Noise produced by the Project and any associated subsystems shall be designed and furnished such that the ambient noise level in the BESS control room, or any typically occupied area with applicable standards in a building shall not exceed 50 dBA.

3.6.1 Compliance Measurements

Seller shall make audible noise measurements before and after commissioning of the Project to verify compliance with the requirements. Seller, immediately upon notification, shall correct any noncompliance. The corrections may include replacement of equipment that is causing noncompliance. Seller shall make these corrections at no cost to Owner. If equipment and facilities must be removed from service, this period will be counted as outages towards the availability guarantee period. The measurements shall be made at three or more selected locations outside the building or facility fence

using a Type 1 sound level meter that complies with the requirements of ANSI S 1.4 "American National Standard Specification for Sound Level Meters."

3.7 Broadband Interference

Seller shall take necessary precautionary measures to ensure that there will be no missed operation, damage or danger to any equipment or system due to broadband interference and effects. The broadband interference includes:

Radio Interference	
AM Band	535 – 1,605 kiloHertz (kHz)
FM Band	88 – 108 (megaHertz) MHz
Television Interference	
Low VHF Band	30 - 72, 76 - 88 MHz
High VHF Band	174 - 216 MHz
UHF Band	450 - 512 MHz
UHF Band	470 - 806 MHz
Microwave Communication	5.8 – 7.2 gigaHertz (GHz)
	10.7-11.7 GHz
	22.5-23.6 GHz
Wireless Communication	
Cellular Phone	750 - 790 MHz
804 - 894 MHz	
Supervisory Control and Data Acquisition (SCADA)	941 - 960 MHz
Personal Communication Systems	1.80 - 2.00 GHz

Interference to any radio service that requires a license, FCC licensees, military radio frequencies or medical devices is prohibited.

3.7.1 Radio Interference

Seller shall ensure that the Project does not degrade radio reception. The radio interference level along the perimeter of the property shall not exceed 100 microvolts per meter (μV/m) between 0.5 kHz and 30 MHz along a contour of 1,500 feet surrounding the energized Project equipment. This contour ends 500 feet from the energized lines where it tapers to a constant 100 feet from the outermost phase of the distribution lines.

3.7.2 Television Interference

Seller shall ensure that the Project and related equipment does not generate any discharge sources that could degrade television reception. Seller shall take all necessary action to ensure that television reception is not adversely affected.

3.7.3 Wireless Communication Interference

Seller shall ensure that there are no discharge sources from the Project and related equipment that could cause interference with wireless communication systems. Seller shall take all necessary action to ensure that cellular and PCS communication is not adversely affected.

3.7.4 Microwave Interference

Seller shall furnish information concerning any potential interference sources and levels that might emanate from the Project and related equipment that could adversely affect microwave communication. Seller shall take all necessary action to ensure that any microwave system is not adversely affected.

3.7.5 Compliance Measurements

Seller shall make measurements before and after commissioning of the Project for the purpose of verifying compliance with the requirements listed above. Seller, immediately upon notification, shall correct any noncompliance. The corrections may include replacement of equipment that is causing noncompliance. Seller shall make these corrections at no cost to Owner. If equipment and facilities have to be removed from service, this period will be counted as outages towards the availability guarantee period.

A reasonable effort shall be made as the frequency spectra are being obtained to determine the source(s) of the interference at various frequencies. Seller shall perform measurements in such a way as to identify the source of the interference being measured across the frequency range in order to determine if the Project complies with this Technical Specification.

All broadcast signals, radio noise, television interference and broadband interference measurements shall be made with instruments that comply with 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.

Radio signal strength shall be measured using instruments with average detectors. Radio noise measurement shall be in quasi-peak levels for AM band and peak levels for FM band. Measurements shall include at least three complete frequency scans at selected locations around the perimeter of the property line. The average values for these measurements shall be reported for each location and radio station frequencies including 1.0 MHz.

1) AM broadcast radio signals from 535 to 1,605 kHz above 100 μV/m shall be measured using a calibrated loop antenna with an instrument that has either an average or root mean square (rms) detector at three selected locations along the 1,500-foot contour line around the BESS and at one or more locations down the distribution lines along the constant 100-foot contour line. The measured radio signal strengths shall be reported along with their call letters and their frequency. Signal-to-noise ratios will be calculated for each measured radio signal. The antenna shall be oriented for maximum pick up of the broadcast signals.

2) Radio noise shall be measured from 500 kHz to 30 MHz using a calibrated loop antenna with an instrument that has both an average (or rms) and a quasi-peak (QP) detector at three selected locations along the 1,500-foot contour line around the Project and at one or more locations down

the distribution lines along the constant 100-foot contour line. The antenna shall be oriented for maximum pick up of the noise.

3) Television and FM broadcast signal strengths, over the frequency ranges specified above, shall be measured using calibrated broadband antennas appropriate for the frequencies being measured and with an instrument that has an average (or rms) detector at three selected locations along the 1,500-foot contour line around the Project and at one or more locations down the distribution lines along the constant 100-foot contour line. The measured radio and television signal strengths shall be reported along with their call letters and their frequency. Signal-to-noise ratios shall be calculated for each measured FM radio and TV signal. The antenna(s) shall be oriented for maximum pick up of the broadcast signals.

   VHF and UHF broadband interference shall be measured over the frequency range of 30 to 2,000 MHz using calibrated broadband antennas appropriate for the frequency range with an instrument that has both an average (or rms) and a QP detector at three selected locations along the 1,500-foot contour line around the Project and at one or more locations down the distribution lines along the constant 100-foot contour line. The antenna shall be oriented for maximum pick up of the noise.

4.0 DESIGN, FABRICATION AND CONSTRUCTION REQUIREMENTS

4.1 General

Seller shall supply the complete permitting, design, engineering, procurement, installation, construction, commissioning, start-up, and performance verification of the Project and LGIA systems for the commercial operation of the Project.

The Project design and construction shall comply with all current local, state, and federal regulations, codes, and applicable standards. The Project fire protection system shall also comply with Owner's insurance requirements.

All equipment supplied shall be designed to ensure satisfactory operation under the specified site temperature conditions and other atmospheric and environmental conditions prevailing at the site.

All equipment, components, and materials shall be new and free of defects in material or workmanship.

Seller shall verify all information provided by Owner, Owner's Seller, and third-party suppliers prior to incorporating the information into Seller's design.

4.2 Building, Structures and Systems

Seller's scope includes but is not limited to providing the following:

- All site preparation including any necessary civil work.
- Site Storm Water Pollution Prevention Plan (SWPPP).
- The BESS will be fully contained in weatherproof, environmentally-conditioned enclosure(s) or building.
- Supports and foundations for all buildings, enclosures, structures, transformers, switchgear, conduit, and overhead cabling.

- Battery cells/modules, battery management system, racks, bus bars, and all necessary electrical and battery equipment necessary for a fully functioning BESS to be housed in modular containers or in a dedicated building. The BESS must be appropriately sized for all necessary augmentation to maintain rated capacity through the required Design Life of the facility based on the use cases and conditions contained in these Technical Specifications.
- All Project Balance of Plant components.
- DC system with voltage sources and panel boards for communications networks and relay protection equipment.
- An uninterruptible power supply (UPS) system for Project control and protection systems and communication equipment to provide orderly shutdown in the event of loss of all auxiliary power.
- Power conversion systems.
- Project related medium voltage (MV) terminations, duct banks and cable routing and collection bus connections including but not limited to AC panel boards, circuit protection, and backup distribution sources with necessary isolation/step-down transformers.

The BESS building/enclosures or components within them shall adequately contain both normal and failure conditions of its constituents with respect to toxic or hazardous substances. Appropriate alarms shall annunciate locally and remotely when hazards are exposed including corrosive or toxic electrolyte/electrodes or fumes and secondary containment means shall be provided if such hazards occur.

Seller shall provide comprehensive safety data sheets (formerly called MSDS) in the new Global Harmonized System (GHS) format as a written chemical inventory of every hazardous chemical in the Project to which employees are exposed. Further, Seller shall be responsible for:

1. Developing and maintaining a hazard communication program detailing the plans in place for safe handling and storage of all chemicals used in normal operations and repair of the Project.

2. Maintaining proper SDS labels and warning signs associated with these same chemicals.

3. Training Owner employees on Project chemical hazards and use of necessary personal protection equipment and precautions as part of the turnover exercise.

Should any of the components within the Project require an operating environment less severe than the site environment, the Project shall provide appropriate conditioning of the enclosed space.

All portions of the Project must be sufficiently hospitable to installation, inspection, and service personnel to not restrict the performance of those duties. The Project is to be automated with no operator presence required.

Seller shall provide a description of any processes special to the de-commissioning of the Project. Seller shall include descriptions for configuration to begin disassembly, making the energy storage components safe at all times, disconnection and disassembly sequence, and packaging/handling/ shipping requirements of the BESS. This is not required for the electrical equipment common to commercial/industrial/utility power systems unless directly related to handling of the energy storage components.

4.2.1 Engineering Services

Seller shall design and engineer the Project in accordance with prudent utility practices, with the professional standards, skill, expertise, and diligence of design and construction of professionals regularly involved in utility-grade, utility-scale, grid-connected BESS projects for electric utilities in the United States. The design must conform to the requirements and conditions of all applicable permits and laws, be in compliance with the operating guidelines, and meet Owner specifications.

Seller is responsible for all engineering for the Project. All design drawings, specifications, and calculations shall be signed by a professional engineer-of-record registered in the state or jurisdiction of the project. Seller shall submit to Owner all completed design drawings, data, and documents for review and comment. These engineered design drawings, data, and documents must be submitted to Owner for review and comment before construction is to begin.

Seller is responsible for ensuring that all components are installed above the 100-year flood plain (battery system, PCS, SCADA system, Security System, control building, transformers, etc.).

Any third-party study or independent engineering reviews (such as the geotechnical study) shall be provided to Owner.

4.2.2 Construction Services

Prior to beginning construction, Seller shall provide a comprehensive onsite construction management plan in accordance with all applicable laws and policies and Health, Safety, and Environmental Plans of Seller. No later than 30 days prior to initial site mobilization, Seller shall prepare and submit such Plans to Owner. Seller shall also provide Owner with an evaluation and appropriate documentation of the safety record for any licensed Subcontractor that will be performing work on the Project. Seller and subcontractors must register with and be approved by ISNetworld. The comprehensive onsite construction management plan will clearly establish Health, Safety, and Environmental goals for the Project.

Seller shall assemble, construct, and install with its own labor forces and/or with Subcontractors labor, tools, and equipment necessary to complete the Project, including but not limited to the following Works:

- Site preparation, site grading, site improvements, stormwater management facilities and removal of excess debris.
- DC cabling and junction boxes.
- AC trenching and cabling.
- Inverters, switchgear, and transformers and accompanying supports and/or concrete pads.
- Perimeter security fencing (described in Sections 6.13.3 and 6.3 Project Security).
- Security lighting.
- Installation of the monitoring system and revenue grade metering.

Seller shall provide all utilities necessary during construction, including but not limited to electricity, portable water, sewer/toilets, fuel and communications. Seller shall be responsible for all costs associated

with construction power. Seller shall be responsible for removal of all trash and construction debris. Seller shall be responsible to provide its own job trailers, and other temporary facilities for its employees.

4.2.3 Quality Assurance/Quality Control Requirements

Seller shall submit a Quality Assurance/Quality Control (QA/QC) Plan for the proposed project delivery. The QA/QC Plan shall define the systems and procedures which will be used by Seller to ensure that the Project will comply with the requirements detailed in this Technical Specification in addition to any other standards and policies determined by Owner.

Seller shall submit to Owner a copy of its QA/QC Plan for review not later than 45 days after contract execution for Owner review and comment. The Project shall be managed in accordance with the program.

The QA/QC Plan shall include, but is not limited to, such procedures and systems as the following:

- Road construction and compaction.
- Reinforcing steel and conduit placement.
- Concrete placement and testing.
- All wire insulation testing—Megger testing or very low frequency testing.
- Factory testing of batteries, PCS and transformers by the manufacturer.
- Fuse tests.
- Terminations pull testing
- All visual inspections
- Grounding continuity testing
- Earth-ground resistivity testing
- BESS inspection and manufacturer documentation of factory test per the manufacturer's existing program
- Metering and instrumentation calibration testing
- SCADA indication, control and operator interface verification
- Step-up transformer testing
- Weld testing for transformer support including other anchorage
- Weld testing for racking supports
- Inverter phase rotation and matching with utility
- Protective relay settings
- Verification of security camera system operations, including device points, sequences, and communications
- Other Seller-prescribed procedures

All onsite QA/QC testing procedures shall be witnessed and documented by a qualified representative of Seller. Owner shall observe and witness QA/QC as necessary and at its discretion. A qualified engineer of Seller shall date and sign documentation indicating completion and acceptance of each onsite QA/QC test procedure.

4.3 Storage of Materials and Equipment

Prior to the arrival of equipment and materials at the Site, Seller shall install a fenced, secured area and provide security for the storage of such equipment and materials. Seller shall notify Owner of the location and layout of intended staging areas, parking areas, storage areas, office areas, workshops, and other temporary facilities. Temporary construction roads and staging areas not converted to permanent roads (if any) shall be restored in accordance with all permit requirements.

Seller shall be responsible for receiving, protecting, moving and storing all material at the Site in a secure manner and a manner that maintains temperature control for battery cells and modules required under warrantees. Climate controlled facilities should be constructed before battery modules arrive on site as well as other OEM recommended requirements to guarantee temperature controls are maintained for cells so that warrantees are not violated.

4.4 Equipment

As described in detail throughout this document, Seller shall purchase and furnish to the Site all material required to complete the Project, including but not limited to, the following material:

- Miscellaneous steel
- Components (nuts, bolts, clamps, etc.)
- BESS
- PCS
- DC cabling
- AC cabling
- Electrical switchgear
- Transformers
- Remotely accessible data acquisition system
- All materials related to drainage and access roads required by the civil engineering plan
- All electrical conduit and junction boxes
- Concrete equipment pads
- Fencing, gates, lighting, security cameras, and security camera recording equipment
- Communications infrastructure

Each item of equipment to be supplied by Seller shall be subject to inspection and testing during and upon completion of its fabrication and installation as per Owner's LGIA requirements for distribution systems (34.5 kV and below).

Installed equipment and materials shall be new, of good quality and suitable grade for the intended purpose, and not a lower grade or quality than specified in the design and engineering plans or in

manufacturers' recommendations. Utility-grade equipment shall be used. Commercial- or residential-grade equipment shall not be acceptable. No equipment shall utilize polychlorinated biphenyls (PCBs).

Seller shall provide a Spill Prevention Control and Countermeasures plan and provide secondary containment where required and to prevent accidental discharge of chemicals. Seller shall provide a list of all major equipment to be purchased, constructed, and installed as part of the Project. The list shall identify both the items and quantities.

4.5 Power Conversion System (PCS)

The PCS is the interface between the DC battery system and the AC system and provides for charging and discharging of the battery and may consist of one or more parallel units. The PCS shall be designed to have Design Life as listed in Table 5.

4.5.1 PCS Requirements

The PCS shall be a smart static device (charger and inverter) using solid-state electronic switch arrays in a self-commutated circuit topology. Line-commutated systems or systems that require the presence of utility voltage or current to develop an AC output are not acceptable. Only commercially proven switch technology and circuit designs are acceptable.

The PCS, in conjunction with the BESS Master Controller, shall be capable of completely automatic unattended operation, including self-protection, synchronizing and paralleling with the utility, and disconnect functions.

The control of the PCS shall be integrated with the overall BESS Master Controller. A proven and established combined instrumentation and control system shall be provided for the BESS SCADA System. Each SCADA system shall feed into a central controller that shall be the primary interface with the Owner's controls and shall be compatible with the utility's existing SCADA system.

The PCS also shall include all necessary self-protective features and self-diagnostic features to protect itself from damage in the event of component failure or from parameters beyond safe range due to internal or external causes. The self-protective features shall not allow the PCS to be operated in a manner that may be unsafe or damaging. Faults due to malfunctions within the PCS, including commutation failures, shall be cleared by the PCS overcurrent protection device(s).

One purpose of the Project is to assist Owner in responding to abnormal utility system conditions. Therefore, Seller shall design the PCS, including its controls, power supplies and connections to sensors, to be immune from utility system voltage and/or frequency transients and similar events. Further, the PCS shall be capable of operating continuously at rated output under the normal voltage and frequency ranges and providing full output for the required operating modes specified.

All PCS components shall be designed to withstand the stresses associated with steady state operation, transient operation and overload conditions as implied by this Technical Specification. Seller shall be responsible to demonstrate that all relevant aspects of overvoltage stresses have been considered.

The PCS shall be housed in a separate room or enclosure within the BESS structure, with provisions to prevent moisture condensation and entrance of rodents, insects, and/or similar material into air intake/exhaust ports or any required structure penetration.

The PCS system shall include provisions for disconnection on both the AC and DC terminal, for maintenance work. Conductor separation must be clearly visible; flags or indicators are not acceptable. These disconnects shall be capable of being locked open for maintenance work. PCS capacitors shall be provided with bleeder resistors or other such means of discharging capacitors to less than 50 V within one minute of de-energization.

An interlock system shall be provided for access to the PCS room or enclosures if live parts are exposed when opened. A visible disconnect switch or draw-out breaker and grounding devices shall be provided for maintenance of the PCS equipment. The interlock system shall prevent access to the PCS equipment until the AC and DC circuit breakers or disconnect switches are open and the PCS bus is grounded.

4.5.2 Interference and Harmonic Suppression

The PCS shall not produce Electromagnetic Interference that will cause interference with 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 Electromagnetic Interference effects.

The BESS must meet the harmonic specifications of IEEE 519 and Owner's power quality standards. Harmonic suppression may be included with the PCS or at the Project AC system level. However, Seller shall design the Project electrical system to preclude unacceptable harmonic levels in the Project auxiliary power system.

Seller shall perform studies to determine required AC harmonic filter types and ratings if filters are required to meet the harmonic specifications. In addition, these studies shall be used to demonstrate that the AC filters do not cause any resonance with Owner's power system and that the harmonic distortion limits can be met by the filters designed by Seller. Seller shall design the Project to be completely compatible with Owner's existing capacitor banks and their associated controls. Owner will not be required to change or modify the existing system to accommodate the Project. However, actual compliance will be based on field measurements after commissioning.

4.5.3 PCS Cooling System

The purpose of the PCS cooling system is to remove the heat produced by the PCS operation and transfer this heat to the outside ambient air or to be used as auxiliary heat for the building or enclosures as appropriate.

Either water cooled or air-cooled systems are allowed. However, the final rejection of waste heat shall be to the outside ambient air. No discharge of cooling system water shall be allowed. The cooling system shall be furnished complete with all necessary equipment and facilities, including, but not limited to, interconnecting piping, ductwork, circulating pumps, blowers, heaters, make-up reservoirs, heat exchangers, filters, water treatment plants, instrumentation, automatic controls, alarms and control power.

The cooling system shall be designed such that the failure of any single component of the cooling system will allow the Project to continue to operate at full capacity. All joints and gaskets are designed for high reliability and to comply with seismic requirements.

The cooling circuit for water cooling systems shall be a closed loop de-ionized water or water/glycol mixture recirculating system. Each loop and each branch shall have manual valves to isolate it from the rest of the system without disrupting the operating loop. If a water/glycol system is proposed, Seller shall

prepare a Spill Prevention Control and Countermeasures plan and provide secondary containment for accidental discharges of the mixture.

The high purity (high resistivity) water (if used) in the closed loop system shall be circulated through the heat producing electrical equipment at a constant flow rate. A purifying loop to maintain the high purity in the closed system shall be provided.

Seller shall determine the source of the water supply for cooling system make-up water and obtain water service if required.

Non-recirculating (once-through) or recirculating air systems may be proposed, depending on the requirements of the PCS selected by Seller. If a recirculated air system is used, a heat exchanger shall be provided. If a non- recirculated (once-through) air system is used, a two-stage air filtering system shall be provided. The air handling systems shall include filtering which is adequate to keep dust from the interior of the PCS system.

Since the energy to heat or cool the building or enclosures and Project efficiency will be used in the life cycle cost evaluation, Seller is encouraged to provide the most efficient HVAC systems, including auxiliary heat recovery subsystems that are practical.

4.6 Step-Up Transformers

Transformers shall meet transformer efficiency standards. A transformer shall be used by Seller to match the secondary voltage of the PCS to the distribution system. The intermediate output(s) may be at any Seller determined AC voltage.

The transformer may be configured with any Seller specified winding configuration. However, it should be noted that the LGIA requires a grounding transformer to provide a source for ground fault current if the step-up transformer winding configuration does not provide a grounding source on the high side of the transformer. If a grounding transformer is required due to the Seller provided step-up transformer design, the grounding transformer shall be designed, provided and installed by Seller.

Transformers shall be rated for inverter source operation and the environment in which they will operate. The transformer shall be supplied with a no-load tap changer with high-voltage taps capable of operating at 2.5 percent above and below nominal voltage at full rating. The transformer shall be supplied with a disconnect switch on the transformer high-voltage side to isolate the transformer once de-energized. The switch/transformer configuration shall be designed for loop feed. Transformers shall be either dry-type, or oil filled, FR3 or equivalent is not acceptable. Enclosure finish shall be a top powder coat that is designed for a 20-year service life. Seller shall provide and install step-up transformers as provided in the Agreement. Owner shall reserve the right to attend factory witness testing of step-up transformers.

For interconnection to the Transmission Provider’s system Seller shall provide equipment and installation in compliance with the requirements of the Large Generator Interconnection Agreement and Owner’s Standards and Specifications.

The transformer may be used to aid in harmonic cancellation. If the transformers are a liquid-filled type, Seller shall provide an adequate oil containment system, subject to Owner’s acceptance. PCBs shall not be used. Seller shall provide a SPCC if transformers are liquid-filled type.

4.7 Revenue Meter

Seller shall provide design inputs to a revenue metering system. Design shall be consistent with requirements as per LGIA.
The metering system design shall adhere to the requirements of Transmission Provider's revenue metering specifications. A bi-directional revenue grade meter shall be installed at each location specified above to measure the energy (kWh) generated by the Project and each generation source. The revenue grade meter shall be American National Standards Institute C12.20 0.2 percent Class Underwriters Laboratories, Inc. (UL) listed, ISO9001 certified, which is accepted by all authorities requiring revenue grade. The meter must have a display for easy reading of current power generation and lifetime generation and shall be compliant with Western Renewable Energy Generation Information System certification requirements for Renewable Energy Credit sales or trading. The Transmission Provider will procure, install, test and own all revenue metering equipment. Seller shall coordinate with the Transmission Provider for the installation.

4.8 Project Switchgear

Switchgear shall be in a National Electrical Manufacturers Association (NEMA) 4 lockable enclosure if located outdoors. Switchgear shall include an auxiliary compartment containing all instrument transformers associated with the protective relays shown in the one-line diagram(s). The protective relay system shall be specified, designed, and installed in accordance with interconnecting utility's requirements. Switchgear monitoring and communication hardware shall be included to meet the requirements of Section 4.7 Revenue Meter and Section 7.0 Supervisory Control and Data Acquisition, and the metering requirements of Owner. Relay current transformers shall be C400 accuracy class at a minimum unless a higher class is required due to saturation current per IEEE C37.110.

Medium-voltage protective device selection and relaying should be based on the use of Schweitzer Electric Laboratories (SEL) relays or approved other, as required and specified in the LGIA.

In general, the interconnection design and components should meet the requirements of the Transmission Provider and the LGIA (including the necessity of a grounding transformer if required).

MV switchgear shall be arc resistant type.

4.9 Protection Requirements and Relay Settings

A complete protective relaying system shall be provided for the PCS and transformer(s) as stated below:

- Inverters equipped with internal relays with 27, 59, 81U/O and voltage-controlled overcurrent 51C functions shall be provided with one utility grade relay with 27, 59, 81 U/O and 51C functions as secondary protection. Otherwise, two utility grade relays and one Owner-designated interrupting device shall be installed to meet the protection requirements.
- Protective relays shall be hardwired to the device they are tripping.
- Interconnection interrupting devices shall have DC trip coils and tripping energy shall be derived from Seller supplied battery separate from the BESS main batteries.
- Owner will review Seller's relay settings and their calibration and test results of those relays to satisfy Transmission Provider's protection practices.
- Seller shall provide phase and neutral overcurrent protection for the PCS transformer(s).

- Protective relays shall have backup power of 125 V_{DC} system supplied by station batteries.
- Relay settings files are to be included following the completion of the IFC design package.

Seller shall use microprocessor type protection equipment compatible with Transmission Provider's relay protection schemes to the extent possible.

The protective relaying and metering shall be integrated with the Project control system and communications channel to the Transmission Provider's SCADA system. However, integration into the Project control system shall not circumvent normal protective relaying functions nor shall any protective relay or revenue metering values be used for control within the project control system. The control system for the BESS and PV systems may use metering values from the revenue meters through a DNP 3.0 link if desired. These values may only be used for indication within the project control system. Metering, separate from revenue metering and protective relays, may be installed for any control purposes at Seller's discretion.

4.10 Points List

The points list shall be included as a deliverable in spreadsheet form. The Master Points List is to include all equipment connections to stakeholder devices including, but not limited to:

- BESS equipment
- Utility
- IEDs
- Reliability entity (ISO)
- Transformer monitoring and control
- BOP SCADA

4.11 Auxiliary Power

Primary AC station service shall be provided from the low voltage side of the Project PCS transformer bus. If required by Seller's design, back-up station service shall be provided by a Seller specified means. All facilities required to provide primary and back-up station service to the Project and building, including auxiliary power transformers, transfer switches, protection and distribution panels shall be Seller's responsibility.

In the event of a loss of the Auxiliary Power connections to Project, primary and/or backup station service may or may not be available. Back-up UPS to power Project controls, pumps and auxiliaries in the event of a total failure of the primary and back-up station service feeds shall be provided for orderly shutdown. The UPS shall be separate from the BESS main battery system and sized for an orderly shutdown of the Project for a loss of station service with the UPS at 80% rated capacity. The UPS shall be housed in a separate location from the BESS main battery to facilitate ease of maintenance.

All auxiliary DC station service requirements for the BESS shall be designed, engineered, furnished and installed by Seller. 125 V_{DC} shall be used for protective relay power.

4.12 Civil/Structural

Seller shall design all systems and site improvements in accordance with applicable codes and standards. Seller shall design necessary road improvements to meet state and local transportation codes and meet or exceed requirements presented by construction equipment, delivery vehicles, and operation and maintenance traffic. All BESS and PV equipment, building or enclosure foundations and structures shall

be engineered by or under the direct supervision of a qualified professional engineer or architect registered in the state of the project as applicable. All final (Issued for Construction) drawings, specifications and calculations shall be wet-stamped by Civil/Structural Engineer or Architect registered in the state of the project as applicable. All stormwater calculations and design documents shall be overseen, signed and sealed by a Civil Engineer or Landscape Architect familiar with local codes and requirements, and registered in the state or jurisdiction of the project. All design shall be in accordance with seismic design requirements as specified elsewhere in this Technical Specification, and by the Seller provided geotechnical study.

Seller shall gain access to the site from existing public and private roads. Existing roads shall not be blocked or restricted without prior approval of Owner and local agencies. Seller shall be responsible for damage to public roadways resulting from the work performed. Seller shall also be responsible for the facilities access road's preparation/interconnection with the main road.

Seller shall perform required Site preparation, to include earthworks, SWPPP, and erosion control. Seller shall attempt to minimize earthwork and vegetation disruption for the installation of the Project to the extent it is compliant with the use permits; however, vegetation should be controlled to minimize fire danger and provide the ability to operate and maintain the Project. Any land contours that may affect BESS and PV electrical generation should be included in the BESS and PV system performance estimate. If required, Seller shall import engineered fill to slope the Site and prevent accumulation of standing water. Any direct burial cabling shall be protected with adequate bedding materials to ensure long-term cable integrity. Dust control shall be maintained in accordance with state and local requirements until Final Acceptance is achieved. Seller shall provide other Site maintenance as needed during construction.

Existing structures and utilities that are adjacent to or within the limits of the Project area shall be protected against damage. Seller shall be fully responsible to Owner or other property owners for all repairs in the event of removal or damage of any existing structure, equipment or systems that are intended to remain in place.

4.12.1 Geotechnical Analysis

A geotechnical analysis shall be provided by Seller and performed by a qualified geotechnical engineering firm. The results of the analysis shall be used when designing the foundations for the structures on the Site.

At a minimum, the following should be included in the analysis:

- Review publicly available geotechnical information and reports. This may include soils and geologic maps and literature, photographs, hydroelectric reports, groundwater reports, and water well data.
- Coordination and mobilization of the geotechnical services team for subsurface exploration of the Site. This should include working with the local utilities to mark any existing underground utilities (such as cables, gas lines, piping, etc.). This cannot be conducted until Owner has mitigated the prairie dog permitting requirements.
- Study the Site to determine the presence of faults, ground fissures, and other potential geologic hazards that could affect the structural design and construction of the Project.
- Drilling or digging of exploratory borings and pits. The quantity and depth shall be determined by Seller.
- Performance of cone penetration tests. The quantity and depth shall be determined by Seller.

- Laboratory testing of collected soil samples from the borings and test pits. An evaluation of the in-place moisture content and dry density, gradation, plasticity, consolidation characteristics, collapse potential, expansivity, shear strength, compressive strength, resistivity, chloride content, sodium sulfate content, and solubility potential (total salts) should be conducted.
- Analyze the corrosivity of the soil. Include a recommendation for the type of cement to be used in concrete foundations. Also include recommendations for corrosion protection for underground steel, including rigid metal conduit (such as the need for polyvinyl chloride [PVC] coating).

In addition to the above minimum requirements, local jurisdictional regulations may require site specific hydrologic and infiltration testing. Seller should determine specific requirements and coordinate with geotechnical engineering firm to obtain any required testing information, related to proposed stormwater management facility designs.

A detailed report shall be provided outlining the tasks performed and the results of the testing. Included in the report should be any recommendations for the foundation designs, structural support designs, corrosion protection for both underground steel and concrete, pile drive frequency, minimum pile size, and any geologic conditions that may prevent the development of the Project. Specifically, an opinion on the viability of driven piles as the PV racking supports should be provided.

4.12.2 Environmental Loads

All structures on the Site need to be designed using environmental loads as specified in the American Society of Civil Engineers (ASCE) 7 code book *Minimum Design Loads for Buildings and Other Structures* and the applicable state building code if more stringent requirements. These include wind loads (Chapter 6), snow loads (Chapter 7), rain loads (Chapter 8), ice loads (Chapter 10), and earthquake loads (Chapter 11). Each structure on Site shall be grouped in Occupancy Category II as defined in Table 1 1 of ASCE 7. The corresponding importance factor shall be used for each load calculation.

4.12.3 Excavation

Seller shall perform all common and deep excavation necessary for installation of all foundations and utilities. All excavation shall be in accordance with OSHA regulations. Excavation spoils shall be the Seller's responsibility and may be used for backfill or embankment if suitable, per ASTM D 2487 for this application. Unsuitable or excess excavated material shall be properly disposed of.

Seller shall verify that earth materials exposed in excavations are consistent with those assumed for Seller's foundation designs. If earth materials are different than assumed for particular foundation design, Seller shall modify the design and/or treat the earth material (over excavate, replace, etc.) as necessary to provide foundation meeting design requirements including frost depth.

Seller shall be responsible for making all excavations in a safe manner and consistent with the requirements of the Occupational Safety and Health Administration.

Seller shall provide adequate measures to retain excavation side slopes to ensure that structures, equipment, and persons working in or near the excavation are protected.

Seller shall protect all above grade and below grade utilities. Protect below grade liquid systems from frost.

4.12.4 Construction Surveying

Seller shall furnish all labor, equipment, material and services to perform all surveying and staking essential for the completion of the Project in conformance with the plans and specifications.

Seller shall retain qualified survey crews knowledgeable in proper and up-to-date survey techniques and shall use these qualified survey crews when conducting the survey. Such crews shall be under the supervision of a Professional Land Surveyor registered in the state or jurisdiction of the project.

4.12.5 Fills

Earth fill material adjacent to and below structures shall conform to Seller's design requirements for the structure. Seller prepared specifications and drawings shall indicate the types of soil to use for particular fills, compaction, and compaction testing requirements. These same requirements apply to access roads to the Project site.

Fill shall be placed as uniformly as possible on all sides of structural units. Fill placed against green concrete or retaining walls shall be placed in a manner that will prevent damage to the structures and will allow the structures to assume the loads from the fill gradually and uniformly.

4.12.6 Fencing

The entire site shall be enclosed with a permanent fence in accordance with Owner's Standard #9.

4.12.7 Equipment Pads

All equipment pads shall be located such that adequate personnel access is provided to such equipment. A minimum of 4.0 feet (or 1.5 meters) horizontal clearance from obstructions that would otherwise limit access to the equipment on the pad shall be provided around all equipment pads. The pads shall be sized sufficiently to allow safety and adequate working space around the equipment. The inverter stations, switchgear, substation (if applicable), and other buildings shall be elevated above the Federal Emergency Management Agency 100-year flood plain. The slope of the earthwork around the inverter stations and other equipment shall allow safe and ergonomic access to the equipment and provide for adequate drainage and maintenance. Above ground electrical equipment, including transformers, inverters, PV panels and BESS building or enclosures will be protected with bollards painted yellow.

4.12.8 Foundations and Concrete Work

All foundations and supports must be designed in accordance with the applicable state building code using the calculated environmental loads discussed above and soil properties provided in the geotechnical report. In addition, all placed concrete shall at a minimum comply with ACI 301 and ACI 117 publications. Form materials and required steel reinforcement shall comply with local regulations and site specifications. At a minimum, reinforcing bars shall comply with ASTM A 615 or ASTM A 706 for Low-Alloy-Steel Reinforcing bars.

4.12.9 Corrosion Protection

Corrosion protection shall be utilized on the structures of the Project. The type and amount shall depend on the selected materials of construction and conditions at the Site. A study of these conditions along with recommendations from the geotechnical report shall be used to design the corrosion protection.

The corrosion protection study shall be performed by a qualified corrosion expert and documented with references and calculations showing that the foundations, supports, racking, fasteners, and conduit shall

meet a Design Life in aboveground and belowground conditions, as specified in Table 5 and 6. If galvanized materials are used, field-applied zinc coatings shall meet American Society for Testing and Materials (ASTM) A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. This standard contains minimum requirements for the material, surface preparation, and application process. For example, repairs to damage due to vibratory pile driving shall conform to ASTM A780.

It is required that all holes in structural members requiring galvanization shall have the holes drilled before the galvanization is applied. Should holes be drilled in the field, galvanizing shall be applied to the exposed steel as specified in ASTM A780. All field welds shall have a field-applied galvanization as specified in ASTM A780. For example, if torque tubes with a 3.0-mil (0.003-inch) hot-dip galvanization are to be welded in the field, a field-applied coating, such as hot stick repair, shall meet or exceed the original 3.0-mil coating thickness of the torque tube per ASTM A780 requirements.

Only steel bolts with pre-applied corrosion inhibitors or stainless-steel bolts and fasteners shall be allowed in the entire mounting structure.

4.12.10 Erosion Control & NPDES Coverage

Seller shall submit a site-specific Erosion and Sedimentation Control Plan. If required by local regulations, this plan is to be reviewed and approved by the local jurisdiction prior to construction. The erosion and sedimentation control plan will be consistent with and incorporate applicable elements of the SWPPP in addition to local regulations. All areas of temporary soil disturbance are to be graded, if necessary, and re-vegetated in a timely manner to limit erosion as required by the local jurisdiction. In addition to the Erosion and Sedimentation Control Plans, depending on state regulation the site may need to apply for coverage under the National Pollutant Discharge Elimination System (NPDES). This coverage is normally issued by the state environmental agency and is normally required for any site disturbing 1 acre or more. Seller to investigate and apply for any permit authorizations related to earth disturbing activities.

4.12.11 Grading and Drainage

The grading and drainage plan shall be designed and installed in accordance with local code and permit requirements. The grading and drainage plan will be consistent with and incorporate applicable elements of the SWPPP and the erosion control plan. All structures required for the drainage plan, if any, shall comply with state standard specifications for drainage facilities. Grading and drainage will be designed to efficiently convey water away from the site, prevent ponding and point source discharge, promote sheet flow of water, and limit long-term maintenance of the Project site. Stormwater Management facility designs if required shall meet all state and local design requirements for Water Quality, Volume and Rate reduction as deemed appropriate for the site.

4.12.12 Dust Control

Seller shall apply dust control materials, at Seller's expense, to minimize raising dust from construction operations and traffic, including but not limited to haul routes, using only dust control mixtures approved by the local jurisdictions.

4.12.13 Site Finish Grade

Seller shall leave the Site in a clean condition upon completion of the work. Efforts shall be made to restore area to a clean condition as soon as practical. Seller shall remove all trash, debris, and stockpiles.

The Site access roads shall be returned to a condition that meets the original specification by repairing road damage such as ruts, gouges, and weather damage that may have occurred during construction.

The Site finish grade within the equipment footprint and in areas required for operation and maintenance of the Project shall be fully stabilized in a manner that meets or exceeds local jurisdiction requirements. Provisions of the SWPPP for final storm water drainage shall be implemented.

Seller shall seed and mulch all areas of the Project Site that have been disturbed beyond the permanent portion of the Site and access road, per the SWPPP.

4.12.14 Construction Signage

Seller shall provide temporary signage for local traffic control in accordance with state department of transportation and/or local city requirements and in accordance with Owner's standards.

4.12.15 Human Access

Seller shall make access to all equipment safe and reasonably ergonomic for maintenance staff. For example, if an inverter pad is elevated, the earthwork surrounding the concrete pad shall have a safe approach slope.

The Project shall include a separate room or enclosure to serve as a storage area for tools, spare parts and similar items. Seller shall provide appropriate shelving and lockable cabinets. It shall also include an area for a desk and a file cabinet to store BESS manuals, documents and drawings.

4.13 Mechanical

All mechanical design shall be in accordance with the International Mechanical Code and the International Fire Code, the additional documents incorporated by reference and the additional requirements herein. All mechanical design shall be performed by or done under the direction of a Professional Engineer registered in the state. All Life Safety requirements shall meet all national, state, and local codes, as well as agree with the local Authority Having Jurisdiction.

In accordance with State and Local Laws, all final (Issued for Construction) drawings, specifications, and calculations shall be wet stamped by a Registered Mechanical Engineer in the state where the project is located.

The BESS components shall be fully contained in weatherproof, environmentally-conditioned enclosures or building. The BESS shall have complete and failsafe battery and PCS thermal management systems.

Seller shall provide heating, ventilation and/or space conditioning for the BESS components, as required, to meet the equipment manufacturers' recommendations over the range of site conditions and over the full operating range. Seller shall provide documentation and design calculations supporting the adequacy of the BESS heating, ventilation and/or space conditioning.

Ventilation and space conditioning equipment controls shall be interlocked with the fire protection and suppression systems to operate appropriately in the event of fire.

Ventilation system fans shall be provided with non-return, motor operated dampers. Forced ventilation air streams shall not impinge directly on electrical equipment. Inlet and outlet enclosure dampers shall be of a design that prevents wind driven water and dust intrusion. If required, ventilation systems shall be provided with an interlocked and automatic temperature control system, including appropriate alarming, for each Project building or enclosure.

Space site ambient temperature conditioning as required for the Project enclosure equipment provided shall be provided as complete systems with all accessory items required for proper operation. Consideration shall be given primarily to requirements for efficient conditioning of the installed BESS and PV equipment except in normally occupied areas such as the control room. Normally occupied areas or areas requiring access for local operation shall consider operator comfort in addition to requirements for equipment conditioning. Space air conditioning equipment shall be designed for the loss of one unit without derating of the Project. Where heating or cooling is provided, the equipment shall have a minimum EER, IEER, SEER rating in accordance with the Energy Codes. Space air conditioning shall be provided with an automatic temperature control system, including appropriate alarming, for each Project operational enclosure.

4.13.1 HVAC / Thermal Management

The following is a general summary of the HVAC Requirements for each Project Operational Enclosure.

4.13.1.1 Project Specific Requirements to Determine Equipment Sizing, Quantities & Configuration:

Each Mechanical system and option indicated in this section is dependent on project and enclosure specific requirements. The required information will determine the size, quantity and configuration of the Mechanical Equipment. The required information is noted as follows:

- Location of the Storage Facility – Climate Zone, Outdoor Max and Min Ambient Temperatures
- Storage Building / Container Assembly and Dimensions
- Space Temperature / Humidity Requirements for the Battery Storage Rooms
- Battery Rack Configuration
- Battery Heat Dissipation (BOL – Beginning of Life) & (EOL - End of Life)
- Location of Transformers, PCS (Indoor / Outdoor) – For Indoor – Heat Dissipation
- Available Clearances for Mechanical Equipment (Installation and Servicing)
- Available Clearances for Ductwork
- Fire Protection System(s) Configuration and Control Sequencing

4.13.1.2 Battery Energy Storage Building:

Battery Room(s):

- Provide 3-phase Air-Cooled AC-unit(s) dedicated for each defined array of batteries within each Battery Room. Each AC-unit Supply Air ductwork is to be installed in a manner that directs the supply air via supply air diffusers on to the batteries per the battery manufacturer's recommendations. Each AC-unit is to also have Return Air ductwork that is to be installed above the Supply Air ductwork. Each AC-unit is to be provided with an Air-side Economizer.

- Provide Exhaust Air Fan(s) dedicated to the space to provide ventilation of the space to meet or exceed code compliance of minimum 1 cfm/sq.ft. The Exhaust Air Fan(s) will include 100% stand-by fans. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by the AC-units during normal operations.

- Provide isolation dampers in the ductwork as required in coordination with the requirements of the Fire Protection System(s) Configuration and Control Sequence.

Control Room(s):

- Provide Air-Cooled AC-unit(s) dedicated for each Control Room. Unit shall be ducted to the space with supply air and return air ductwork. Each AC-unit is to meet minimum outside air requirements for the occupied Control Room space. Each unit is to be provided with an Air-side Economizer.

CO2 Room(s):

- Provide One (1) Exhaust Air Fan dedicated to each space to provide ventilation of the space. The Exhaust Air Fan will be ducted into the space with air inlets at the ceiling and extended to the floor level. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by a Passive Air Intake.

Fire Pump Room(s):

- Provide One (1) Exhaust Air Fan dedicated to each space to provide ventilation of the space. The Exhaust Air Fan will be ducted into the space with air inlets at the ceiling and extended to the floor level. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by a Passive Air Intake.

Provide the BMCS and Control Facilities for the Following Typical Systems:

- Battery Room AC-Unit and Ventilation Systems
- Control Room AC-Unit Ventilation Systems
- CO2 Room Ventilation Systems
- Fire Pump Room Ventilation Systems

4.13.1.3 Battery Energy Storage Container(s):

Three (3) options for Mechanical Equipment configurations have been listed. These options are not listed in order of preference.

- Option #1 – AC-units and Fans on top of Storage Container Enclosure:
    - Provide Air-Cooled AC-unit(s) dedicated for the defined array of batteries within the Storage Container. The Air-Cooled AC-units are to be install on top of the Storage Container. Each AC-unit Supply Air ductwork is to be installed in a manner that directs the supply air via supply air diffusers on to the batteries per the battery manufacturer's recommendations. Each AC-unit is to also have Return Air ductwork ducted into the Container. Each AC-unit is to be provided with an Air-side Economizer.

  - Provide Two (2) Exhaust Air Fan(s). Each exhaust Air Fan is to be installed on top of the Storage Container. Each exhaust fan is to meet or exceed code compliance of minimum 1 cfm/sq.ft. The first exhaust fan will be the base exhaust fan. The second exhaust fan will be a 100% stand-by. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by the AC-units during normal operations.
  - Provide isolation dampers in the ductwork as required in coordination with the requirements of the Fire Protection System(s) Configuration and Control Sequence.

- Option #2 – AC-units on Ground, Fans on Roof of Storage Container Enclosure:
  - Provide Air-Cooled AC-unit(s) dedicated for the defined array of batteries within the Storage Container. The Air-Cooled AC-units are to be install on the Ground near the Storage Container. Each AC-unit Supply Air ductwork is to be installed in a manner that directs the supply air via supply air diffusers on to the batteries per the battery manufacturer's recommendations. Each AC-unit is to also have Return Air ductwork ducted into the Container. Each AC-unit is to be provided with an Air-side Economizer.
  - Provide Two (2) Exhaust Air Fan(s). Each exhaust Air Fan is to be installed on top of the Storage Container. Each exhaust fan is to meet or exceed code compliance of minimum 1 cfm/sq.ft. The first exhaust fan will be the base exhaust fan. The second exhaust fan will be a 100% stand-by. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by the AC-units during normal operations.
  - Provide isolation dampers in the ductwork as required in coordination with the requirements of the Fire Protection System(s) Configuration and Control Sequence.

- Option #3 – AC-units Mounted to Side of Storage Container, Fans on Roof of Storage Container Enclosure:
  - Provide Air-Cooled AC-unit(s) dedicated for the defined array of batteries within the Storage Container. The Air-Cooled AC-units (Multiple smaller wall mounted units) are to be install on each side of the Storage Container. Each AC-unit Supply Air ductwork tap into the container is to be installed in a manner that directs the supply air via a supply air diffuser on to the batteries per the battery manufacturer's recommendations. Each AC-unit is to also have Return Air ductwork duct tap into the Container. Each AC-unit is to be provided with an Air-side Economizer.
  - Provide Two (2) Exhaust Air Fan(s). Each exhaust Air Fan is to be installed on top of the Storage Container. Each exhaust fan is to meet or exceed code compliance of minimum 1 cfm/sq.ft. The first exhaust fan will be the base exhaust fan. The second exhaust fan will be a 100% stand-by. Each Exhaust Air Fan is to be Explosion Proof / Spark Proof. Make up-air to the Exhaust air fans to be provided by the AC-units during normal operations.
  - Provide isolation dampers in the ductwork as required in coordination with the requirements of the Fire Protection System(s) Configuration and Control Sequence.

- Provide a BMCS and Control Facilities for the Following Typical Systems:
  - Battery Room AC-Unit and Ventilation Systems

4.13.1.4 Quality Assurance for Air-Cooled AC-units:

- Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
- Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- Unit Energy Efficiency Ratio (EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings.
- Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

4.13.1.5 Additional Thermal Management Coordination Items:

- Provide a CFD (Computational Fluid Dynamics) Analysis of the Proposed Installation.
- Provide supplemental steel supports where required for all rooftop installations.
- Provide concrete equipment pads where required for equipment placed on the ground/floor.
- Coordinate all structural equipment weights, unit supports and pads.
- Coordinate all Electrical Requirements with the Electrical Seller.
- Coordinate all Fire Alarm Requirements with the Fire Alarm Seller.

4.14 Safety and Project Security

4.14.1 Fire Protection and Suppression

Seller shall design and install a fire protection system that will provide fire detection and fire suppression systems for the buildings and/or enclosures, and equipment that comprise the Project as necessary. The design shall be performed by a licensed Fire Protection Engineer in the state where the project is located, and all design documents shall be signed and sealed by that Engineer.

The fire protection systems shall conform to all national, state, and local codes and standards including, as well as incorporating and implementing the recommendations of the following:

- National Fire Protection Association (NFPA) 850 Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations (for transformers and general areas and overall interface with the power station)
- National Fire Protection Association (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems
- National Fire Protection Association (NFPA) 10 Standard for Portable Fire Extinguishers National Fire Protection Association (NFPA) 13 Standard for the Installation of Sprinkler systems
- National Fire Protection Association (NFPA)15 Standard for Water Spray Fixed Systems for Fire Protection

The fire protection systems shall also comply with when required, as well as incorporating and implementing the recommendations of the following when not fully required by the owner, AHJ, Insurance agent:

- FM Global Property Loss Prevention Data Sheet 2-0, Installation Guidelines for Automatic Sprinklers
- FM Global Property Loss Prevention Data Sheet 2-1, Corrosion in Automatic Sprinkler Systems.
- FM Global Property Loss Prevention Data Sheet 2-8, Earthquake Protection for Water-Based Fire Protection Systems.
- FM Global Property Loss Prevention Data Sheet 2-10r, Dry Pipe, Deluge, Pre-action Valves and Accessories.
- FM Global Property Loss Prevention Data Sheet 2-81, Fire Protection System Inspection, Testing, and Maintenance.
- FM Global Property Loss Prevention Data Sheet 4-1n, Fixed Water Spray Systems for Fire Protection
- FM Global Property Loss Prevention Data Sheet 4-4n, Standpipe and Hose Systems.
- FM Global Property Loss Prevention Data Sheet 4-5, Portable Extinguishers
- FM Global Property Loss Prevention Data Sheet 4-9, Halocarbon and Inert Gas (Clean Agent) Fire Extinguishing Systems.
- FM Global Property Loss Prevention Data Sheet 5-33, Electrical Energy Storage Systems
- FM Global Property Loss Prevention Data Sheet 5-40, Fire Alarm Systems.
- FM Global Property Loss Prevention Data Sheet 5-48, Automatic Fire Detection.
- FM Global Property Loss Prevention Data Sheet 5-49, Gas and Vapor Detectors and Analysis Systems

All fire suppression, detection, and alarm systems shall be designed and installed in accordance with the applicable NFPA codes and standards. All equipment shall be UL listed and/or FM approved, were FM compliance is required by the owner. Seller shall provide a main fire alarm control panel in the control room that shall monitor all fire suppression, fire detection, and fire alarm systems. Additional local fire panels shall be provided as required.

The fire protection system design and associated alarms shall take into account that the Project will be unattended at most times.

Designing engineer and Seller shall calculate and consider the heat content of the battery cell materials, based off the data collected in the UL 9540A testing, in designing an appropriate fire protection system.

Separate fire protection and barrier systems may be used in the battery, PCS and control areas.

All buildings and enclosures shall be designed in accordance to the applicable state and local building, mechanical, fire, and energy conservation codes. Where a building is not provided, life safety and egress requirements shall still be applied and considered in the overall equipment arrangement.

Within 30 days of Effective Date, Seller shall submit its proposed fire detection and suppression philosophy and basic design elements with calculations to Owner and appropriate third parties having jurisdiction. Seller is responsible for obtaining system design approval, installation inspection, and testing as required by Owner and third parties with jurisdiction

4.14.1.1 Fire Separation

Design engineer/ Seller shall provide adequate separation between the BESS and the other buildings, structures, equipment, and systems located on the site. Separation shall be provided by either spatial separation, fire walls/barriers, or exposure protection system such as water spray systems. Separation and exposure protection requirements shall be determined in accordance with the local building codes, FM Data Sheets 1-20 and 5-33, and applicable NFPA standards, including the latest edition NFPA-855, all based off the testing data from UL 9540A

Structures housing the batteries may be divided into multiple battery rooms, separated by two (2) - three (3) hour fire barriers based on referenced codes, in order to limit the potential impact of a fire. The maximum size of a battery room shall be on the order of 3,000 square feet. This area limitation is a guideline and should be adjusted as practical for economic and design efficiencies.

When multiple outdoor battery enclosures are utilized, they shall be separated from each other in accordance with FM Data Sheet 5-33, by either 20 feet or masonry fire barriers, and NFPA-855.

Transformers shall be located and installed in accordance with the location and separation requirements of NFPA 850 and FM Data Sheet 5-4. Transformers shall be provided with a means to contain their oil content without exposing adjacent transformers, buildings, enclosures, or other equipment and structures. Seller shall provide the required spatial separation between the adjacent equipment and buildings or shall provide rated fire separation barriers/walls.

4.14.1.2 Fire Suppression Systems

Fire suppression systems shall be provided for all buildings and enclosures as required. Battery areas shall be provided with a multi- phase fire suppression approach. One such approach is, 1) Clean agent fire suppression system per NFPA 2001 for initial fire control; and 2) double interlocked pre-action sprinkler system per NFPA 13. Both systems will be activated by means of the associated fire detection system. Each battery room shall be provided with an independent fire suppression system. In the engineers selection of systems, they are responsible to provide documentation to the owner, Seller, local Fire Dept, plan reviewer, etc., that states that the designed system is designed to fight the different fire hazards, and fires that can be experienced, such as an electrical (non-thermal runway fire), thermal run away fire, explosion mitigation or prevention, etc. Hazards to be identified by a licensed fire protection engineer in accordance with local, industry, and the latest NFPA standards on battery protection, list of hazards and protection system to be provided to owner and AHJ prior to design for approval.

Where separate battery enclosures are utilized, either outdoors or indoors, the clean agent system discharge can be limited to the battery enclosure with the fire. Where separate battery enclosures are installed indoors, the pre-action sprinkler system shall be extended into the individual enclosures in addition to general building coverage, this method of protection must be approved by the local fire, AHJ and owner prior to design, care should be given to any impacts to the insurance rates of sites protected with

Outdoor battery enclosures are not required to be provided with a pre-action sprinkler system when they are adequately separated from adjacent battery enclosures. Only clean agent fire suppression need be provided for the enclosure. For this case, final water fire suppression will be provided manually by means of fire hoses.

The required concentration of clean agent shall be determined by the manufacture of the battery units via the required UL 9540A testing and must be based on fire suppression test results for the specific battery chemicals being utilized. The clean agent concentration shall comply with the latest NFPA-2001 requirements, including the design concentration factor as outlined in NFPA-2001-2018 section 5.4 and shall allow personnel occupancy of the room/enclosure for at least five minutes without any adverse health effects.

The clean agent system(s) shall be designed using a main gas supply bank. Seller shall determine if an installed reserve bank is required based on the relative availability of the clean agent being utilized, and to comply with local codes and NFPA-2001. As a minimum, Seller shall provide on-site storage of clean agent reserve cylinders for the largest single clean agent system and the means for quickly replacing the used cylinders with the uninstalled reserve cylinders, it is highly recommended that the

Abort switches shall be provided for each clean agent system installed in a building, or a min of one (1) abort switch for each container of batteries installed outside. The abort switches must be in the hazard area located close to all exit doors and be within distance of doors as stated in NFPA-2001 All required warning signs shall be provided and installed by Seller as required by NFPA 2001.

All door, windows, vents, or opening of any kind that could allow for air flow in or out of the hazard area must be placed on self-closing, so that upon detection of an issue they can close, any openings that cannot be closed must be accounted for with extra agent as outlined in NFPA-2001. All HVAC units are to be shut down at the same time, and all duct work leading from the space to the outside to be closed with airtight dampers, in the event the system cannot be shut-down or the ducts and vents not shut, additional agent must be provided to comply with NFPA-2001.

The water density for the design of the pre-action sprinkler system shall be determined by Seller based on the battery technology being used, guidance of NFPA 855.

The pre-action valve is to be UL listed and FM approved for use. It is recommended to use a Double interlock Pre-action valve be used, to reduce the risk of false alarms, accidental water flow into the pipe, and water leaks from piping. Systems to be either Electric-Electric activation, that uses one of the following activations and detection methods, cross zoned smoke detectors, cross zoned heat detectors, or a min of two (2) concentration levels for automatic air sampling systems, levels to be determined by designing engineer/Seller in compliance with NFPA and FM requirements based off testing from UL 9540A. Systems can be Electric-Pneumatic activation, where the electronic follows the requirements outlined above. All Pre-action systems to be provided with electronic accelerator.

Where the AHJ, Fire Dept or other code enforcement do not allow for the use of double interlock valves to be used a single interlock system can be used, with either pilot line or electric actuation can be used, with electronic being recommended. All single interlock valves to be provided with an electronic accelerator.

The pre-action sprinkler system piping shall be supervised using nitrogen bottles, or a nitrogen generator that complies with the requirements of NFPA-13 and is FM approved. The loss of pressure in the piping shall be alarmed on the local control panel and main fire alarm control panel in the control room. All valves and components to be housed in a controlled dedicated area/room, it is to be heated to protect from freezing, be protected from physical damage from items such as cars, trucks, lifts, etc. All information required by the local fire dept, including drawings, specifications, life safety plans and other required details by the AHJ and Fire Dept that are coordinated by the installing Seller and the fire dept and AHJ. Valves and valve room to be remotely located away from the battery units to a min distance outlined in

the UL 9540A testing, NFPA-855, and local requirements, to protect the valves and components from damage from a unit on fire, such as explosion and fire damage that could compromise a system.

4.14.1.3 Fire Detection and Alarm Systems

Designing Engineer/Seller, and installing Seller shall design, furnish and install a fire detection and alarm system throughout the Project, including detection systems associated with the clean agent systems for each battery area, and the other rooms and areas identified in this Technical Specification. All fire detection and alarm system equipment shall be UL listed/ FM approved and shall comply with NFPA 70 and NFPA 72. Detector locations shall be subject to Authority Having Jurisdiction approval.

Installing Seller shall be responsible for the design, furnishing, installing, programing, and testing of a complete intelligent, addressable, supervised, manual and automatic, non-coded, and state-of-the-art fire detection and alarm system. System shall include all electrical relays, interface modules, control transformers, fire protection and detection conduit and tubing, and other miscellaneous electrical equipment and instrumentation, including all local devices as required to ensure proper operation of the fire protection systems, as specified herein and as required by the applicable codes and standards. Detection system shall also provide for the detection of carbon monoxide (CO), hydrogen (H_2) gasses, and other combustible or explosive gasses based on the UL 9540A testing, that may be released in all battery rooms/areas.

Fire Detection and alarm system shall consist of the following:

- Fire detection and alarm systems associated with the required fire suppression systems in the battery areas and all other building areas, rooms, and enclosures.
- Monitoring and supervision of clean agent systems.
- Manual pull stations throughout building and enclosures, including along paths of egress and at all entrances and exits from energy storage containers
- Audible and visual alarms throughout building and enclosures.
- Red strobe beacons outside each battery room or enclosure for indication, located above any paths of entrance or exit to the space that fire has been detected in the room/enclosure.

Seller shall be responsible for providing duct smoke detectors installed in the building/enclosure HVAC systems. All alarms from the duct smoke detectors shall be brought to the Fire Alarm System Control Panel.

Seller shall be responsible to provide local audible and visible alarms and manual pull stations.

Seller shall furnish and install automatic and manual fire detection systems, alarm and signaling systems, including but not limited to: air sampling type smoke detectors (VESDA or equal), spot type smoke detectors, pull stations, horns, strobes, etc. Seller shall be responsible for the installation and connection of all detection devices. The number of detectors to be provided for fire detection in a certain area or room and the corresponding location of these detectors shall be determined by Seller and based upon the manufacturer's recommendations and NFPA 72 requirements.

All detection, tripping and isolation circuits shall be electrically supervised for continuity. Discontinuities shall be indicated by a "trouble" indicator and alarm at the respective local control panel and at the Main Fire Alarm Control Panel. Pathways shall be Class A with a pathway survivability of Level 0.

Each battery room/area shall be provided with two zones (Zones 1 and 2) of air sampling type smoke detection, VESDA or equal, with each zone providing full coverage of the battery room/area being protected. This detection system shall control the release of the clean agent system into the battery room. Rooms and areas that do not have batteries shall be provided with spot type smoke detectors.

The air sampling smoke detectors shall provide programmability of four smoke density alarm thresholds within the systems sensitivity measurement range. Setting of time delays for each of the four alarm thresholds shall also be programmable. Relay outputs shall be provided for remote indication of alarm conditions on the local system panel.

Alarm levels shall be:

- Alert
- Pre-Alarm
- Fire 1
- Fire 2

System shall be designed for resistance to unwanted alarms while still achieving maximum sensitivity.

A time delay of 30 seconds for room evacuation shall be provided prior to the release of the clean agent into large battery rooms. The time delay shall be adjusted downward for smaller battery enclosures. The time delay shall start at the time that the system has alarmed and received all permissions for clean agent discharge.

Activation of the clean agent extinguishing system for each battery room/area shall be via crossed-zoned smoke detection: room aspirating smoke detection systems (both Zone 1 and Zone 2 at Fire 1 alarm level). This shall also release water into the pre-action sprinkler system piping.

Fire alarm control panels shall be wall mounted type, requiring access from the front only. Panels shall be provided with internal battery backup power.

Panel shall provide for HVAC system shutdown for the room being served based on the following:

- Duct smoke detector detects smoke.
- Spot smoke detector detects smoke.
- Aspirating smoke detector reaches Fire 1 alarm level (either zone).

4.14.1.4 Portable Fire Extinguishers

Seller shall furnish, locate, and install portable fire extinguishers in the building and enclosures in accordance with NFPA 10, and as required by the local Authorities Having Jurisdiction. Quantities, type, and sizes of extinguishers shall be determined by Seller in accordance with NFPA 10 requirements.

Portable hand-held fire extinguishers shall be provided at required locations.

4.14.1.5 Testing

All testing shall be performed in accordance with the applicable NFPA code/standard and related electrical specifications, local requirements, and the additional requirements as contained herein.

All testing shall be properly documented in accordance with the applicable NFPA codes/standards, verifying proper testing and test results, and will be submitted to Owner and the Authority Having Jurisdiction for approval.

The piping distribution systems for the clean agent systems shall be inspected and tested to determine that they are in compliance with the design and installation documents. As a minimum, the inspection and testing shall be as identified in NFPA 2001 for Installation Acceptance.

Pressure and flow testing, and enclosure integrity testing for clean agent systems shall be performed as required by NFPA 2001.

All fire detection systems shall be fully tested after installation in accordance with NFPA 70, NFPA 72, and NFPA 2001, such that alarms are received on the Fire Alarm Control Panel and transmitted to the remote monitoring location. As a minimum, each switch, control, alarm, etc., shall be operated or caused to alarm to verify proper function and operation. Actual operation of valves and detectors should be used to initiate alarms, signals, and trips (no simulated signals).

4.14.1.6 Operation and Maintenance of Fire Protection Systems

Fire suppression and fire detection systems shall be operated and maintained in accordance with the requirements of this Technical Specification and the appropriate NFPA standard. Water based fire suppression systems shall be maintained in accordance with NFPA 25.

4.14.2 Project Security

Seller shall provide a security system for the Project. The security system around the perimeter shall include a 7-foot-high chain link fence with 1-foot top guard (total 8-foot high) of three strands of nine-gage barbed wire. The perimeter fence shall include two locked gates: one with a width of 20 feet for vehicles and one pedestrian entrance with a width of four feet. During construction, Seller shall utilize temporary fencing as necessary to maintain security and prevent the movement of livestock. The entire site shall be enclosed with a permanent fence in accordance with Owner design standards.

Perimeter signage shall be provided by Owner and installed by Seller in accordance with Owner standards. Signage shall be installed every 65 feet along the perimeter fence and on all gates. Signage shall be installed five feet above ground level.

Signage that will be provided by Owner will include the following:

Warning! Hazardous Voltage Inside Keep Out

English SI# 7999852

Spanish SI# 7999854

No Trespassing

SI# 8252306

Mounting Hardware

SI# 7999092

Seller shall be responsible for security during construction.

Seller shall contract with AVTEC SYSTEMS INTEGRATOR, A DIVISION OF CACHE VALLEY ELECTRIC, (Security Sub-Contractor), to provide and install the necessary security equipment. Contact:

Avtec – System Integrator
Michael Petric
(801) 908-4191
michael.petric@cve.com

This equipment may include, but is not limited to:

- LED Spot or LED flood lights.
- Security cameras located such that they are capable of adequate identification of intruders covering the perimeter of the Site. Cameras shall be placed at a height that permits line-of-sight access to the property.
- Cameras with a control and detection system that assists in the detection and identification of intruders.
- Network - Digital Video Recorders used to record video that could be used for evidence in the event of theft or vandalism.
- Seller shall negotiate with third party vendor to identify the scope of work that will be performed by Seller, to ensure that a complete and operational security system as described by third party vendor is provided. Third party vendor shall provide to Seller the security system design, which will indicate the location of cameras, DVRs, security lighting and any security communications equipment, based on third party vendor's overall System design. The work that may be provided by third party may include the furnishing and installation of wiring, cabling, labor, tools, equipment, and ancillary materials required for a complete and operational security system. At minimum, it is expected the Security Sub-Seller will provide the following equipment: cameras, network DVRs, and any specialized security communications equipment.
- Seller shall be responsible for the furnishing and installation of all necessary conduits, 120-V_{ac} power extensions for all Security related equipment.
- Seller shall provide a free-standing weather-proof enclosure with adequate space required for Security Control Equipment as specified by the third party.
- Installation of telephone lines, and/or cellular modem(s), and/or local area network for the interconnectivity of all related Security System Equipment.

- Seller shall provide fiber optic cable for Security System Communications. Fiber optic cable shall consist of a minimum of six fiber strands between each required camera location.
- The system shall be complete, tested, and fully operational. Prior to construction, Seller shall provide the following:
    - Descriptive statement and single-line block diagram to show how all related equipment will interface and operate as a complete system.
    - Product data: manufacturer's technical data sheets on each product to be used.
    - Drawings, including plans, elevations, equipment mounting heights, and dimensions required to show devices' locations and demonstrate accessibility compliance in accordance with referenced documents.
    - Detailed schematic wiring diagrams for all system devices; wiring information shall include cable type, conductor routings, quantities, and connection details at devices.
    - Manufacturer's user's manuals for operations, administration, installation, and maintenance.

4.14.2.1 Security System Installation

All system components and appurtenances shall be installed in accordance with the manufacturer's specifications, referenced practices, guidelines, and applicable codes. All necessary interconnections, services, and adjustments shall be furnished as required for a complete and operable system as specified. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

All security system wiring shall be installed in dedicated conduit throughout. Cable shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other wiring. All low-voltage wiring outside the control console, cabinets, and similar enclosures shall be plenum rated where required by code.

All wiring conductors connected to terminal strips shall be individually numbered and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the device as identified and shown on the drawings.

4.14.2.2 Security System Components

Security system components may consist of LED spot or LED flood lights, cameras, alarms, network video recorders, communication lines, and all wiring required for all the components. The security system shall be sufficient to monitor and deter any theft or vandalism onsite. The security component supplier shall provide detailed specifications of each component.

Seller shall coordinate with Owner's SCADA design/instrumentation and control engineer to ensure sufficient bandwidth is available on the network to accommodate the proposed security system. Owner may elect to reduce the equipment needs based on the location of the Site and subsequent security requirements.

Surveillance cameras and pan/tilt/zoom (P/T/Z) drives shall meet the following minimum requirements. Surveillance cameras and P/T/Z drives shall be provided by Seller. Alternative solutions providing higher

upgradeability and compatibility with future products are acceptable at no additional cost, subject to Owner's approval.

The P/T/Z unit shall meet the following design and performance specifications:

- The unit shall be microprocessor controlled with network / IP based programming via standard WEB based interface.
- Each pan/tilt drive unit shall operate as an independent unit with exclusive programming and setup data contained on each unit's nonvolatile memory.
- The unit shall be capable of 360-degree continuous pan rotation with a vertical unobstructed tilt of +36 to -85 degrees.
    - Manual Control Speeds of: 0.1 degree to 40 degree per second (Pan), and 0.1 degree to 30 degree per second (Tilt)
    - Preset Speeds of: 100 degree per second (Pan) and 30 degree per second (Tilt)
- The unit shall pan and tilt under manual control.
- The unit shall be capable of 16 learned tours and 256 configurable preset locations for Alarm Call-up configuration.

The camera shall meet the following specifications:

- The sensor type shall be 1/2-.8-inch Type Exmor CMOS Sensor.
- The camera shall provide a minimum of 1080p (1920x1080) resolution, at 30 images per second (ips).
- Camera shall provide a minimum of two simultaneous video streams: Dual H.264 or H.264 and Scalable MJPEG.
- Camera shall allow for control and monitoring of video via IPv4 and IPv6 Networks.

The motorized lens shall meet the following design and performance specifications:

- The camera shall provide 16:9 Aspect Ratio and shall provide a 30X optical zoom and 12X Digital Zoom.
- The lens shall provide horizontal angle of view of 59.5 degrees (wide) to 2.1 degrees (telephoto).
- The lens shall feature an automatic focus with manual override.
- A step-down power transformer shall be provided for each camera. Transformers shall be rated 120/24 V_{AC} and shall have an adequate volt-ampere rating for the load at 40 degrees C ambient air temperature. Individual Fuse Distribution shall be provided.

The camera and lens housings shall be weatherproof and part of an Integrated Optics Cartridge (IOC). The IOC shall accommodate specified camera and lens combinations. IOC shall be dry nitrogen filled to 10 psig, to protect Camera Sensor / Lens optics from condensation and corrosion.

Camera assembly shall be provided with integrated IR Illumination. IR Illumination Transmitters shall be integrated to the Pan / Tilt Assembly Housing so as to provide IR Illumination for areas being viewed by the camera.

- IR Illumination shall be provided for distances up to and including 330 feet from each camera location.

Video Wiring System

Description: 100-ohm, four-pair UTP, covered with a black PVC jacket.

- Comply with ICEA S-90-661 for mechanical properties.
- Comply with TIA/EIA-568-B.1 for performance specifications.
- Comply with TIA/EIA-568-B.2, Category 6.
- Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - Communications, Direct Burial Rated: Type F/UTP, complying with NFPA 262.
    - General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher. All terminations shall use TIA/EIA 568B wire termination color coding.

Power and/or Auxiliary Input/Output cable shall be multi-conductor twisted shielded cables selected for use with the specific equipment to be controlled for installation in concealed conduit system. Cables shall have outer jacket of PVC and shall be suitable for direct burial installation.

All cables and conductors that serve as control, sensor, low voltage power, or data conductors shall have surge protection circuits installed at each end that meet the IEEE C37.90.1 surge withstand capability test. Fuses shall not be used for surge protection.

If fiber is to be used for the communication backbone and copper is to be used for each camera connection, then Fiber to copper convertors are to be provided for each camera location. Theses convertors need to be capable or at least 1GB connectivity.

Network Video Recorder and Multiplexor

The network video recorder (NVR) and multiplexer shall be provided as one integrated unit. The NVR shall be provided by Seller.

The NVR shall provide for live and playback viewing while the system continues to record new images. It shall be capable of time division, multiplexing multiple cameras and storing their digitized and compressed images on integral hard disk drives, and search and retrieval either locally at the unit or from a remote work station using a graphical user interface. It shall have Ethernet connectivity.

The NVR shall record video on an internal hard disk drive(s). It shall support multiple internal and external hard disk drives of minimum one (1) Terabyte, or large enough to store up to one month of the camera recordings (whichever is greater). Minimum redundancy level RAID 5 is required with a hot swappable drive.

The NVR shall support archiving of images on an external archiving device. It shall support recording on portable / removable storage media.

The NVR viewing software shall provide the following displays as a minimum in live and playback mode: full-screen, sequencing, quad, 9-way, or 12-way. It shall allow the user to rearrange cameras in any multi-screen display, in both live and playback modes. The display options shall include but not limited to:

- Camera tilting
- Title display, per monitor
- Time and date, per monitor

4.14.2.3 Security Software

Seller shall provide a minimum of two software and database management licenses. Seller shall provide two copies of the software on CDs for backup and a complete user manual. Software shall be Windows compatible. Seller shall provide free software upgrades during the warranty period of the system as a minimum. In addition, camera licensing is required with one (1) license per camera.

4.15 Drainage Systems

Sanitary drainage, roof (storm) drainage, and floor and equipment drainage systems shall be provided, as required, to service all project buildings. All systems shall be gravity drainage systems with all pipe uniformly sloped in the direction of flow. Minimum slopes for all drainage systems shall conform to the requirements of the applicable Plumbing Code.

All plumbing fixtures and washing facilities shall be drained to the sanitary system. Floor drains in toilets, washrooms, and showers, if included, shall also be drained to the sanitary system. All such drains shall be routed independently from all other drainage systems to the Project Sewage Treatment Facility or to the local sanitary sewer system. Connection to the local sewage line is Seller's responsibility.

All plumbing fixtures and sanitary drainage related floor drains shall be trapped and vented to the outside in compliance with the applicable plumbing code.

All roof drains shall be provided with dome strainers, integral expansion joints, flashing collars, and underdeck clamps. All horizontal roof drainage piping shall be insulated and jacketed to prevent sweating.

Floor and equipment drains shall be connected to a common drainage system. Drainage from areas wherein chemicals can enter the drainage system shall be neutralized before combining with ordinary floor and equipment drains. Drainage from areas containing oil shall be processed through oil separators prior to discharge.

Equipment drains shall be sized on the basis of the largest drainage rate from equipment to be drained. Equipment drains shall be provided for all equipment with continuous drips or subject to frequent flushing. Equipment drains shall also be located at each fire protection system alarm valve station.

All station floor drains shall be a minimum of 4 inches in size. All areas containing concentrations of oil shall be provided with dikes, trenches, and/or drains sized to contain the maximum anticipated spill.

Any section of drainage system which cannot be drained by gravity to its disposal facilities shall be provided with pumps. Pumps for the sanitary drainage system shall be duplex sewage ejectors of the non-

clog type, submersible, vertical submerged type or pneumatic type. Sewage pumps shall be installed in cast iron basins. Pumps for the roof and floor and equipment drain systems shall be duplex sump pumps of the vertical, submersible type installed in concrete pits or cast-iron basins.

4.16 Toxic Materials

If a significant amount of a toxic substance can be emitted from the equipment during a failure, fire or emergency/protective operation, an alarm system to alert personnel shall be included in the equipment. The toxic nature of the substances as well as treatment for exposure to it shall be included in the Operation and Maintenance (O&M) manual. Sellers shall provide battery safety data sheets and test data with the bid.

Coordination and approval from the local fire protection agency is required prior to acceptance by Owner.

4.17 Spare Parts and Equipment

Seller shall evaluate its design with regard to failure rates, effects and BESS reliability. Seller shall provide a recommended spare parts list, including prices and availability, as part of his proposal. Spare parts that are readily available from stock and available within sufficient time to meet the required availability shall be considered off-the-shelf items and not required as spare parts in stock at the site. These parts shall be listed and so noted on the spare parts list. Seller shall also identify spare parts that Seller recommends should be stocked locally to ensure prompt repair due to any failure that can be reasonably expected, considering the length of time required to obtain replacement parts. Owner will determine the need for and purchase separately all spare parts.

All spare parts for equipment covered by this Technical Specification shall comply in all aspects with the requirements of this Technical Specification. This includes documentation identical in kind and format to that required for the original equipment or material. Each of the spare parts shall be fully identified by reference to the spares list, part number, cost, and manufacturer drawing number.

If Seller, his suppliers, or sub suppliers cease manufacture of any of the spare parts, or if for any reason any spare part will become unavailable at any time during the Design Life of the facility, as specified in Table 5 and 6, Seller shall notify Owner in writing at least 180 days prior to the unavailability of such spare parts. Seller shall provide Owner the opportunity to purchase sufficient stock of spare parts to support the system for its expected life.

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

Seller shall provide, receive, store locally, distribute and restock spare parts, materials, test equipment, instruments, tools, and consumables required for start-up and operation of the systems and equipment within its scope until Substantial Completion.

4.18 Project Access

4.18.1 Construction Access

Seller shall abide by all load limits established by the applicable state department of transportation.

Seller shall be responsible for providing, operating, and maintaining equipment, services, and personnel with traffic control and protective devices, meeting the requirements of the *Manual of Uniform Traffic*

Code Devices as required, allowing traffic flow on haul routes and onsite access roads in a safe manner. Seller shall be responsible for any costs to comply.

Seller is responsible for construction of temporary access around areas of excavation and other construction activity, if necessary and as required.

4.18.2 Site Access

The Site access road shall be designed and installed by Seller. This design shall be based on sufficient soils and subsurface investigation by a qualified professional engineer licensed in the jurisdiction of the project to ensure that the constructed road will meet its intended purpose. The Design Life of the access road shall be 30 years (assuming annual maintenance). The Site access road shall be a gravel compacted road (unless local regulations specify otherwise) sufficient to satisfy the loading requirements of the equipment vendors and to provide all-weather access for operation and maintenance of the BESS. Site access roadway design shall comply with local permit requirements and be appropriately graded for drainage.

Temporary construction roads and staging areas not connected to permanent roads (if any) shall be restored by Seller in accordance with permit requirements.

4.18.3 Onsite Roads

Seller shall provide a minimum setback of 20 feet between the perimeter fence line and any equipment or as directed by local authorities if more distance is required. This setback space may be used as a perimeter road.

For interior service roads as necessary, Seller shall allow a minimum road width of 10 feet between BESS containers and PCS/MVT equipment. Road surfacing shall meet local fire and emergency vehicle access requirements.

Roads shall have a minimum 75-foot inside radius, unless otherwise instructed by state or local requirements. A smaller turning radius may be approved with written approval from Owner.

4.19 Signage and Labeling

Permanent naming placards should be placed on all equipment, including inverters, combiner boxes, transformers etc. Naming on placards and/or tags shall match drawing naming convention. Security signage shall be in accordance with Owner requirements and meet current Industry Standards.

All cables shall be labelled to meet applicable codes and standards. All cables shall have a label affixed to the outer jacket with a Brady or equivalent cable marker at each termination of a type accepted by Owner before installation. Labelling will match the point to point drawings. Seller is required to place arc flash labels on all inverters, combiner boxes, and other equipment requiring such. A method for ensuring labeling is complete must be included in Seller's QC Inspection Point Program.

4.20 Surge and Lightning Protection

Seller shall provide a lightning risk assessment performed to Industry Standards by a certified lightning protection professional, as outlined in Section 4.21.2 External Lightning Protection System (LPS). The results of this assessment shall be the basis for determining the requirements and extent of the facility LPS and a surge protection system that provides protection of the batteries, DC power circuit, PCS,

measurement control and communications systems, and other major electrical equipment including transformers.

4.20.1 Surge Protection

A staged, comprehensive surge protection system, inclusive of Types 1, 2, and 3 surge protective devices (SPDs), shall be incorporated as determined by the lightning risk assessment (A-3.7.1 Electrical Engineering) or as required by the PCS manufacturers in all relevant pieces of electrical equipment. Protection shall be provided within the inverter on both the DC and AC sides as required by inverter manufacturer. Additionally, surge protection shall be provided in combiner boxes, and measurement control and communication systems as determined by the lightning risk assessment study. Type 3 surge protection installed within that equipment shall be mounted on DIN rails and must have finger safe replaceable modules that can be exchanged without the use of tools. SPDs shall be applied on all power circuits (AC and DC) and all communications and control circuits in a coordinated, staged manner. The operating status of the power SPDs shall include visual indication and shall be able to be remotely monitored by a set of integral contacts.

In addition to the performance requirements indicated above, all SPDs shall be compliant to the respective domestic or international standards, including, but not limited to, the following standards and guidelines:

- UL Standard 1449 3rd edition.
- IEEE Guideline C62.41.1-2002
- IEEE Guideline C62.41.2-2002
- IEEE Standard C62.42-2005
- IEEE Standard C62.45-2002
- IEEE Standard 1100-2005

4.20.1.1 SPDs Applied on AC Power Circuits

SPDs applied on AC systems must meet all the requirements listed above in this general section and must be specifically designed for and compliant to UL 1449 3rd edition. SPDs must be selected for the system voltage where they are to be applied. SPDs are to have a short-circuit current rating (SCCR) higher than the short circuit availability where they are installed, therefore not requiring external fusing. SCCR of 200,000 A is ideal.

4.20.1.2 SPDs for Measurement, Control, Instrumentation, and Communications Circuits

All critical non-power circuits are to be protected with appropriate DIN rail-mounted pluggable surge protection for the system they are applied. Surge protection bases are to permit signal continuity even if the SPD module is removed from the base.

4.20.2 External Lightning Protection System (LPS)

Based on the findings of the lightning risk assessment and/or the discretion of Owner, an external LPS may be required to be installed. If so, Seller shall provide an LPS to protect the overall Project from direct

lightning strikes to any portion of it, including, but not limited to, inverters, outside cabinets, and buildings housing electrical equipment. The LPS shall consist of air terminals of proper height and spacing (using the rolling sphere method), properly rated and properly designed and placed down-conductors to assure safety of personnel during discharges, and a properly designed and installed ground system.

The systems shall be designed in accordance with the latest globally recognized standards for such designs, which are IEC 62305-1 and IEC 62305-3, or NFPA 780.

Grounding systems shall be in compliance with IEEE Standard 142-2007, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.

Designs are to be provided by a recognized expert LPS design firm, supplier, or professional engineer licensed in the state of the project and are to be submitted to Owner. All components of the LPS shall be in compliance with the selected system design standard chosen.

4.21 Design Package

4.21.1 Engineering Design Package

Based on the review of the Project Site and infrastructure, Seller shall design (or have designed by consulting engineers) a Project (including all layout, civil, electrical, and structural components) that will meet the required performance and that is capable of being operated in a safe, normal, reliable, and continuous manner as required by the Contract at all operating conditions and modes specified above. The system design shall comply with all applicable laws and regulations and applicable permits. Studies prepared by Seller's third-party consultants shall be provided to Owner for review.

The Engineering Design Package shall include all items:

- Studies related to the Project, such as the geotechnical engineering report and the lightning protection study.
- Schematic and preliminary designs.
- Design calculations.
- All drawings including mechanical, fire protection, HVAC, electrical, structural, civil, and construction drawings Site plans, schematic single lines, index and detail drawings.
- Project schedule.
- Product and manufacturer description information.
- Bill of Materials.
- Equipment details, descriptions, and specifications.
- Instrumentation and electrical lists, including preliminary circuit schedules.
- Layout and arrangement of equipment.

The Engineering Design Package shall be provided prior to commencement of construction.

4.21.2 Maintainability

Maintenance features shall be provided to optimize maintenance work. This shall include adequate space inside Project enclosures, adequate space around and inside DC racks removable panels in electromechanical enclosures, and positioning of equipment access to allow removal of equipment, and other features that facilitate material handling. Required maintenance activities during normal operations and how it impacts system SOC and performance must be appropriately considered.

4.21.3 Operability and Safety

The Project shall be designed for primary operation via its own autonomous control. The secondary operation shall be via remote dispatch centers and the Project shall also have the capability to operate via local panels for normal startup, operation, shutdown, and emergency shutdown capability for all BESS related equipment. BESS, balance of plant equipment, power conversion, instrumentation, controls and monitoring devices shall be designed for ease of operation and maintenance. Attention shall be given to adequate lighting, access, and ventilation of operational spaces.

The BESS and supporting equipment shall be operable from remote dispatch centers under all normal conditions including automatic startup and shutdowns as a load following mode of operation.

Where redundant equipment is supplied, the idle device shall be capable of immediately backing up the operating device. The switchover shall be accomplished automatically through a system local panel, or the BESS SCADA system.

“Single point of failure contingency” shall be incorporated into the Project design such that the loss of any single process device, instrument or switch shall not interrupt BESS availability to the grid. For example, all circuit breaker position switches shall employ two sets of contacts where those contacts are used for operational interlocks.

The target Minimum Availability of the BESS is stated in Table 5 and should meet or exceed this amount during periods of expected tasking. This includes expected maintenance outages. Seller shall provide their calculation of the BESS availability and the fraction of the power and energy available during various types of service.

5.0 BESS FACILITY INFORMATION

The major equipment items shall include a battery, four-quadrant bi-directional PCS, MV step-up transformer, and local and remote control/monitoring equipment. Additional equipment shall include battery monitoring system, harmonic filters, HVAC system, fire suppression system, auxiliary cooling systems, wiring, connectors, protective devices, grounding, junction boxes, enclosures, instrumentation, foundations, temporary supplemental power supply connections, and all other items needed for a fully functional, utility interactive BESS, installed to meet the requirements set forth in this Technical Specification.

The BESS shall be designed to produce low-cost power capacity, with low-cost energy storage as a significant secondary factor. Costs include initial cost as well as overall BESS efficiency, cell life, disposal and replacement cost, maintenance costs and other contributors to life-cycle energy cost. The BESS shall also be designed to have high reliability, to have a Design Life as listed in Table 1, and to be designed for unattended operation, with remote monitoring and control by Owner’s SCADA system.

The failure of any single system component, except the main step-up transformer, should not affect the performance requirements described in Section 5.1. Seller shall provide a system with all necessary

component redundancy, diversity and margins to ensure rapid return to service in the event of any major component failure.

5.1 BESS Technical Objectives

The BESS shall be "Utility Grade." This means that all equipment shall be expected to last through the Design Life with only typical routine maintenance and planned consumable goods. The energy storage modules will change in chemistry and can be addressed with a mix of replacement and augmentation.

5.1.1 Project Objectives

The overall objective of this Project is to meet the use cases called out in section 2.0 and optimize the priority of the system operation for revenue and grid requirements as shown in Table 1 below.

TABLE 1: BESS PROPOSED BASE CASE PERFORMANCE REQUIREMENTS

Rated Continuous Discharge Power (MW)	Project Specific
Duration (hr)	4.0
Power Factor range (leading to lagging)	+/- 0.9
Output Voltage Range (pu)	0.95 pu – 1.05 p
Output Frequency Range (Hz)	60 /59.0 Hz – 60.5Hz
Rated Continuous Charge Power (MW)	Project Specific
Maximum Charge Power (MW)	Project Specific
Expected number of daily full charge / discharge cycles	0-3 daily
Maximum Inactive Period	4 weeks
Battery Modules Minimum Component Life (years)	15
PCS Minimum Design Life (years)	20
BESS Minimum Design Life (years)	20
Minimum Availability (%)	95%

5.2 BESS Availability

Seller shall design, engineer, and furnish equipment with the objective of producing a BESS system that will meet or exceed stated guaranteed energy availability performance based on equipment availability and degradation or the failure of equipment within this contract as measured at the point of interconnection.

5.2.1 BESS Definitions

For the purposes of calculating outages, the BESS is defined as all equipment within Seller's scope of supply and shall apply under all operating scenarios. The following definitions shall be used for describing the availability and reliability of the BESS:

- Accountable BESS outages are outages caused or necessitated by the BESS equipment that result in reduced capacity or loss of essential function of the BESS system. These outages may be initiated by failure of components, loss of battery capacity, the operation of protective devices, alarms or by manual action. Such outages include both Forced Outages due to equipment problems and Planned and Maintenance outages for BESS maintenance as defined by NERC.

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

- Availability is the percentage of real time, measured cumulatively from the data historian, that the BESS is available during the availability guarantee period. The availability guarantee period for the project shall be proposed by the Seller. Availability shall be calculated as follows:
    - [1-(Σ accountable BESS outage durations in hours/ guarantee period in hours)] x 100

- The capacity of the BESS is the maximum alternating current (AC) power transfer level expressed in both MW and megawatt hours (MWh) at the point of interconnection. The BESS shall be in an accountable outage if either the maximum required output (MW) or the required duration at maximum output (MWh) cannot be met.

5.2.2 Acceptance

Title and ownership shall pass to Owner upon written acceptance of the BESS system for operation. Maintenance responsibility shall remain with Seller until the system meets the criteria of the availability guarantee period set forth in Section 5.2.3 - Availability Guarantee. Final acceptance of the BESS will not be granted until all provisions of the Technical Specification have been met, the availability guarantee period has been successfully completed, all training is complete, and all required documentation has been received.

5.2.3 Availability Guarantee

The availability guarantee period for the Project, during which the performance of the Project will be observed to determine fulfillment of the above requirements, will start at Substantial Completion and it will continue for an agreed upon period for a period proposed by Seller and/or negotiated in the final BTA. For the purposes of calculating outages, the Project is defined as all equipment within Seller's scope of supply.

Seller shall install the necessary communication equipment to monitor the Project remotely and respond to alarms and outages. Outage reports will be provided by Seller and verified by Owner.

During the availability guarantee period, Owner will maintain and make available to Seller operation records of the number and duration of outages and the total energy delivered. Seller shall define the intervals at which Owner will make the operation records available to Seller. Such records will be obtained from the information gathered and stored by the Project control system supplied by Seller as described elsewhere in these Technical Specifications.

Seller shall prepare a response plan for maintenance and repair of the Project during the availability guarantee period. The response plan shall address the method of detection of required maintenance or repair as well as the method of accomplishing such actions. If subcontractors are used, the plan shall list specific subcontractors Seller proposes and the level of training provided to them.

If actual availability is below the specified level, Seller shall, at no cost to Owner, analyze the situation and provide corrections and modifications to meet the availability requirements. The availability guarantee period shall then continue until [18] consecutive months of operation at or above the

availability requirement, as defined in Section 5.1 - BESS Technical Objectives, is achieved. Seller's commitment to provide the maintenance services and repair or replacement of parts during the availability guarantee period shall not be restricted by the terms and conditions of original manufacturer's warrantees on individual components of the Project.

Seller shall test performance according to Section 8.5, Acceptance and Performance Testing. Seller has verified the required availability of the BESS, all defective and spare parts have been replaced, all training is complete and all final documentation including as-built drawings has been received.

Seller is required to provide the completed Appendix A-10 Plant Performance Guarantee/Warranties as a part of the RFP response.

5.3 BESS Performance Guarantee

Seller shall state in their proposal, the specific factors used in determining the capacity guarantee, including the number and type of events assumed in estimating module life. Seller shall also provide a description of how the performance and life of individual modules relates to the performance and life of the entire battery.

In addition, Seller shall provide a detailed description of any environmental or planned maintenance requirements on which the capacity guarantee is based. Information provided shall include the frequency of such planned maintenance actions and estimated person-hours to complete each task. Alternatively, Seller may retain planned maintenance responsibility for the battery portion of the BESS until the capacity guarantee has been met.

Seller shall also furnish a curve or table and data showing the guaranteed life expectancy to maintain rated capacity, as the number of discharges or the total energy delivered or other Seller specified parameters, varies. The table shall demonstrate that the installed capacity and energy proposed by Seller are available throughout the entire BESS life cycle. The initial installed capacity and energy, and annual performance degradation rates shall be provided.

Owner expects to perform a rated capacity discharge test once per year to determine compliance with this requirement. This test will be conducted at rated frequency and voltage at the point of interconnection within the specified normal range.

5.4 BESS Life Expectancy Warranty

The guaranteed life expectancy shall be based on the system studies performed by Seller and the outage information and operating descriptions contained in this Technical Specification. Seller shall warrant that the BESS will perform in accordance with the guaranteed life expectancy.

5.4.1 Degradation

A report detailing the annual expected BESS degradation will be required to show system capacity over the lifetime of the BESS site. This report will include:

- Battery module capacity
- Charge and discharge limits
- Battery module expected degradation based on use case

- Proposed augmentation needed to maintain POI power level (to be performed at Owner's discretion)

In addition, an annual report will describe commercial operation year performance prior as described in Section 5.6.

5.4.2 Augmentation

It is typical for augmentation to be assessed at relevant time intervals based on battery degradation to keep battery performance above Owner set minimum capacity for the lifetime of the project. For this RFP, Owner does not require Seller to include costs for augmentation in Seller's RFP response. However, it is required for Seller to provide the battery degradation parameters for Owner to assess.

5.5 BESS Power and Energy Ratings

The BESS shall be nominally rated based on project specifics at a power factor determined by the requirements of the utility, with four quadrant (full power circle) operation, AC power output and 4 hours duration or as required to meet the operating scenarios as described in this specification. The requirements for VAR support shall be as described below. This power shall be measured at the Revenue Metering Point on the high side of the step-up transformer and as well as on the low side of the step-up transformer for Owner's monitoring purposes. Losses and power consumed by all required BESS auxiliary systems, including the HVAC, shall be subtracted from the gross power measured to determine the net power delivered.

The rated capacity at the end of useful life shall apply to the normal voltage and frequency operating range as specified in Section 3.4 - Electrical Design Parameters. In addition, the BESS shall be capable of providing adequate energy to prevent load shedding under N-1 conditions on Owner's system and operating scenarios described in Section 5.6 - BESS Operation.

5.5.1 Overload Capability

Seller shall provide, a curve showing the inherent overload capability (if any) of the proposed BESS as a function of time. It is not a requirement to design specific overload capability into the BESS.

5.6 BESS Operation

The BESS shall be capable of operating in a completely automatic mode, as selected by Owner's system operations or through a local system interface and shall be capable of four quadrant (full power circle) operation to provide for peak power limiting operations, potential hybrid renewable energy plant smoothing, charge/discharge operations, VAR support, and other operating support, as described in this Technical Specification. The BESS controls shall also allow for manual (local and remote) setting of all operating states and modes.

The BESS shall be designed to provide continuous control of real and reactive power over its entire operating range. The BESS shall appear to the power system to be a continuous control device and one that does not exhibit a step change in its net output characteristic during start-up or as it varies over its operating range. However, nothing in this section shall prohibit the use of mechanically or electronically switched devices for VAR support.

Seller shall specify, for the type of battery proposed, the method used to determine the point where further discharge is no longer practical or safe and the battery must be recharged before further use. Examples of common methodology are discharge cutoff voltage or the maximum amp-hour capacity that can be reliably discharged. Throughout this Technical Specification, the term discharge limit shall be used to mean Seller specified methodology.

The BESS operating functions shall be programmed in a higher-level programming language and made available to Owner so that software modifications can be made or new functions can be added if the need arises at some point in the future. Any required supporting software such as compilers and linkers shall also be made available to Owner.

The operating functions described below will be limited and confirmed with the battery vendor by the charge and discharge limit to prevent damage to the battery. Termination of any operating scenario by the discharge limit, without reaching rated capacity discharge, will be deemed a failure for the purposes of calculating availability.

A detailed annual report shall be provided by the Seller on the anniversary of commercial date of operations including the degradation of the BESS for the commercial date prior. This report shall be used for commercial and warrantee purposes during the operational phase.

The following sections discuss common inverter control functions that shall be implemented in the BESS as part of the local and remote automatic BESS controls.

5.6.1 Real Power Controls

- Function RPS: Real Power Smoothing - This is a real power control mode function for the BESS that monitors the potential hybrid renewable energy plant real time power output for fluctuations. The BESS responds to smooth out the renewable systems fluctuations and mitigate any power quality issues due to renewable systems output variability. The BESS response shall smooth the net power output from the combined renewable systems and BESS while also preserving the BESS available stored energy.
- Function Direct Charge/Discharge Storage - This is a basic function that can be used to discharge or recharge the BESS to a specified state of charge (SOC) and at a specified rate.
- No-Grid-Charging Mode – System should accommodate programming times and conditions under which grid charging will not be active.

5.6.2 Reactive Power Controls

If reactive power is for the Facility, it will be based on the point of interconnection agreement and the BESS services agreement identified by PacifiCorp Transmission. Below are examples of what may be required under this section:

- Direct Voltage Control – In this function the BESS shall output VARs to control the POI voltage to a specified setpoint voltage and a specified droop, and with a specified maximum and minimum kVAR range which shall not be exceeded. The BESS shall be normally operated with voltage control enabled.

- Watt-Var Function – In this function the BESS shall actively control its reactive power output as a function of the real power output. The reactive power output follows a user defined Watt-Var or P-Q curve. The Watt-Var curve is a piece-wise linear user defined curve entered as X,Y point pairs where the x-axis is the power output and the y-axis is the corresponding VAR output.
- Function CV: Constant VARs – This function allows the BESS to produce a constant VAR output at a specified level.
- Fixed Power Factor Function – This function allows the BESS to produce or absorb power with a user entered constant power factor. The power factor range is +/- 0.00 to 1.00.
- Watt Power Factor Function – In this function the BESS actively controls the BESS power factor as a function of the real power output of the BESS. This function utilizes a piece-wise linear curve defined by X, Y point pairs, to determine the power factor of the BESS output at any BESS real power output.

5.6.3 Miscellaneous and Support Functions

- Scheduling Function – This function is used to perform the real and reactive control functions via a time-based schedule and/or a load-based schedule. The Schedule function can define when different X-Y curves become active and what the ramp rate will be when transitioning between scheduled functions. When more than one function is active for Real Power or Reactive Power control then the schedule shall define a priority order for the functions.
- Event Logging and Reporting Function – this function shall be used to record any protection events triggered by the inverters including but not limited to i.e. over current, over voltage, over temperature, sequence of event reporting (SER), etc.
- Status Monitoring Function – this function shall include voltages, SOC, Inverter Status, Usable Energy, BESS rack and module temperature, Present Operating Mode, Inverter Active and Reactive Power output, power factor, present line frequency, Connect/Disconnect Status, Operating Time, Connected Time, and possibly other BESS information.
- Function Connect/Disconnect – This function shall be implemented by two sets of commands, one being a virtual command and the other being a physical command. The virtual Disconnect command sets the real and reactive output of the BESS to zero. A physical Disconnect provides galvanic isolation between the inverter and the grid. Additional details regarding Shutdown, Disconnect, and Operate modes are provided in the Sections 5.6.7, 5.6.8, and 5.6.9 below.
- LHVRT Function – This function shall be used to specify the low and high voltage ride through characteristics of the BESS. This function will be used to specify the trip, suspend and normal operation ride through voltage characteristics as per IEEE P1547, protection coordination studies, and Owner policies.
- LHFRT Function – This function shall be used to specify the low and high frequency ride through characteristics of the BESS. This function will be used to specify the trip, suspend and normal operation ride through frequency characteristics as per IEEE P1547, protection coordination studies, and Owner policies.
- Local/Remote Mode Function – This function when in Local Mode shall block commands by offsite sources to enable safe local maintenance and diagnostics and provide a means for secure on-site management. This function shall also allow the return to remote control.
- Automatic/Manual Mode – This function shall enable and disable the BESS from performing any of the automated control functions for real and reactive power. When switching from automatic to

manual mode the BESS real and reactive outputs shall ramp down to zero at a specified ramp rate.

5.6.4 VAR Support

The BESS may be required to provide VAR support for voltage regulation under steady state and contingency operating conditions as described below. The BESS shall be capable of up to full rated output, when operating within the normal sustained voltage and frequency ranges specified in Section 3.3, Electrical Design Parameters, or as determined by Seller's system studies. The voltage regulator controls shall not be affected by changes in system frequency. The voltage regulator controls shall include Owner selectable setpoint and droop characteristic and shall be capable of setting by Owner's SCADA system or by a local control interface.

Nothing in this section shall be construed as limiting the ability of the BESS to operate in other modes as described in these Technical Specifications. The VAR output of the BESS may be limited based on remaining inverter capacity used for real power output unless supplemented as described above. The final VAR requirements will be provided to the successful Seller at a later date.

5.6.5 Charging

Seller shall specify charging requirements.

Seller shall design the charging system to ramp up from zero to the maximum demand at an Owner selectable ramp rate as described elsewhere in these Technical Specifications to avoid shocking the system and allow generation to follow load easily. Seller shall provide a curve showing how demand from Owner's system varies with time throughout the charging cycle. The BESS control system shall allow Owner's dispatcher to initiate remotely Seller-specified/programmed charge cycle. The maximum demand required by the charging cycle shall be Owner selectable but shall not exceed Seller specified charge rate. Seller shall provide data showing how the recharge period varies as maximum demand decreases.

Seller shall also specify restrictions, if any, on operation of the BESS during any portion of the charge cycle. Seller shall provide a curve or table and data showing the state of charge of the battery as a function of time.

Automatic or programmed charge cycles shall be implemented to prevent SOC going below the battery vendor specified SOC limits whenever possible.

5.6.5.1 Charge Rate

There will be times when the BESS may be directed use overload charging capability (if any) exceeding the normal maximum charging rate for a short duration. Seller shall provide, a curve showing the inherent overload capability (if any) of the proposed BESS as a function of time. It is not a requirement to design specific overload capability into the BESS. Overload charging will not be allowed if the batteries are charged above the Seller specified maximum charge level. When the BESS is nearing the Seller specified maximum charge level, the BESS charging shall ramp down linearly to zero at an Owner selectable ramp rate.

Seller shall provide adequate energy storage capacity and level of charge to accommodate the number of charge/discharge occurrences and total energy requirements described elsewhere in this Technical Specification.

5.6.6 Shutdown

The shutdown state shall be defined as battery DC contactor/breakers and PCS AC breaker open; non-critical power supplies de-energized; control system power may remain energized. This mode includes both normal shutdown and system trips requiring reset.

The control system shall initiate shutdown under the following conditions and remain in the shutdown state until a reset signal, either local or remote, is initiated:

- Emergency trip operation.
- AC circuit breaker trips (either main or PCS breaker) that isolate the BESS.
- Door interlock - initiate shutdown when the door to the PCS is opened. A “defeat” feature shall allow for maintenance. Interlocks shall be self-resetting.
- Smoke/fire alarm.
- Fire Suppression operation.
- Control logic trouble.
- DC ground fault - field adjustable setting.
- Failure to restart from disconnect state after automatic restart attempts.
- Remote disable (no reset required).

5.6.7 Disconnect

The disconnect state shall be defined as balance of plant (BOP) DC contactors/breakers and battery DC contactors/breakers and PCS AC breaker open; non-critical power and control system power energized.

Some faults or failures are expected to be transient in nature. The control system shall open contactors upon fault occurrence and may be manually started-up after an operational Seller determined manual reset or operational procedures agreed upon with the Owner. The control system shall go to the disconnect state under the following conditions:

- Synchronization Error - The PCS is unable to synchronize with the utility grid.
- Grid transient conditions (i.e., line switching or reclosure action).
- Utility voltage out of emergency operating range as defined in this Technical Specification.
- Utility line frequency out of emergency operating range as defined in this Technical Specification (field adjustable in 0.1 Hertz increments).
- Over-temperature on the battery, PCS, controls or other equipment.
- Excess explosive gas level.
- Owner and grid operator requested outages.

5.6.8 Start Operate

The Operate state shall be defined as all contactors/breakers closed and power available to flow to or from the BESS, PCS and transformer system to the utility system. Normal operation shall include all operating scenarios as described herein and discharge and charge modes. It also may include additional modes and sequences deemed necessary by Seller.

The BESS shall operate normally and automatically, with no faults detected or critical alarms as defined in Section 7.0.

5.6.9 Specific Operational Requirements

The BESS must not be damaged if there is no power available from Owner for a period of up to 168 hours with the BESS discharged to its lower operational limit. If the system proposed by Seller cannot meet this requirement, or if there are advantages to Owner to specify a shorter duration, Seller shall specify the maximum period that can be sustained without damage. The design shall include provisions for connecting a mobile generator to charge the batteries if the 168-hour requirement cannot be met.

Seller will indicate any required rest (neither charging nor discharging of the BESS) periods, their duration and what event they must follow or precede.

The BESS shall have appropriate functionality to accept an emergency disconnect input. Once the emergency disconnect is activated, the BESS project must immediately cease operation.

During manual operation of the BESS project, the system must indicate which, if any, autonomous functions are disabled.

Owner may impose rest intervals, such as charging off-peak and discharging on-peak. If no other tasking is done, this will create a rest period between each half cycle. This shall not adversely affect BESS performance and shall be included in capacity calculations. Provide the maximum rest period allowed (days, weeks, months).

If another condition requires special action for a string or the battery bank, describe this condition, how often it occurs, what event triggers the need for it, what it takes to correct it, whether the string/BESS remains available during this period to be approved by the Owner on a case-by-case basis. Examples are some type of reconditioning (holding at 100 percent DOD) or charge equalization (holding at 100 percent SOC).

The cells within a battery shall either be self-balancing, or their periodic balancing be handled automatically by battery module management electronics. Similarly, the modules within a string shall either be self-balancing or periodic balancing handled automatically by string/bank management electronics.

The BESS SCADA system shall store historic performance data metrics which describe the quality of system performance for each function over the last 168 hours minimum. Seller to ensure interface with Owner to offload reports at an agreed interval. Historical performance data metrics shall be stored for long term (2 years at minimum) for performance analysis and warranties.

The design must include prudent provisions for technology improvement. Battery modules shall allow for upgrade or replacement with higher performance cells to the extent practical. Where such changes are made to a battery module, all modules in that battery string must also be upgraded before the upgraded modules are placed into service.

5.6.10 Large Generation Interconnection Agreement Requirements

This section is intended to supplement but not replace any interconnection requirements determined by the Transmission Provider through the large generation interconnection process.

The main bus of the Project switchgear is to be connected to the POI. Protective relaying will need to comply with previously determined design from the Cluster Study.

The BESS project shall at all times monitor voltage at POI. If POI voltage deviates from the trigger voltage, the BESS project shall respond instantaneously with appropriate reactive power to ensure POI voltage is within the limits.

The BESS monitoring system shall always monitor system SOC and provide a mechanism to regulate SOC to ensure recovery of SOC after discharge events.

Communications to Owner shall be tied to the communications system extended to the Site by Owner, via communication cable installed in accordance with Owner's standards. Seller shall be responsible for engineering associated with communication system tie-in in consultation with Owner.

The BESS control system shall be configured to adhere to the communication systems requirements outlined by Owner and as further outlined in the Integrated Automation Equipment in section 6.1 of this document.

5.7 BESS Electrical Systems

Seller's scope of supply will end at the POI as defined in the Interconnection Agreement and as defined in the Points List. The electrical auxiliary power system shall be sized so that in no case it limits unit output power relative to the specified nominal capacities detailed in Table 1. Any revisions to the existing electrical power system installation (e.g., protective relaying) shall be designed for Owner coordination, safe operation and maintenance.

Load flow, dynamic stability, harmonic interaction, short circuit, voltage droop, coordination, grounding system safety and other studies shall be performed to properly determine equipment capacity, performance, withstand requirements, transformer impedances, etc. Seller shall submit design criteria, harmonic profile, short circuit characteristics, and calculations associated with these studies to Owner for review. Owner will provide data on existing Owner equipment and electric grid as necessary and will be available to facilitate Seller's performance of these studies.

Electrical systems shall not inhibit the BESS from complying with Frequency Ride Through (FRT)/ Voltage Ride Through (VRT) requirements per Owner's requirements listed in the Technical Specification.

Areas of the BESS enclosures subject to explosive concentrations of gases due to faulty systems, failure of ventilation, etc., shall be classified as hazardous locations in accordance with the latest NFPA criteria. Accordingly, electrical equipment in those areas shall be provided with the appropriate enclosures for the installed locations.

Electrical system design shall be performed under the supervision of a professional engineer. Specifications and drawings shall be sealed if required for submittal to regulatory agencies.

Electrical systems shall be equipped with protective relaying to trip circuit breakers for de-energizing and isolation of equipment in the event of electrical faults. Seller supplied relaying protection will include primary and back-up relaying and overlapping zones of protection. Seller protection relaying is to be coordinated with Owner's existing relaying. Areas of Seller supplied relaying will include, but not be limited to, MPTs, MV system, and DC/UPS systems. Protection relaying shall comply with Owner's requirements.

5.7.1 BESS AC System

The BESS AC system shall be connected to the main step-up transformer and connected to Seller switchgear as required.

The high side of the main step-up transformer bus connection shall be considered the BESS point of connection insofar as determining rated power, efficiency, VAR supply/consumption, harmonics and similar electrical parameters

Seller shall design the BESS for the maximum overall (charge/discharge) efficiency, including parasitic loads.

The BESS shall be designed for "0" MVAR exchange at the point of the BESS interconnection when operating in standby mode.

The BESS low side main circuit breaker must be open, or inverters blocked before closing the MV breaker(s) or switch(es). The BESS low side main circuit breaker or PCS shall be used for synchronization of the BESS to the MV collection system.

Seller shall design and install underground conduit, power cable and wiring from the BESS equipment to the main step-up transformer, MV switchgear, and instrument transformers.

Seller's protection system shall be capable of interrupting maximum fault currents (as determined by equipment and system studies) in any portion of Seller's scope of supply.

Seller shall, in close coordination with Owner, design, engineer, furnish and install all appropriate hardware (relay protection, SCADA, BESS controls, metering, etc.) and software.

5.8 BESS Enclosure

If a building is proposed, Seller shall design, engineer, and provide the building suitable for use to house the BESS and all indoor components. Seller shall provide on-site inspection, coordination with required building inspectors, and design review of the building required to accommodate the BESS commensurate with the BESS Design Life, including but not limited to seismic events, wind loads or other controlling criteria.

The BESS building or enclosure, including PCS and Control Room shall be designed with the appropriate insulation to meet local building codes and ensure an energy efficient operation of the HVAC and/or ventilation system.

Limited geotechnical data is available for the Project location and included as a part of the specification. This data is provided for information only and may be used for bidding purposes. Seller shall provide all assumptions used as the basis for their bid.

The building or enclosure design shall consider materials on the basis of being maintenance free with a maximum durability and minimum cost for replacement and repair. Structural systems shall be engineered for ductile modes of failure to the extent possible.

5.8.1 Building Design

See Section 4.11.2 for Environmental loads that shall apply to the building.

- Structural Framing: Design primary and secondary structural members and exterior covering materials for applicable loads in accordance with the Metal Building Manufacturers Association's (MBMA) "Design Practice Manual"

- Structural Steel: For design of structural steel members, comply with the requirements of the American Institute of Steel Construction's (AISC) "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" for design requirements and allowable stresses.

- Light Gauge Steel: For design of light gauge steel members, comply with requirements of the American Iron and Steel Institute's (AISC) "Specifications for the Design of Cold Formed Steel Structural Members" and "Design of Light Gauge Steel Diaphragms" for design requirements and allowable stresses.

- Welded Connections: Comply with requirements of the American Welding Society's (AWS) "Standard Code for Arc and Gas Welding in Building Construction" for Welding procedures.

Basic Design Loads: Include live load, wind load and seismic load, in addition to the dead load. All loads shall be based on the site-specific conditions and latest IBC, state and local codes.

- Live Load with Snow Load shall be based be in accordance with IBC and the state local code.

- Wind Load: Wind load shall be based be in accordance with IBC and the state local code.

- Seismic Load: Seismic load applied shall be in accordance with IBC and the state local code,

- Auxiliary Loads: Include dynamic live loads such as those generated by suspended ceilings, sprinkler systems, electrical or mechanical systems or any suspended HVAC units, and exterior frames and doors.

Design: Each member shall be designed to withstand stresses resulting from the combination of loads that produce the maximum allowable stresses in that member as prescribed in MBMA's "Design Practices Manual".

5.8.2 Shipping Container or Metal Enclosure

If containers are proposed, it shall be in accordance with the International Standard ISO 1496-1 or similar standards.

5.9 Other BESS Facility Design Requirements

5.9.1 Hydrogen Mitigation

If applicable for the battery chemistry proposed, Seller shall calculate the maximum hydrogen emission rates for the battery and design a fully redundant forced-air ventilation/fan system accordingly to satisfy all codes and standards. These calculations shall be included in the proposal and shall include the safety margins used.

Seller shall provide and install hydrogen detectors and configure their control logic such that the hydrogen detection system alarms at one percent hydrogen concentration. Additional alarms and logic shall be provided to stop battery charging if the hydrogen concentration exceeds a safe level.

Any enclosures into which hydrogen may propagate during normal or abnormal operations shall be protected against accumulation of a flammable or explosive mixture of hydrogen and air, and against ignition by an external spark of any such mixture that may nevertheless occur.

If flooded electrolyte cells are used, Seller shall install flash arresters on the cells.

5.9.2 Emission Mitigation

As relevant to the type of cell proposed, Seller shall design the BESS and produce calculations which demonstrate that the cells, method of charging, HVAC and overall system design are such as to comply with the OSHA requirements for any and all emissions that may be present under all conditions, for example: thermal runaway.

5.9.3 Electrolyte Spill Containment

The BESS design shall mitigate 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 local sewers or the surrounding site soils. The design shall address containment of water from the fire protection system, as applicable. Seller shall provide a Spill Prevention Control and Countermeasures plan and provide secondary containment where required.

The O&M manual shall address procedures to cleanup electrolyte spills, as applicable.

5.9.4 Painting / Logos

Seller shall paint the entire exterior of the building or enclosure with a finish coat in a color approved by Owner. The paint shall be suitable for application to the exterior material of the building or enclosure and the environmental conditions applicable to the site.Owner may supply image(s) of company logo for display on buildings or enclosures, after painting. Upon completion of painting, remove surplus material, rubbish, and debris resulting from this Work and leave the building and enclosures and Site in a neat, clean and acceptable condition.

All builders' hardware shall be suitable for the required functions. Hardware shall be of a durable grade consistent with the life expectancy of the facility and appropriate Federal specifications. Exit and fire door hardware shall conform to UL specifications. Installation of exits shall conform to NFPA No. 80.

6.0 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

The BESS SCADA system will supervise and monitor BESS operations. The BESS SCADA System shall be compatible with the Owner's historian database and applicable protocols. The BESS SCADA system shall incorporate an RTU to send data to the Owner's historian.

SCADA pricing should include hardware and software (including all software subscriptions for first year of the project) for the Design Life of the Project. The monitoring system shall provide energy generation data, historical data, meteorological data, and all other applicable data to record operational history. The system shall be configured to sample data at a rate of once per second, with 1-to-10-minute average intervals and shall be configured to update the server at least once every 15 minutes. The system shall be configured to sample and store the 1-to-10-minute averaged interval data for a period of 24 months based on Owner preferences.

The monitoring system shall be capable of issuing alarms and notices to instantly alert the proper personnel in a timely manner, both locally and via Owner SCADA system, to potential system problems and outages. The monitoring system shall specify a module-level monitoring system capable of detecting that an abnormal module condition exists or may exist. Abnormal module conditions shall include all types of module failures that are commonly known to occur for the type of module used. At a minimum, the module monitoring system shall identify three alarm states as follows:

- The monitoring/alarm system or procedures shall alert Owner when the number of failed or inadequately performing modules or other Seller determined conditions indicates that preventative maintenance should be performed to keep the BESS at the specified performance levels. Maintenance required to correct problems identified may be performed at the earliest convenience.

- The monitoring/alarm system or procedures shall alert Owner when the number of failed or inadequately performing modules or other Seller determined conditions indicate that the BESS is in imminent danger of failing to meet specified performance levels or potential safety hazards exist. Maintenance should be scheduled as soon as possible.

- The monitoring/alarm system or procedures shall alert Owner when the BESS can no longer meet the specified performance criteria or safety hazards exist. Immediate corrective action is required to return the BESS to specified performance levels or correct safety hazards.

Seller shall include, in the Operation and Maintenance Manual, the recommended corrective action and maintenance procedures for each alarm level or observed condition provided. In all cases, the monitoring/alarm system or procedures will record data on the number and general location of failed cells, to expedite maintenance and module replacement. This recorded data shall be stored in non-volatile memory. Seller shall design the system so that the data can be retrieved remotely from Owners Transmission Provider Grid Operations either through the SCADA system or through other suitable means. Such monitoring/alarm system shall be part of the control system and alarmed to Owner's SCADA system. Additionally, the design of the system shall include an alarm journal of recorded alarms during a time period specified by owner/operator to pull historical alarms, filter by level, and sequence of events/alarms

The metering and monitoring system shall comply with the accuracy requirements and general standards set forth in IEC 61724 which shall have an accuracy of better than two percent of the reading.

All electronics shall be enclosed in a NEMA 4 enclosure or in a control room within the building. This system may be housed in the same enclosure as the security equipment. The data shall be collected at hardwired locations and transmitted. Seller shall test the installed communications system to demonstrate its ability to meet the requirements of its intended use. Testing shall be done when the final system interconnections have been made.

Seller shall furnish and install all materials and equipment necessary to complete the SCADA installation. The monitoring system shall be configured for automatic reporting of generation statistics required by Owner. The data shall be collected at the hardware locations and transmitted via a SCADA system to be provided and installed by Seller. Points to be monitored by the SCADA system shall include, at a minimum:

- Inverters
  - AC voltage
  - DC voltage
  - AC current
  - DC current
  - KiloWatts (kW)
  - Kilovars (kVAR)
  - KiloWatt hours (kWh)
- Metering
  - Monitor and store date from the Project meter on an interval between 5 and 20 seconds
- Transformers
- Video security and surveillance monitoring buildings or shelters
- Project switchgear

All monitored project electrical generation equipment (e.g., inverters, transformers, switchgear) shall be monitored to capture real time AC and DC electrical characteristics, including:

- Voltage
- Current
- Power
- Frequency
- Power factor

All monitored project electrical generation equipment (e.g., inverters, transformers, switchgear) shall be monitored to capture all diagnostic information, including:

- Temperatures
- Alarms

- Status indicators
- Fault states
- Communication Status

6.1 Integrated Automation Equipment

A proven and established instrumentation and control system shall be provided for the BESS. The Owner's control systems will supervise and monitor the BESS SCADA system while the BESS SCADA and Controller will act as the master.

6.1.1 Network Devices

6.1.1.1 Network Servers

Seller shall supply and install an Owner-approved and commercially-proven hardware and software package from vendors to implement the BESS SCADA System. The BESS SCADA System shall include one or more servers providing data gathering, operator interface, alarming, historian and other functions necessary to fully monitor and automate the BESS. The BESS SCADA System shall include hardware and software maintenance, including all software updates and subscriptions, for a minimum of 20 years. The BESS SCADA System shall be configured to sample data at a rate of once per second, with 1-to-10-minute average intervals and shall be configured to update the server at least once every 15 minutes. The BESS SCADA System shall be configured to sample and store the 1-to-10-minute averaged interval data for a minimum of 24 months. No EOL hardware to be used at time of installation.

The BESS SCADA System shall include a networked GPS synchronized clock capable of providing time synchronization signal to other devices in the BESS SCADA System using IRIG-B via coaxial cable.

All hardware and software shall support and implement standard, open protocols and datasets as specified in the MESA-ESS and MESA-DEVICE standards. No proprietary protocols shall be utilized. The BESS SCADA System shall retrieve data from all capable devices within the BESS and interconnect substation. The BESS SCADA System shall be capable of interfacing with Owner's external historian database protocol systems with full MESA-ESS Level 3 compliance.

All servers and functionality shall be implemented with redundant hardware and software in a hot standby architecture. Virtualized systems may be utilized to provide redundancy.

All hardware shall support redundant hot-swappable power supplies, hot-swappable solid-state drives, and RAID. All software shall be installed on a commercially available operating system with regularly provided security and reliability updates.

6.1.1.2 Routers, Switches, and Modems

Seller shall supply network hardware as necessary to connect all servers, relays, meters, and other equipment capable of communicating with the BESS SCADA System and Owner's corporate SCADA via external networks. All hardware shall be implemented using ruggedized industrial models unless housed in climate-controlled cabinets.

Seller shall supply one or more network switches as necessary to the BESS SCADA System network. Switches shall meet or exceed IEEE 1613 (Class 2). Switches shall support modern security functionality,

including VLAN, SNMPv3, RSTP, MAC-based port security, traffic prioritization, port mirroring, PTP time synchronization and pass through, user-based accounts, and dual power supplies.

Seller shall supply one or more network routers as necessary to connect the BESS SCADA System network to Owner's existing SCADA system via external networks. Router shall meet or exceed IEEE 1613 (Class 2). Router shall support stateful firewall with NAT, IPSec Virtual Private Networking, AES256, RADIUS centralized password management, multi-level passwords, SSH/SSL encryption, MAC-based port security, VLAN and SNMPv3, external user access logging for auditing purposes.

Seller shall supply modems as necessary to support the requirements of Owner and/or telecom utility to connect Owner's external network. Seller shall work with Owner to determine the number of internet connections needed and minimum bandwidth requirements. Seller shall work with Owner to determine a list of acceptable internet providers.

6.1.1.3 Operator Workstations

Seller shall supply two operator workstations. Each workstation shall consist of one monitor, keyboard, mouse, and PC for display of the operator interface. All components of the workstation shall be utility grade off the shelf components and capable of operating in the BESS environment. Each workstation shall include all software necessary to access the BESS SCADA System and all functionality of the installed equipment with licensing for a minimum of five years.

Remote operation workstation shall be included for the remote operations of the BESS site. This can be achieved via remote access VPN tunneling or SSL.

6.1.2 Control and Monitoring Network

6.1.2.1 Supervisory Control

Seller shall supply BESS controllers compliant with the communication methods, protocols and datasets provided in the MESA-ESS and MESA-Device standards. Any operational function of the BESS shall be capable of being controlled through the BESS SCADA System HMI via either local or remote operator workstations. Function parameters of any operating function shall be capable of being modified remotely or locally.

The control system shall be configurable and capable of hardware, firmware or software upgrades to provide additional operating functions in the future, if needed. Seller shall provide 10 percent additional or spare hardware capacity to add to or reconfigure the modes of operation via software applications, replacement firmware, expansion of the operating system memory or additional input/output and/or logic.

The control system shall have the necessary hardware and software such that it is compliant with the latest Owner standards and NERC CIP reliability standards for control system security requirements.

6.1.2.2 Integration Panels

Seller shall supply one or more integration panels within the BESS to install the PLCs, RTUs and other devices necessary to provide the required functionality of the BESS SCADA System. Each integration panel shall match the design of other panels as specified in this document, including power source, fuses, terminal blocks and other equipment necessary to the function of the BESS SCADA System. In the event

that there is loss of Auxiliary power, UPS shall be included in the design and installation inside the panels containing essential control and network hardware.

The integration panels shall provide operators with the ability to cut out active alarms via panel mounted test switches. The integration panel shall allow operators to connect to the facility network via standard Ethernet port for control or diagnostic purposes.

6.1.2.3 Interoperability

The BESS System shall communicate with Owner's corporate SCADA system via the communication methods, protocols and datasets provided in the MESA-ESS standard. Parameters to be communicated to Owner will include, but not be limited to: SOC, actual and contractual Up Reserve and Down Reserve capability when the BESS is responding under its frequency response, status of frequency response, power output in MW, energy output in MWh, available energy capacity in MWH, circuit breaker status, physical availability in percentage, voltage at Revenue Metering Point, and other telemetered information that Owner may require for system operations.

In the event of loss of communication between Owner and the BESS SCADA System, a provision must be made for the BESS systems to institute Owner's desired behavior in such circumstance, including but not limited to maintaining the previously communicated operating behavior, accepting a curtailment command from a local terminal, or a safe and linear shutdown.

6.1.3 Local Control

The BESS local controls and indication requirements shall be designed in close coordination and with an approval from Owner. The BESS shall include a local control panel or console within the BESS control room. The local control panel may consist of manual control switches, with redundant control actions initiated by digital signals through a local control console. Emergency trip push buttons shall be manually operated and not require action from the digital control, as described elsewhere in these Technical Specifications. As a minimum, the following operator controls shall be located on the local control panel:

- Trip/reset for the MV circuit breakers connected to the main step-up transformer.
- Trip/reset for the PCS circuit breaker.
- Trip/reset for the DC circuit breaker/contactor.
- PCS on/off.
- BMS on/off
- Reset toggle or push-button. When reset is initiated, the control system shall resume control and proceed to the appropriate operating mode.
- Reset cut-out selector switch to disable remote or local reset signals.
- A selector switch to manually set the operating state (i.e., shutdown, disconnect and operate) and to have the control systems set the operating state automatically.
- A selector switch to manually set the operating mode (i.e., VAR control, discharge and charge) and to have the control system set the operating mode automatically.
- An emergency trip pushbutton shall be located near the control panel and be suitably protected to prevent accidental operation.

6.1.3.1 Remote Control

All functionality available through the Local Control Units shall be available via the BESS SCADA System for remote operation via Owner's SCADA connection and remote operations center.

6.1.3.2 Application-Specific Control Panels

Where appropriate, additional control panels shall be provided to control specific functionality and applications of BESS equipment. All functionality available at these panels shall be available remotely via the BESS SCADA System.

6.1.4 Integrated Automation Controls

The BESS SCADA System shall consist of established manufacturers' components such as balance of plant instruments, equipment and integral controls, process input/output equipment and companion PID "loop" controllers, equipment specific controllers, communication processors and various other necessary devices. The integrated BESS SCADA System electronic components taken together shall form the interconnecting means and functions required to; control, monitor, alarm protect, interlock, diagnose, maintain, and safely operate BESS facilities installed under an assigned project scope of work.

The installed BESS SCADA System equipment shall perform the requirements of supervisory and discrete control, equipment protection and process interlocking, component diagnostic, upset analysis, maintenance guidance, and alarm/data logging or archiving functions. Seller selected BESS SCADA System hardware and software provided shall meet all desired modes and conditions of operation, assuring a safe, environmentally compliant, and economic operation of distributed energy storage capabilities described in the scope of work.

BESS related systems startup, manual operation, shutdown, response to upsets, and other operating conditions shall be performed by: 1) intervention by an operator in any specific BESS local control point: or 2) remotely from a central or dispatch center via HMI operator positions with necessary software for that BESS facility. Once desired and stable functional BESS mode has been achieved, autonomous and selected supervisory modes shall automatically maintain, within tolerance, that selected mode until override, or manual intervention by the central or dispatch operators is enabled.

Supervisory, monitoring and mode management required BESS functions shall be gained by means of both local and/or remote operator HMI interface workstations. Functions and logic of control, protection, and interlock of BESS components and support systems shall be distributed to independent-microprocessor based controllers or unit programmable controllers as feasible to minimize a single point of failure.

Likewise, interface and networking equipment between the BESS SCADA System and the separate process control and instrumentation packages of individual equipment shall be redundant for both communication functions and control power source. The intent of the Project is that the BESS SCADA System as a Supervisory and Control System HMI be designed and implemented for intuitive and understandable human interactions, high reliability, including critical system redundant BESS and PV control and sensing elements for specific BESS systems, to enable the desired degree of safe and automated operation.

HMI interaction and autonomous control of some independent auxiliary BESS systems may be as self-contained as practical. These independent systems may be controlled through integrated distributed controllers with local control panels incorporating a self-contained HMI. Alerts, alarms and process data along with auxiliary system diagnostic information shall be sent to the BESS System. Independent auxiliary BESS system controls shall be developed upon a common architecture, with data communications protocol compatible with the BESS SCADA System. Simplicity of operator interaction and ease of maintenance should be the design criteria.

The fundamental BESS SCADA System control logic and related functions shall be segregated to the extent that failure of one or more modes of operation does not result in the failure of other functions. The BESS SCADA System controller shall be designed with regard for redundancy in critical "control loop" functions so that no single component fault will cause the failure of process-controlled equipment in any one system or cause the BESS diagnostics and protection systems to malfunction.

BESS SCADA System indication, control and alarm element redundancy shall be provided for all events or upsets in critical "control loop" functions that may directly cause a self-protection system to activate. Redundancy in the BESS SCADA System controller architecture shall be configured such that selected standby process equipment shall alarm and start automatically upon failure of the primary system. Specific standby components shall have self-initiated automatic start capability field wired to function in parallel with fundamental BESS SCADA System control logic.

6.1.4.1 Control of Fire-Suppression Systems

Fire panel shall communicate with Owner's SCADA via a standard protocol as listed in this Technical Specification. The minimum remote monitoring requirements shall be as follows:

- System State
- Fire/Smoke Detector Status
- Fire System Trouble
- Countdown to discharge
- Discharge Completed
- Manual Release Request
- Abort
- Alarms/Warnings

6.1.4.2 Control of HVAC Systems

HVAC system shall communicate with Owner's SCADA via a standard protocol as listed in specifications. The minimum remote monitoring requirements shall be as follows:

- System State
- Area Temperatures
- Manual Control
- Alarms/Warnings

6.1.4.3 Control of Electrical Systems

BESS auxiliary electrical power shall communicate with Owner's SCADA via a standard protocol as listed elsewhere in this Technical Specification. The minimum remote monitoring requirements shall be as follows:

- Availability of normal and backup power sources.

6.2 Instrumentation

All metering, sensors, transducers and test points in the BESS shall be easily and safely accessible for calibration, maintenance and troubleshooting by Owner. Seller shall provide and install current and voltage test switches for each protective relay and for each set of metering within a CT circuit.

Seller shall provide a complete metering system for the BESS, including any required current and voltage transformers, to measure all required parameters at the Revenue Metering Point. The metering system shall be utility grade, revenue class accuracy in all components. The metering system shall be capable of measuring all required quantities, including but not limited to, BESS MVA in/out, BESS MW in/out, MWh in/out, MVAR in/out, MVARh in/out, voltage, frequency and harmonic content. Bi-directional quantities shall be measured and recorded independently. Metering of net quantities is not acceptable.

Seller shall furnish and install a complete metering system, including any required current and voltage transformers, for the AC station service. The metering system shall be utility grade, revenue class accuracy in all components. The metering system shall measure all BESS AC auxiliary station service loads, whether served from the primary or back-up AC station service system.

As a minimum, the BESS shall include instrumentation to measure and report locally and to Owner's SCADA, as applicable to the system proposed, the following:

- Battery voltage and current at sufficient points to monitor the condition of the battery.
- Cell temperature at sufficient points to represent the battery temperature.
- Charging system trouble alarms.
- Battery ground faults, including fault location.
- Temperatures in PCS, battery rooms or other critical cabinetry.
- Hydrogen detectors.
- Smoke detection.
- Fire suppression equipment.
- Battery leakage current-to-ground.
- Other sensors and equipment, as needed to provide for monitoring and alarms as determined by Seller.

As a minimum, the following meters shall be installed on the BESS local control panel and/or be displayed on the local control console. Meters shall be digital displays and shall be no less than 1.0-inch high. These metering signals shall also be supplied to Owner's SCADA system.

- Battery voltage overall and in each string
- Battery current overall and in each string
- PCS DC power overall and from each PCS
- PCS AC power (real, MW) overall and from each PCS
- BESS net AC power (real, MW)
- BESS net AC power (apparent, MVA)
- BESS net AC power (reactive, megaVARs)
- PCS Transformer High Side Voltage (each phase)
- BESS net AC Amperes (each phase)

As a minimum, the following indicator lights or similar displays shall be installed on the local control panel or console.

- PCS breakers status
- Status of all contactors and motor-operated disconnect switches (if applicable)

At a minimum, the following alarm functions shall have indicator lights or similar displays on the local control panel or console, as applicable:

- PCS breaker trouble alarms (to be determined)
- Grid voltage present
- Battery, PCS or other equipment over temperature
- Battery ground fault (DC ground current exceeds trip level)
- Smoke/Fire detection
- Fire Suppression Activation
- Excess hydrogen level detected
- Synchronization Error Shutdown
- Control logic trouble
- Blown fuse
- Building door(s) and/or gate open
- Battery under voltage
- Module under voltage
- String under voltage

At a minimum, alarms from the battery monitoring/alarm system, if automatic, shall be displayed locally at the control panel or console and Owner's SCADA system.

The BESS control and instrumentation systems shall include provisions for determining and storing in non-volatile memory, the sequence of abnormal events, trips and/or alarms that cause the BESS to go to a

disconnect or shut down state. In addition, the BESS shall include a dynamic system monitor or fault recorder to record the BESS output and waveform, and other Seller and specified parameters, for all events where the BESS is required to operate as described elsewhere in these Technical Specifications. Waveform recording shall be triggered automatically by Seller and Owner specified means and shall record a sufficient amount of pre-event data to analyze the event.

The BESS shall transmit all the above meter quantities and alarm/status indicators to Owner's SCADA system as described elsewhere in these Technical Specifications. Seller shall provide all transducers, interposing relays, or other equipment required to interface to Owner's SCADA system. Seller shall engineer and install wiring from the BESS equipment to the interface enclosure located in the control room. Such wiring shall be placed in conduits or wireway and shall be designed for ease of installation of future wiring by Owner.

6.3 BESS + Wind or Solar Controls

The control panel or console shall also include meters, indicators and display, as described in Section 7.2 - Instrumentation.

The control system shall include the capability to adjust all the ±VAR supply criteria and discharge power levels for automatic operation. Seller shall include the capability to adjust voltage/current/time profiles for battery charging and battery end-of-discharge voltage, and/or program temperature corrections/adjustments to such parameters.

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

As applicable to the design/layout of the BESS and Wind/PV plant (Wind or PV plant), there shall be one or more Emergency Trip push-button(s) strategically located within the battery compartment(s). The push-button(s) shall be suitably protected to prevent accidental operation. Operation of the push-button(s) shall turn off the PCS and open the DC contactor. There shall be a similar push-button(s) in the immediate proximity of the PCS that, when operated, shall turn off the PCS and open the PCS DC contactor and AC breaker.

If deemed convenient for maintenance, Seller may duplicate relevant control panel or console functions on the PCS.

Only balanced three-phase control of the BESS and Wind/PV systems is intended under this Technical Specification. It is not the intent to utilize the BESS and Wind/PV systems to correct for system unbalances. However, the BESS and Wind/PV systems shall be designed to operate in the presence of all unbalances that may exist on Owner's POI.

The BESS and PV control system shall be designed to provide for automatic, unattended operation of the BESS and PV systems. However, the control system design also shall provide for local manual operation and remote operation or dispatch of the BESS and Wind/PV systems from Owner's SCADA system.

All local and remote control and monitoring system components shall be housed in the separate control room in the BESS building or enclosure. The control room shall be insulated to meet local, State and national building codes and shall be furnished with redundant HVAC units.

The control system shall be designed such that the failure of any single component of the control system will allow the BESS and Wind/PV system to continue to operate at full capacity.

The control system shall be of digital design, shall be fully redundant using a hot standby design. The design shall be such as to prevent externally supplied, control panel or local signals from causing the BESS and Wind/PV systems to operate in an unsafe manner or in a manner that may damage the BESS, Wind/PV system, its equipment, or the connected utility system equipment. The BESS and PV systems shall include provisions for an orderly and safe shutdown, even in the absence of utility power.

One purpose of the BESS and Wind/PV systems is to assist Owner in responding to abnormal utility system conditions. Therefore, Seller shall design the control system, including its power supplies and connections to sensors, to be immune from utility voltage and/or frequency excursions, transients and similar events. The control system shall meet or exceed the surge withstand capability requirements of IEEE C37.90.

The control system also shall provide for setting the operating mode from a local control panel and by signals from Owner's SCADA system. Initiation and continued operation in any of the modes shall be as allowed by the state of charge of the battery, as well as the set operating state (i.e., shutdown, disconnect and operate).

All software provided by Seller shall recognize and automatically adjust for daylight savings time. The BESS and Wind/PV control system shall be designed to allow for software upgrades without taking the BESS and/or Wind/PV systems out of service.

7.0 TESTING AND START-UP

7.1 General

Seller shall furnish all supervision, technical personnel, labor, normal and special test instruments, tools, equipment, spare parts and consumables and materials required to perform the electrical, instrumentation and mechanical checkout and testing of components and equipment to verify the initial operation of the systems and equipment in Seller's scope.

Seller shall perform and successfully complete Commissioning Tests on systems and equipment in Seller's scope of supply to demonstrate the safety, operability and reliability of the systems and equipment within specified design limits according to the contract, engineering drawings, documents and specifications. All normal and necessary tests shall be conducted using written test procedures.

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

7.2 Tests

Seller shall be responsible for testing the equipment and systems within his scope. The tests shall include, but are not limited to:

- Grounding System Testing
- Megger Tests

- High Pot Tests (or VLF)
- Functional Tests of all Controls, Protection Relays and Interlocks
- Functional tests of all Safety Devices and Alarms
- AC/DC Motor Tests
- Battery and UPS Test
- PCS Test
- Switchgear Test
- Control Circuit Checkout
- Instrument and Loop Calibration
- Fire protection test
- All manufacturer recommended equipment tests

Additional required procedures include:

- Start-up Program Organizational Procedure
- Safety Tagging Procedure
- Confined Space Entry Procedure

7.3 Factory Testing of the Battery Modules

Seller shall test and submit test data for the modules designated for use on this project. At a minimum, the following tests shall be performed.

- Energy and Power Capacity
- Heat Generated
- Efficiencies
- Maximum hydrogen release rates
- As applicable, maximum noxious and toxic material release rates

Seller shall provide a test plan for all required module tests. Test data for production lots other than those being supplied for this project are not acceptable.

7.4 Factory Testing of the PCS

Seller shall develop and submit a factory test plan. As a minimum, sufficient tests shall be conducted to demonstrate that all controls, protective functions and instrumentation perform as designed and follows this specification. Successful tests performed on scale models or analog simulators will be deemed to meet the intent of this paragraph. The tests shall demonstrate that the PCS is capable of synchronizing with - and operating in parallel with - the utility connection.

Factory testing shall include a burn-in test. For this test, the PCS shall be operated at a site ambient temperature of 120° F for eight hours. Alternately, the burn-in test may be performed separately on each component or subassembly of the PCS.

7.5 Acceptance and Performance Testing

Prior to BESS final commissioning, a Control System Acceptance Test developed by Seller and mutually agreed upon by Owner and the control system integrator will be performed by Seller. Software and simulated BESS conditions will mimic the performance functions with data logging of the results using scaled values. To the maximum degree possible the verification can be done during the factory validation test of the control system. On site verification should still be performed. Seller and Owner are expected to participate and will require a four-week notice or shorter if agreed on by both parties before the testing is performed.

Seller shall be responsible for demonstrating that all systems in Seller's scope of work meet the design requirements in accordance with the required performance functions.

Following commissioning and startup, the Provisional Acceptance Tests listed in Table 9 shall be conducted at the Worksite to demonstrate compliance with the required performance guarantees.

All measurement instruments and systems used in Provisional Acceptance Tests and Final Acceptance Tests shall be calibrated prior to beginning the tests and shall have calibration certificates demonstrating calibration.

TABLE 2 PROVISIONAL PERFORMANCE TESTS

TEST	COMMENTS
BESS Ramp rate tests	The test sequence consists of a ramp from zero output (MW and MVAR) to full MW discharge, then ramp to full MW charging, then ramp back to zero output. The real power MW ramps will be in conjunction with reactive output (MVAR) adjustments to avoid voltage violations on the system
SCADA tests	Verify indication of all metering, alarms and controls for BESS, control building, and connected systems.
Voltage regulation testing	Test the Facility to hold the MV bus voltage as Owner system permits and within the operating conditions of the Existing Facility.
Curtailment interface tests	With the Facility online, verify the response to various real-power set points and ensure the Facility decreases to appropriate levels.
Annunciator tests	Verify proper indication of annunciated alarms and conditions, including reset and acknowledgment of alarms.
RTU tests	Testing to verify the interface between Owners' Facility and the BESS.
BESS Acceptance tests Startup/shut down, including emergency shut down Instrumentation/control systems functions and diagnostics Power in/Power out tests (including a full discharge test and a discharge test of each string summed to the total discharge capability) Ramp power in and out Demonstration of response to variable power commands at various states of charge Verify lead/lag controller/droop response to System frequency changes Verify receipt/response to Owner's Automatic Generation Control signals Verification of analog BESS signals (i.e. status parameters) to Owner	

7.5.1 Function Verification

After the BESS has been installed, Seller will perform comprehensive testing on the entire system to verify compliance with all requirements of this Technical Specification. Owner may, at Owner's discretion, witness these tests.

Special attention shall be given to demonstration of utility interface with Owner's protection and SCADA/EMS control signals, circuits and functions. Testing shall include, as a minimum, measurement of harmonic content and power factor at full and partial power levels for both charge and discharge.

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

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

7.5.2 Performance Verification

The BESS performance verification shall include tests as determined by Seller to verify that the performance criteria specified in these Technical Specifications can be met or exceeded. Accordingly, Seller shall provide a total system performance verification plan to ensure correct BESS response to system disturbances and operating scenarios described in this Technical Specification. The tests shall include, but not be limited to a constant discharge at the rated power and energy requirements listed in Table 5, or to maximum discharge limit.

The total system performance verification plan shall be submitted to Owner for review and approval 60 days prior to BESS performance tests.

Each discharge cycle, as determined by Seller, shall be followed by Seller specified normal charge cycle.

Ramp up/down tests shall be performed to demonstrate the BESS meets the specifications for the different operating modes.

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

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

7.5.3 Actual Operating Experience

It may not be possible due to system constraints to test all facets of the BESS function as part of the performance verification tests specified above. The actual operating experience of the BESS and PV system through the availability guarantee period shall be deemed an extension of the performance verification tests.

Actual operating experience will be documented through Seller furnished sequence of event recorders, digital fault recorders and other system monitoring equipment capable of identifying system disturbances and associated BESS performance. Additional information may be provided by monitoring equipment installed by Owner at other locations.

Documented failure or malfunctions of any BESS component during the availability guarantee period shall be deemed as a failure of the system commissioning test. Seller shall, at no cost to Owner, make the necessary repairs, replacements, modification or adjustment to prevent the same failure or malfunction from occurring again. The replacement of certain BESS components in response to a system failure may

necessitate, at the discretion of Owner, the duplication of certain performance verification tests which shall be performed at Seller's expense.

7.5.4 Other Compliance Tests

Seller is responsible for obtaining before and after BESS installation measurements to ensure the Project complies with this Technical Specification in the following areas. Owner reserves the right to perform (or request others to perform), at Owner's expense, identical compliance test measurements for the following:

- Broadband frequency signal strength and noise voltage
- Harmonic voltages and currents
- Audible noise measurements

7.6 Commissioning and Startup

Seller shall provide a commissioning and startup plan for the Project.

Seller shall coordinate with Owner to develop an acceptable commissioning plan that includes a checkout and startup procedure. This work will assure: that systems are activated in a manner that is safe for personnel as well as for the equipment, that Seller work is complete and according to the contract documents, and that the systems perform as required by the contract documents and are ready to be turned over to Owner. As the construction and installation of the systems nears completion, Seller and Owner shall prepare punch lists and conduct system walk-downs, sub-system and system checkouts, startups, testing, and turnovers.

The final approved Acceptance Test and Commissioning Procedures shall, at minimum, include the following:

- Safety plan during startup and commissioning.
- Review of all QA/QC testing on the DC and AC sides of inverters.
- Detailed procedure for Project startup, including switching sequencing.
- Confirm testing and energizing inverters in conformance with manufacturer's recommended procedures; note operating voltages; and confirm inverter is performing as expected.
- Testing the system control and monitoring system to verify that it is performing correctly.
- Testing the communication system for offsite monitoring.
- Testing the Project metering and protective relaying to verify they meet utility requirements.
- Detailed procedure for interface and initialization with the grid and completion of all Transmission Provider forms to be provided prior to construction.
- Documentation of successful startup and commissioning procedure.
- Written notification submitted by Seller to Owner that the completion of Acceptance Testing and Commissioning has occurred.

7.7 Synchronization Procedures and Requirements

All testing shall be done in accordance with the LGIA and all the requirements to achieve electrical and mechanical completion of the Project.

7.8 Mechanical and Electrical Completion

Seller shall achieve Backfeed and assure that the Project has been synchronized with the Owner Interconnection Facility (in accordance with Transmission Provider's requirements) before conducting the Capability Verification, Guarantee Design Conditions, and Guaranteed Performance Tests.

Mechanical Completion means:

1. Equipment for the Project has been installed, including with the required connections and controls to discharge and charge the BESS into the system and produce electrical power.
2. All remaining electrical systems have been checked out and are ready for operation.
3. All electrical continuity and ground fault tests and all mechanical tests and calibrations have been completed.
4. All instrumentation is operational and has been calibrated in accordance with manufacturers' standards and guidelines and, where possible, loop checked.

7.9 Power Capacity Test

Prior to starting the energy capacity test, a power capacity test shall be performed. This test shall be performed after several days of continuous, regular use, and is to consist of a measure of the BESS' instantaneous power output capability under normal conditions. The test report shall consist of the following:

- Any agreed upon deviations to the test procedures.
- Instrument calibration sheets/certificates.
- Test data (manual and from the data acquisition system).
- Corrected test data
- Field notes
- Calculations
- Post-test uncertainty analysis
- Conclusions

Detailed test procedure in Appendix XX

7.10 Energy Capacity Test

Seller shall submit its proposed plan to comply with the testing procedures 60 days prior to the date that Seller anticipates the commencement of the test. The objective of the Project Energy Capacity Test Procedure is to demonstrate to Owner that the Project has achieved the Energy Performance Guarantee (in

MW_{AC}) under project test conditions. The submittal by Seller regarding the Energy Capacity Test Procedure shall, at a minimum, include a listing of test instrumentation, calibration procedures, test duration, type of data collected and collection frequency, test data collection procedures, and test reporting.

Seller shall be authorized in writing by Owner to begin the Energy Capacity Test Procedure, which will be to establish the full power rating of the Project. If the rating falls below the guaranteed output, Seller shall take measures to bring the Project up to the required rating.

If Seller shall complete corrective measures to bring the power rating up to an acceptable level, then retesting may occur following notification to Owner in writing.

Seller shall submit preliminary results of the Energy Capacity Testing within 24 hours of the conclusion of the test. Upon Owner's acceptance of the preliminary test results, Seller shall submit to Owner a detailed test report within 5 business days of the completion of the Energy Capacity Test. The test report shall consist of the following:

- Any agreed upon deviations to the test procedures.
- Instrument calibration sheets/certificates.
- Test data (manual and from the data acquisition system).
- Corrected test data
- Field notes
- Calculations
- Post-test uncertainty analysis
- Conclusions

Detailed test procedure in Appendix XX

8.0 MAINTENANCE

8.1 General

Operations and Maintenance requirements will be in compliance with the O&M contract and Seller must meet the technical specifications and requirements of the equipment manufacturers. All equipment and construction documentation to be compiled into O&M manuals. Seller to provide O&M procedures to properly guide the Owner for safe operations of the site.

The Project shall be designed so that regular planned maintenance may be carried out by either Seller (under a separate contract) or by the Owner or by Others. Full Operations and Maintenance manuals for all equipment and the equipment as an integrated facility and site tasks are required by the Seller.

8.2 Period of Performance

O&M period of performance shall be proposed. Minimum period is during construction up to transfer of ownership. O&M by Seller can extend after transfer of ownership under a separate contract.

8.3 Maintenance Prior to Acceptance

Prior to Final Completion of the Project Seller shall be responsible for maintenance of all components of the Project.

8.4 Maintenance Procedures

O&M procedure periods shall be identified to be consistent with manufacturer specified intervals. The BESS is intended to be unstaffed on a day-to-day basis. Expected O&M intervals for all equipment shall be provided.

All equipment planned maintenance for the period of the O&M Contract shall be identified prior to Commercial Operations date and presented in an O&M Plan, in accordance with Vendor's maintenance requirements.

9.0 TRAINING AND TOOLS

9.1 General

Seller shall provide training for the Project as specified below. Seller shall determine the content and duration for each training session. The suggested class durations in this Technical Specification are meant to illustrate the level of training expected. Performance evaluation testing of all trainees (i.e., a written test) is required for all classes.

9.2 Operator Training

Seller shall provide the necessary training in proper operation of the Project and related equipment. This training shall be conducted after completion of the Project performance verification testing, but before system commissioning. It is anticipated that this session will last one to two days and the Seller will provide an outline and syllabus prior to the session. This session will be limited to a maximum of 20 people. Emphasis shall be placed on safety and hands-on operating experience interspersed with the critical background as necessary, including switching procedures and emergency response training.

9.3 Maintenance Training

Seller shall provide necessary training in maintenance of the Project and related equipment, if maintenance by Owner option is chosen. The maintenance training shall be scheduled after successful completion of the availability guarantee period. It is anticipated that this session will last one to two days and the Seller will provide an outline and syllabus prior to the session. This session will be limited to a maximum of 20 people. The maintenance training shall include, but not be limited to:

- safety and grounding procedures
- periodicity of inspections and maintenance
- normal maintenance methods
- repairs and replacement
- diagnostic procedures
- equipment calibration

- re-energization
- special tests
- spare parts
- special tools

9.4 Training Schedule

Training schedule shall be agreed upon prior Commercial Operational Date

9.5 Tools and Equipment

Seller shall provide all “special tools and equipment” for maintenance and operation which are not normally or readily available. Seller shall submit a complete list of tools and equipment needed for erection/installation and maintenance and a list of special tools and equipment that will be provided, including prices. Special tools and equipment shall become the property of Owner at the completion of the BESS and PV installation. Owner reserves the right to purchase additional quantities of tools if desired.

9.6 O&M Documentation

Seller shall supply Owner with all manuals and/or handbooks (in printable electronic format) that provide, either in a single manual or handbook or collectively, complete operating and maintenance instructions (including inventories of spare parts and tools and parts lists with ordering instructions) for each major piece of equipment and system of the Project. O&M suggested schedule shall be coordinated among major equipment.

9.7 Turnover Documents Including O&M Manuals

Seller shall provide Owner with three paper copies and one editable electronic copy of all manuals.

Hard copy manuals shall be on standard 8-1/2" x 11" paper. Drawings and schedules which are to be bound into the manual shall also be 8-1/2" x 11" or 11" x 17" folded. Each manual shall be assembled and bound in heavy-duty post binders designed for rough usage. Light duty and ring binders are not acceptable. Binder capacity shall not exceed four inches, nor shall material included exceed the designed binder capacity. If the material to be furnished exceeds this capacity rating, multiple volumes shall be furnished. Binders shall be sized to the material to be contained, and capacity should not be more than approximately one-half inch greater than the thickness of material within the binder. All documents, illustrations, specifications, equipment data sheets, drawings, operating and maintenance instructions shall be in the English language. Use of the English system of units on documents is preferred; if the metric system of units is used, the drawing, data sheet, specification or illustration shall clearly indicate that the metric system of units is used. Each manual shall include a Table of Contents, front cover, side label and laminated index tabs and shall be of a consistent format.

The electronic copy of the manuals shall be organized in folders consistent with tabs in the paper manuals. Electronic copies of installation, operation and maintenance manuals shall be organized from the most general information in the top directory to the most specific information in the lowest level folder. The top-level folders shall include a document containing a directory of the subfolders describing the contents of each and every subfolder. Electronic copies of Installation, Operation and Maintenance manuals shall be organized by project, system, subsystem, equipment and components. Manufacturers’ or

vendors' electronic manuals shall be delivered as individual files. Seller shall not merge or combine manufacturer and vendor provided files containing manuals.

The manuals to be provided shall include:

9.7.1 Design Manuals

Design manuals shall contain the following items:

- Drawing List, Drawing and Specification Identification System, Units of Measurement and Formats
- System List and Equipment Numbering System
- List of applicable drawings
- System design requirements
- System and equipment descriptions
- Equipment lists itemizing type, performance and technical requirements.
- Overall performance data

9.7.2 <u>Start Up, Operation and Shutdown Manual</u> for the BESS, including comprehensive and complete procedures for checkout, startup and testing of the Project and will include as a minimum the following items:

- BESS start-up and shutdown procedures
- Startup schedule
- Startup organization chart
- Administrative procedures
- Data sheets
- Test procedures for all tests required for Mechanical and Electrical Completion and Final Acceptance.
- Turnover sequences and procedures
- Safety clearance procedure
- Work responsibility matrix

9.7.3 <u>Installation, Operation, and Maintenance Manuals</u> for the Equipment, including information typically supplied for equipment and/or systems such as the following items:

- System or equipment startup and shutdown procedures
- Description / design criteria of each item of equipment
- Nameplate information and shop order numbers for each item of equipment and components thereof

- Operating procedures and instructions for commissioning, startup, normal operation, shut down, standby and emergency conditions and special safety precautions for individual items of equipment or systems
- List of any start-up prerequisites
- Normal range of system variables
- Operating limits and hazards for all equipment and systems including alarm and trip set points for all devices
- Testing and checking requirements
- Effect of loss of normal power
- Tolerance of electrical supply frequency variation
- Final performance and design data sheets, specifications and performance curves for all equipment including test data and test curves
- Preventive maintenance schedule and maintenance instructions for equipment including standard and special safety precautions and special conditions that trigger non-scheduled maintenance
- Dismantling and assembly procedures for equipment with associated tests and checks prior to returning equipment to service
- Detailed assembly drawings to complement assembly procedures mentioned above including parts lists and numbers for replacement ordering
- Cleaning procedures, including frequency, equipment, resources needed, water source, etc.
- Specifications for any gases, chemicals, solvents or lubricants
- Drawing showing space provided for equipment maintenance for equipment and any fixed facilities for maintenance
- Methods for trouble-shooting
- List of maintenance tools furnished with equipment
- Installation instructions, drawings and details
- Vendor drawings as appropriate
- Installation, storage and handling requirements.

The above requirements are a minimum; however, requirements which are clearly not applicable to specific items or components may be deleted, however, any additional information which is necessary for proper operation and care of the equipment shall be included.

10.0 CODES AND STANDARDS

Codes and Standards will comply with Appendix XX of this Technical Specification.

11.0 REFERENCE OWNER'S STANDARDS

Appendix "A-7" contains the following Owner standards that apply to this Technical Specification:

- RFP Appendix A-7.01: Attachment 1A Project Document Formatting and Requirements.
- RFP Appendix A-7.02: Attachment 1B – Project Document Deliverables
- RFP Appendix A-7.03: Computer Aided Design (PacifiCorp Energy) General AutoCAD/Drafting Standards (Specification DCAP876).
- RFP Appendix A-7.04.1: EBU PX-S01/S01A Substation Equipment—Power Transformer, All Ratings and Substation Equipment—Transformer-Specific Requirements
- RFP Appendix A-7.04.2: EBU PX-S02 Substation Equipment—Collector Substation Main Power Transformer
- RFP Appendix A-7.04.3: ZS-102 Two-Winding Distribution Transformer Inverter Step-Up Liquid-Immersed (Pad Mounted, Compartmental Type)
- RFP Appendix A-7.05: EBU SI-S04 Electrical Equipment—Insulating Oil
- RFP Appendix A-7.06: EBU SI-S02 Wind, Ice, and Seismic Withstand
- RFP Appendix A-7.07: EBU SI-S03 Contaminated Environment Protection
- RFP Appendix A-7.08: SP-TRF-INST Transformer, Oil-Filled Reactor and 3phase Regulator Installation Procedure
- RFP Appendix A-7.09: TD 051 Sign, Danger
- RFP Appendix A-7.10.1: 6B.5—Fence Application and Construction
- RFP Appendix A-7.10.2: Section 02810 Chain Link Fencing and Gates
- RFP Appendix A-7.10.3: Section 02815 Cantilever Slide Gate
- RFP Appendix A-7.11: 6B.6—Substation Grounding
- RFP Appendix A-7.12: GEN-ENG-RELAY-0001 Protective Relaying Standard
- RFP Appendix A-7.13: GEN-ENG-RELAY-0002 Arc Flash Hazard Standard
- RFP Appendix A-7.14: GEN-ENG-RELAY-0003 Relay Current Transformer (CT) and Potential Transformer (PT) Insulation Integrity Test
- RFP Appendix A-7.15: GEN-ENG-RELAY-1003 Thermal Plant Protective Relay Maintenance and Testing – PRC-005
- RFP Appendix A-7.16: Relay Testing and Commissioning Checklist
- RFP Appendix A-7.17: GPCP-EQPMNT-INST Generation Protection And Control Equipment Installation Procedure
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- RFP Appendix A-7.22.1: SV 251 Bird and Animal Protection for Miscellaneous Equipment
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- RFP Appendix A-7.22.3: SV 002 Bird and Animal Protection – General Installation Instructions
- RFP Appendix A-7.23: Volume 8 Consultant Drafting Procedures and Standards (For Engineering Drawings)