1.0 GENERAL REQUIREMENTS

1.1 SUBMITTALS

1.1.1 Contractor shall provide submittals in accordance with Exhibit F – Attachment 10. In addition, the Contractor shall provide:

1.1.1.1 A Siemens PTI Certified PSSE or equivalent model for the BESS, PCS, and BESS Control System

1.1.1.2 A transient model for the BESS, PCS, and BESS Control System that meets MISO requirements (PSS/e)

1.2 QUALITY ASSURANCE AND SAFETY

1.2.1 BESS equipment supplier shall be ISO 9000 certified.

1.2.2 In general, the BESS shall be designed with personnel safety as the top priority. Safety of the operations and maintenance personnel is of the utmost concern and importance in the design of the project. Any safety-related requirements in this document and element specific specifications shall be strictly adhered to and special attention shall be given to such things as the following:

1.2.2.1 The BESS thermal management system and fire protection system shall be complete and failsafe. BESS associated equipment shall have a complete and failsafe fire detection/extinguishing system, compliant with the most stringent current specifications and standards, including the most recent versions of the applicable NFPA, IFC, IBC, and IMC.

1.2.2.2 Portable multi-purpose ABC fire extinguishers for manual fire-fighting purposes will be provided in the area. The number, type and locations of the portable fire extinguishers will be based on NFPA 10. All safe working clearances between equipment shall be met.Interlock switches that create a safe environment shall be provided on all access ports/doors/panels to hazardous voltages and or currents. The BESS shall go into an alarm state and shutdown when one of these ports is opened.

1.2.2.3 The BESS shall be able to shut down safely in all conditions (ground fault, programmed, etc.).

1.2.2.4 The BESS labeling shall be highly visible, no smaller than 14 pt. font in uppercase sans serif typeface, to identify major equipment and associated components of protection.

1.2.2.5 The BESS shall include eyewash station(s) in any areas containing fluid electrolyte or other chemically hazardous liquids, as applicable.

1.2.2.6 Contractor is responsible for the proper placement of eye wash stations, fire extinguishers, and first aid kits

1.2.2.7 Contractor is responsible for meeting all station and equipment grounding requirements.

1.2.2.8 Contractor is responsible for meeting all minimum clearances to MV and HV equipment in the station yard.

1.2.2.9 Contractor is responsible for proper placement of energized components within the Control Building, as applicable.

1.2.2.10 Contractor is responsible for providing barriers to protect personnel from batteries and other energized low voltage equipment that may be within reach.

1.2.2.11 Contractor is responsible for proper arc flash mitigation and protection.

1.2.2.12 Contractor shall provide a secure facility, from the perimeter fence and gates to individual equipment cabinets— allowing access to only qualified personnel.

1.2.2.13 Contractor is responsible for ensuring all Codes and Standards reference within Exhibit F and herein are adhered to.

1.2.2.14 The BESS and all scope of supply shall comply with the applicable local and national codes and standards.

1.2.2.15 Prior to the shipment of the BESS, the BESS equipment supplier shall ensure that all safety measures and protective devices function as intended.

2.0 DELIVERY, STORAGE, AND HANDLING

2.1.1 The BESS shall be capable of withstanding normal shipping and handling shocks and vibration when shipped.

2.1.2 Equipment and materials shall be prepared for shipment and shall be crated in a manner to provide maximum protection during shipment.

2.1.3 The following shall be the responsibility of the Contractor:

2.1.3.1 Receiving, inspecting, unloading and storing (including all equipment and rigging required) of Owner and Contractor supplied equipment and materials. Inspection of the material shall be the responsibility of the Contractor, of which the Owner may witness.

2.1.3.2 All disconnected wires shall be clearly identified, bundled, coiled, and secured. All fasteners required for reassembly shall be arranged in clearly marked packages with invoice attached. These packages shall be shipped securely as an integral part of the BESS components so they shall be immediately accessible for reassembly.

2.1.3.3 BESS components shall be shipped in a manner preventing damage to or degradation of the components due to ambient environmental conditions.

2.1.3.4 Contractor shall not use any Owner employee to load batteries or electrolyte material into BESS modular containers.

2.1.3.5 Any machined surfaces shall be fully wrapped and protected from impact damage in shipment.

2.1.3.6 Moving Parts shall be braced as needed or as recommended by Vendor to avoid shipping damage.

2.1.3.7 Providing all temporary surfaces for safe and efficient offload, storage and erection, in accordance with crane manufacturer and BESS supplier requirements.

2.1.3.8 Contractor shall be required to remove all debris from project site caused or created by the un-crating and assembly of BESS.

2.1.3.9 All hazardous materials must be packed and marked in accordance with all applicable local, national and international Codes.

2.1.3.10 If battery modules/racks are shipped independently of battery container(s), Contractor shall ensure that containers are equipped with proper station service or auxiliary power required to maintain environmental conditions within the container(s) prior to the arrival of the battery modules/racks in order to avoid thermal or environmental damage to the battery cells.

2.1.3.11 Refer to Exhibit F – Scope of Work for additional general requirements.

3.0 DESIGN AND APPLICATION DATA DESIGN RATING

3.1.1 The BESS shall be designed by the Contractor for a use case scenario as required by the Owner.

Table 3.1 – BESS Design Ratings

Design Parameter	Value
Nameplate Power Rating	200 MW
Nameplate Energy Capacity Rating at Design Depth of Discharge	800 MWh
AC Round Trip Efficiency (100% DoD cycle)	Minimum 85%
Availability	99% annual availability
Project Lifetime	20 Years
Seismic	Per Exhibit F – Scope of Work Section 3

1. AC round trip efficiency of the BESS is defined as the ratio of the delivered discharge energy to the delivered charge energy at the Contractor's high voltage POI at BOL.
2. Availability is defined as the percentage of time that the entire BESS is available for operational service (charging, discharging, or in storage mode) and not removed from service for maintenance or due to failure.

3.2 Use Cases

3.2.1 The items in the following list marked with a "Yes" in the "Applicable to Project" column are the use cases that shall be offered by the BESS. Contractor shall coordinate with the Owner as required to determine applicable use-cases. The possible use cases are:

Table 3.2 – BESS Use Cases

Category	Service	Applicable to Project	Command Originates From	Resp. Speed	Duration	Cycle Time	Description
Bulk Energy	Generation Capacity or Resource Adequacy	YES	Owner Operations Center	Sec.	Hrs.	Hrs.	A resource which can be dispatched during peak demand events to supply energy (generation capacity) or to shave peak energy demand. The resource reduces the need to procure new peaking power plants.
	Energy arbitrage	TBD	TBD	Min.	Hrs.	Days	Trading in the wholesale energy markets by buying energy during low-price periods and selling it during high-price periods.
Ancillary Services	Regulation	TBD	TBD	~ 1 Min.	Min.	Cont.	Online energy resources which continuously respond to minute-to-minute fluctuations in system load and correct for unintended fluctuations in generator output
	Load Following/ Shaping	TBD	TBD	5 Min.	Hrs.	Hrs.	An energy resource which varies its power output within a prescribed area in response to changes in system frequency, tie line loading, or the relation of these to each other, to maintain the scheduled system frequency and/or established interchange with other areas within predetermined limits.
	Spinning Reserve	TBD	TBD	Sec. to <10 Min.	10 to 120 Min.	Days	Spinning reserve represents capacity that is online and capable of synchronizing to the grid within 10 minutes.
	Non-spinning Reserve	TBD	TBD	10-30 Min.	10 to 120 Min.	Days.	Non-spinning reserve is offline generation capable of being brought onto the grid and synchronized to it within 30 minutes.
	Voltage Support	TBD	TBD	Sec. to <10 Min.	Hrs.	Cont.	A resource which can contribute reactive power resources onto the grid in order to maintain a desired transmission system voltage or to maintain voltage stability.

Category	Service	Applicable to Project	Command Originates From	Resp. Speed	Duration	Cycle Time	Description
	Frequency Response	TBD	TBD	Cycles	Min.	Cont.	Online energy resource initial response to maintain interconnection frequency within predefined bounds by arresting frequency deviations and supporting frequency until restored to the scheduled value.
	Under frequency Load Shedding	TBD	TBD	Cycles	Min. or Hrs.	Yrs.	Load modifiers which operate within cycles to arrest frequency deviations and support frequency until restored to the scheduled value.
	Black Start Service	NO		Min.	Min.	Yrs.	An energy resource which is relied on as part of the Company's official Black Start plan. Black start service is the ability of a generating unit to start without an outside electrical supply, and is necessary to help ensure the reliable restoration of the grid following a blackout.
Transmission Services	Transmission Congestion Relief/Transmission charge reduction	TBD	TBD	Min.	Hrs.	Hrs. to Days.	Use of an energy resource to offset transmission system power flow and provide transmission system capacity relief during hours of high congestion.
	Transmission Upgrade Deferral	NO		Min.	Hrs.	Hrs. to Days.	Use of an energy resource to provide reliability or resiliency for a specific portion of the transmission system, thus delaying the need to upgrade the transmission system to accommodate load growth or to support reliable transmission service.
Distribution Services	Distribution Congestion Relief	NO		Min.	Hrs.	Hrs. to Days.	Use of a DER to offset distribution system power flow and provide distribution system capacity relief during hours of high congestion.
	Distribution Upgrade Deferral	NO		Min.	Hrs.	Hrs. to Days.	Use of a DER to provide reliability, resiliency, or power quality services for a specific portion of the distribution system, thus delaying the need to upgrade the distribution system to accommodate load growth or regulate voltage.

Category	Service	Applicable to Project	Command Originates From	Resp. Speed	Duration	Cycle Time	Description
	Volt-VAR Control	NO		Sec.	Hrs.	Min. to Hrs.	Use of a DER to contribute volt-ampere reactive (VAR) support to the distribution system for improved voltage management and power factor management.
	Outage Mitigation	NO		Sec.	Hrs.	Hours to Days	Use of a DER to reduce or eliminate power outages to a portion of the distribution system.
Customer Energy Management Services	Power Reliability	NO	TBD	Sec.	Hrs. to Days	Hrs. to Days	Use of a DER to reduce or eliminate power outages to utility customers.
	Time-of-Use Charge Reduction	NO	TBD	Min	Hrs.	Hrs.	Use of a DER to reduce customer charges for electric energy when the price is specific to when (season, day of week, time of day) the energy is purchased.
	Demand Charge Reduction	NO	TBD	Sec to < 10 Min	Min. to Hrs.	Hrs. to Days.	Use of a DER to reduce the maximum power draw by electric load in order to reduce customer peak demand charges.
Renewable Integration	Solar Energy Smoothing/ firming	NO	TBD	Cycles	Min.	Cont.	The variable, intermittent power output from a renewable power generation plant, such as wind or solar, can be maintained at a committed level for a period of time. The energy resource smoothes the output and controls the ramp rate (MW/min) to eliminate rapid voltage and power swings on the electrical grid.
	Solar Energy Shifting	NO	TBD	Hours	Min.	Cont.	The energy resource is charged during periods of peak solar output in order to discharge power when solar output is low or zero later in the day.
	Renewable Energy Credits	TBD					Energy credits for the implementation of renewables. Does not impact number and duration of cycles.

3.3 Cycling and Capacity Maintenance

3.3.1 Assumed Project duty cycle shall be 365 equivalent full cycles per year for the full Project lifetime of 20 years. Contractor shall clearly state in their proposal how equivalent cycles will be determined for the selected BESS technology. Degradation projections for capacity maintenance or augmentation plans should assume one full Depth-Of-Discharge (DOD) of system nameplate energy capacity per day. Attachment 2A shall be populated to describe Contractor's planned Capacity Maintenance Agreement and Capacity Maintenance Schedule.

4.0 PERFORMANCE, AVAILABILITY AND FUNCTIONALITY TESTING

4.1.1 This Section addresses the Performance Requirements Battery Energy Storage System (BESS) Facility.

4.2 Definitions

4.2.1.1 **'BESS Availability' means** BESS availability on in regard to forced and planned outages during Performance Guarantee Period (PGP).

4.2.1.2 **'BESS Energy Capacity'** means the energy capacity (expressed in MWh as measured at the Energy Delivery Point / revenue meter) that can be discharged from the BESS for the specified consecutive storage hours when starting from 100% state of charge, as determined periodically in accordance with applicable test protocols and procedures set forth in this section.

4.2.1.3 **'BESS Plant Auxiliary Loads'** means electrical energy consumed by the auxiliary systems at the BESS Project associated with the operation of the BESS, but not directly a result of DC-AC conversion losses resulting from energy being transferred to or from the Energy Delivery Point during BESS charging and discharging operation. Auxiliaries include controls, cooling systems, fans, pumps, heaters, etc., needed to operate and protect the plant.

4.2.1.4 **'BESS Power Rating'** means the power (expressed in MW as measured at the Energy Delivery Point / revenue meter) that can be discharged from the BESS for the specified consecutive storage hours when starting from 100% state of charge, as determined periodically in accordance with applicable test protocols and procedures set forth in this section.

4.2.1.5 **'BESS AC Roundtrip Efficiency'** means the ratio of the delivered AC discharge Energy to the delivered AC charge Energy, in each case at the Energy Delivery Point and determined in accordance with applicable test protocols and procedures set forth in this section. Measurement of BESS Roundtrip Efficiency shall be for a 100% depth of discharge cycle while charging at the maximum steady state active power at which the BESS can continuously absorb and while discharging at the maximum steady state active power at which the BESS can continuously deliver. Auxiliary loads should not be omitted from the Roundtrip Efficiency calculation.

4.2.1.6 '**Guaranteed Charge Ramp Rate**' is the charge rate in MW per second measured between 15% state of charge to 85% state of charge representing the maximum rate that the BESS can change its input power from the Energy Delivery Point.

4.2.1.7 '**Guaranteed Discharge Ramp Rate'** is the discharge rate in MW per second measured between 85% state of charge and 15% state of charge representing the maximum rate that the BESS can change its output power at the Energy Delivery Point.

4.2.1.8 '**Guaranteed System Latency**" means the guaranteed time measured between when control signal is sent and the BESS responds to the signal by changing the discharge or charge power value by more than 1% of the control setpoint.

4.2.1.9 '**Point of Interconnection**" means high voltage interconnection point of the facility to the MISO Transmission line in the contractor furnished interconnecting substation.

4.2.1.10 **'Performance Guarantee Period (PGP)'** means the time period during which the BESS Power Rating, Energy Capacity, and Availability Tests are being performed.

4.2.2 PERFORMANCE GUARANTEES

4.2.2.1 Performance Guarantees shall apply to the Project as outlined herein and shall be achieved during Tests conducted in accordance with this Section. Performance Guarantees must be satisfied to achieve Substantial Completion or Final Completion of the Project, as appropriate and as further defined herein.

4.2.2.2 "Performance Guarantees" shall mean each of the performance requirements as set forth below:

4.2.2.3 Contractor shall complete the following table:

TABLE 4.1 – PERFORMANCE GUARANTEE TESTS

Parameter	Unit	Performance Requirement	Conditions for Guarantee
Performance Guarantees at Performance Guarantee Conditions			
Guaranteed Energy Capacity	MWh	[By Respondent]	
Guaranteed BESS Power Rating	MW	[By Respondent]	
Guaranteed Storage Charge Hold Duration	Hr	[By Respondent]	
Guaranteed BESS AC Roundtrip Efficiency	%	[By Respondent]	
Guaranteed Charge Ramp Rate	MW/sec	[By Respondent]	
Guaranteed Discharge Ramp Rate	MW/sec	[By Respondent]	
Guaranteed System Latency	Sec	[By Respondent]	
Guaranteed Frequency Response Capability	MW / 0.1 Hz	[By Respondent]	
Guaranteed Maximum BESS Plant Auxiliary Loads (and associated conditions)	kW	[By Respondent]	
Project Reliability		100%	Over the duration of the Reliability Test
Noise Performance Guarantees			
Total Project far-field noise level	dBA	60	At property boundary
Equipment near-field noise limit, at 3 feet from any item of Equipment	dBA	85	Applicable to total Project operation. Guarantee is for each single piece of equipment in free field environment.

4.2.3 MINIMUM PERFORMANCE CRITERIA

4.2.3.1 Minimum Performance Criteria shall apply to the Project as outlined herein and shall be achieved during Tests conducted in accordance with this Section. Project specific guarantees must be satisfied as required in this Section to achieve Substantial Completion or Final Completion of the Project, as appropriate and as further defined herein.

4.2.3.2 "Minimum Performance Criteria" for Substantial Completion shall mean each of the guaranteed performance requirements as set forth below:

4.2.3.3 Bidder shall complete the following table:

TABLE 4.2A – MINIMUM PERFORMANCE GUARANTEE TESTS

Parameter	Unit	Performance Requirement	Conditions for Guarantee
Minimum Performance Guarantees at Performance Guarantee Conditions			
Guaranteed Energy Capacity		[By Respondent]	
Guaranteed BESS Power Rating	MW	97% of Guarantee	
Guaranteed Storage Charge Hold Duration	Hr	97% of Guarantee	
Guaranteed BESS AC Roundtrip Efficiency	%	97% of Guarantee	
Guaranteed Charge Ramp Rate	MW/sec	100% of Guarantee	
Guaranteed Discharge Ramp Rate	MW/sec	100% of Guarantee	
Guaranteed System Latency	Sec	100% of Guarantee	
Guaranteed Frequency Response Capability	MW / 0.1 Hz	100% of Guarantee	
Guaranteed Maximum BESS Plant Auxiliary Loads (and associated conditions)	kW	105% of Guarantee	
Project Reliability		100%	Over the duration of the Reliability Test

4.2.4 "Minimum Performance Criteria" for Final Completion shall mean each of the guaranteed performance requirements as set forth below:

TABLE 4.2B – MINIMUM PERFORMANCE GUARANTEE TESTS

Noise Minimum Performance Guarantees			
Total Project far-field noise level	dBA	60	At property boundary
Equipment near-field noise limit, at 3 feet from any item of Equipment	dBA	85	Applicable to total Project operation. Guarantee is for each single piece of equipment in free field environment.

4.2.5 FUNCTIONAL GUARANTEES

4.2.5.1 "Functional Guarantees" shall mean each of the guaranteed functional requirements as set forth in the table below. Contractor shall be responsible for performing the required Functional Guarantee Testing.

TABLE 4.3 – FUNCTIONAL GUARANTEE TESTS (AS APPLICABLE)

Parameter	**Functional Guarantee (Yes/No + Description if yes)**
Automated Control Operability	[By Respondent]
Anti-Islanding Capability	[By Respondent]
Relay Testing	[By Respondent]
Volt /VAR Regulation	[By Respondent]
Low/High Voltage Ride Through	[By Respondent]
Power Factor Correction	[By Respondent]
Control System Test	[By Respondent]
Fire Protection System Test	[By Respondent]
Black Start Test	[By Respondent]
Workplace Sound Survey	[By Respondent]
Control System Testing	[By Respondent]

4.2.6 TESTING

4.2.6.1 The Contractor shall be responsible for carrying out the Tests for Substantial Completion of the Work as well as for Final Completion of the Work. Performance Tests and Functional Guarantee Tests are those Tests defined herein. These Tests shall be completed as appropriate, but in no event until after Mechanical Completion has been achieved.

4.2.6.2 For the purpose of evaluating guarantee compliance, the Equipment shall be deemed "new and clean" for any and all tests with no allowances for degradation to be considered.

4.2.6.3 Tests shall be conducted in accordance with the test conditions set forth herein.

4.2.6.4 Contractor shall perform a pre-test uncertainty analysis and shall provide such analysis to Owner at least 60 days prior to the performance of the associated Performance Tests. No test tolerance will be applied to the test results. Corrections required to adjust for test conditions that differ from the Performance Guarantee Conditions defined herein will be allowed.

4.2.6.5 All Performance Guarantees and Minimum Performance Criteria shall be met during the same test, if practical, and in accordance with the requirements set forth herein and in the Contract. These Performance Tests shall be the sole determination of whether the Performance Guarantees and Minimum Performance Criteria have been met and shall be binding on the Contractor to determine compliance with the Performance Guarantees and Minimum Performance Criteria.

4.2.6.6 All Tests shall be completed by the Contractor or a mutually agreeable third-party testing contractor under contract to the Contractor. The Contractor shall be responsible for the supply of all personnel, testing equipment, and testing instrumentation.

4.2.6.7 The Tests shall be performed in general accordance with the IEEE codes and ESIC Test Manual procedures (when applicable) or Supplier test procedures, and in strict accordance with the performance test requirements in the Contract, provided that the Owner and Contractor may mutually agree upon deviations from the IEEE codes and ESIC Test Manual procedures (or other applicable codes and procedures). In the event of a conflict, the order of precedence shall be:

4.2.6.7.1 The Contract

4.2.6.7.2 The Test Procedures developed in accordance with the Contract

4.2.6.7.3 The applicable Performance Test Codes

4.2.6.8 During all Tests, the Project and equipment shall be operated in a manner consistent with and within the design limits established by the Contractor and equipment manufacturers. Equipment shall be operated in a manner that is suitable for continuous operation of the equipment and in a manner that is consistent with Prudent Industry Practices.

4.2.6.9 During Tests, the Project shall be operated by or on behalf of Owner under the direction of Contractor.

4.2.6.10 Prior to the Tests being conducted, Contractor may make minor adjustments to the equipment to ensure it is suitable for testing. Such adjustments shall exclude modifications intended to temporarily improve the performance of the Equipment for any Test.

4.2.6.11 Repair of any part or replacement of any item of equipment that could materially alter the performance of the Equipment being tested or the results of a Test will not be permitted during a Test. If the Contractor or an equipment manufacturer performs any repair or alterations after a Test that could materially affect the results of a previously conducted Test, the Contractor shall repeat such Test subject to the terms of the Contract. In no event will Substantial Completion be revoked as the result of such retest, but verification of required Performance Guarantees associated with such retest shall be a condition for Final Completion.

4.2.6.12 Contractor may not operate redundant components to obtain acceptable Test results unless such use is defined for a normal operating scenario asdescribed herein.

4.2.6.13 If a test interruption occurs for any reason, Contractor and Owner shall mutually agree to either: (a) resume the Test after the cause of the test interruption has been rectified, or (b) restart the Test.

4.2.6.14 Owner may waive the requirement to perform any one or all of the Tests if the Owner is not able to schedule for the dispatch of the Project or is otherwise satisfied that the BESS is fully functional and capable of expected functionality and guarantees.

4.2.6.15 Component and Project tests performed by the Owner, in addition to the Performance Tests and Functional Guarantee Tests, shall be allowed.

4.2.7 Test Conditions

4.2.7.1 The conditions upon which the Contractor shall base the Performance and Functional Tests shall be defined in the Test Procedure to be developed by Contractor and approved by Owner

4.2.7.2 At all times during the Tests, the Project as a whole, must comply with all Applicable Laws and Applicable Permits to be considered a successful Test. Contractor shall evaluate and remedy the cause of such failure before attempting the same Test.

4.2.7.3 All Tests shall be accomplished with the Project operating wholly within its design ratings. In particular, none of the following shall occur:

4.2.7.3.1 Overheating of components

4.2.7.3.2 Excessive power consumption

4.2.7.3.3 Operation of tripping or limiting devices, except where the test is intended to demonstrate such operation

4.2.7.3.4 Rubbing, chaffing, or other mechanism of accelerated wear

4.2.7.3.5 Dangerous occurrences due to Project operation or malfunction

4.2.7.3.6 Leaks from or into cooling systems or vessels that present a situation that could result in damage to BESS equipment or BOP Equipment

4.2.7.4 Contractor shall coordinate with the battery system suppliers to develop test procedures including detailed test procedures for the Performance Tests and the Functional Guarantee Tests based on the Project design.

4.2.7.5 Test procedures, correction curves, and proposed results calculation methodologies (the "Test Procedures") shall be submitted to the Owner sixty (60) business days prior to the commencement of the first Test and shall be subject to the review and comment of Owner, Owner's representatives and Financing Parties. Owner will review and provide comments to the draft Test Procedures within twenty (20) Business Days after submission by Contractor. Contractor shall effect any changes to reflect the comments and resubmit the draft Test Procedures to Owner, whereupon Owner will review and provide comments to such draft Test Procedures within fifteen (15) Business Days after re-submission by Contractor.

4.2.7.6 Tests shall be completed with the Project SCADA in automatic control and no manual adjustment or manual control of equipment operation except that which is customary for similar power plants as mutually agreed.

4.2.7.7 The Test Procedures shall include as a minimum:

4.2.7.7.1 The purpose of the Performance Test or Functional Guarantee Test, as applicable

4.2.7.7.2 Personnel responsibilities

4.2.7.7.3 Applicable performance corrections and correction curves

4.2.7.7.4 Codes and standards to be utilized and any mutually agreed upon exceptions to these codes and standards to be taken by the Contractor

4.2.7.7.5 Data collection procedures

4.2.7.7.6 Instrument list including both permanent Project and temporary Performance Test instrumentation to be utilized

4.2.7.7.7 Performance Test operating procedures

4.2.7.7.8 Allowable variation in measured parameters

4.2.7.7.9 Instrument accuracy requirements / Uncertainty Analysis

4.2.7.7.10 Sample data log sheets

4.2.7.7.11 Notification procedures

4.2.7.8 Correction curves shall be included in the Test Procedures. These curves shall accurately correlate to the curve of the suppliers of the applicable Equipment to correct the performance of the Work for variations from the specified design conditions. Each of the correction curves shall have a range to suit the specified conditions. Each curve shall be provided in both graphical and numerical format.

4.2.7.9 The curves will be utilized on-Site as a preliminary indication of test results. Final test acceptance shall be based upon the final test report.

4.2.8 Performance Tests

4.2.8.1 Contractor shall be responsible for carrying out the Performance Tests to demonstrate that the required Minimum Performance Criteria and Performance Guarantees have been achieved. Contractor shall perform all tests in general accordance with the Energy Storage Integration Council (ESIC) Energy Storage Test Manual with any test modifications as mutually agreed with the Owner.

4.2.8.2 The "Performance Guarantee and Minimum Performance Guarantee Tests" to be performed for achievement of Substantial Completion are provided in Table 3.1, 3.2a and 3.2b, and are further defined in the following Articles:

4.2.8.3 Guaranteed Energy Capacity

4.2.8.3.1 Capacity Guarantee - the ability of the Facility to deliver the Capacity Guarantee indicated in the Bid Data Form to the point of interconnection. Measured in total kWh.

4.2.8.4 Guaranteed BESS Power Rating

4.2.8.4.1 The test for determining power rating of the BESS shall incorporate all components including, the storage medium, auxiliary loads, power conversion equipment, HVAC equipment, and the transformer at the point of common coupling to the utility. Thus, system power rating is determined for the entire utility-integrated BESS. The test results reported will provide information useful for validating the energy delivery capability of the BESS tested.

4.2.8.5 Guaranteed BESS Roundtrip Efficiency

4.2.8.5.1 Contractor shall conduct tests to demonstrate the performance of the BESS plant and document the round-trip efficiency. The Guaranteed BESS Roundtrip Efficiency Test, consisting of multiple test cycles shall be performed for a 100 percent depth of discharge at full rated charge and discharge power. Additional roundtrip efficiency tests shall be performed to document 100 percent depth of discharge at 75 percent of rated charge and discharge power and 50 percent of rated charge and discharge power as well as 50 percent depth of discharge (from 75 percent to 25 percent State of Charge (SOC)) at full rated charge and discharge power. Auxiliary loads shall not be disabled or omitted from the BESS Roundtrip Efficiency Test.

4.2.8.6 Guaranteed BESS Charge Ramp Rate Test

4.2.8.6.1 Contractor shall conduct tests to demonstrate the achievable rate of change in the charge input power in MW per second measured between 15% state of charge to 85% state of charge representing the maximum rate that the BESS can change its input powerfrom the Energy Delivery Point.

4.2.8.7 Guaranteed BESS Discharge Ramp Rate Test

4.2.8.7.1 Contractor shall conduct tests to demonstrate the achievable rate of change in the discharge power in MW per second measured between 85% state of charge and 15% state of charge representing the maximum rate that the BESS can change its output power at the Point of Delivery.

4.2.8.8 Guaranteed BESS System Latency

4.2.8.8.1 Contractor shall perform a Performance Test to demonstrate, when the Power Conversion System (PCS) is in active or ready mode and the system is at idle, the guaranteed time measured between when a remote/SCADA control signal is sent and the BESS responds to the signal by changing the discharge or charge power value by more than 1% of the control setpoint. Guaranteed System Latency may be demonstrated during the Charge and Discharge Ramp Rate test.

4.2.8.9 Guaranteed BESS Frequency Response Capability

4.2.8.9.1 Contractor shall test the BESS plant on its ability to meet the Guaranteed Frequency Response Capability and adjust frequency regulation in accordance with the duty cycle called for by the operating grid. Tests shall be performed to confirm BESS ability to control grid frequency through the discharge of power when there is a sudden loss of power from a generation source, or an acceptance of power when there is a sudden loss of load on the grid. Frequency response time will be measured. Test procedures in ESIC Energy Storage Test Manual and Pacific Northwest National Lab Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems may be referenced.

4.2.8.10 BESS Self-discharge Rate Test

4.2.8.10.1 This test shall determine the rate at which the storage system loses charge, not including auxiliary power. This may be expressed as a function of the state of charge and ambient conditions. This should also include all non-variable parasitic losses (tare losses, control power, etc.).

4.2.8.11 BESS Reliability Test

4.2.8.11.1 Following satisfactory completion of all other Performance Guarantee Tests and prior to achieving Substantial Completion, the BESS shall be available for a 7-day continuous reliability test during which time the Project shall be operated by Owner's operations staff under the supervision of Contractor, to demonstrate the Project Reliability. This Reliability Test shall be performed to validate the reliability of the BESS and Project as a whole.

4.2.8.11.2 The duration of reliability testing shall continue until the Contractor can satisfy their Reliability guarantee.

4.2.8.11.3 Contractor shall conduct the testing and shall notify the Owner at least fourteen (14) Days in advance of starting the Reliability Test. Owner's operating Staff, under the supervision of Contractor, shall operate the Project with normal operating staff levels during the Reliability Test. The Project shall operate during the Reliability Test with dispatch determined by Owner within the Equipment's design capability and shall start, stop, ramp, cycle, etc. as determined by Owner. Owner, in its sole discretion, may elect to waive any particular Test and or shorten the duration of any test. The applicable parameters shall be recorded for the Reliability Test.

4.2.9 Performance Test Points and Instrumentation

4.2.9.1 The Contractor shall specify a list of key instruments to be used during a Performance Test in the applicable Test Procedures.

4.2.9.2 All permanent and temporary Performance Test points shall be provided by Contractor in order to demonstrate fully that the Facility performance is in compliance with the Contract.

4.2.9.3 Contractor shall provide drawings indicating the points of measurement together with necessary isolation during Performance Tests. Contractor shall describe the means of measurement of the necessary parameters together with the anticipated standard and accuracy of the instruments.

4.2.9.4 Test instruments shall be calibrated in accordance with the standards of a recognized national organization such as American Society of Testing and Materials (ASTM), Instrument Society of America (ISA), or the IEEE. Contractor shall calibrate and install special test equipment or instrumentation used in testing as necessary.

4.2.9.5 Calibration procedures and records shall be submitted to the Owner as part of the Contractor's written Performance Test reports. Calibration of all Performance Test instrumentation shall be verified for and prior to the applicable Performance Test.

4.2.9.6 Performance Test data shall be monitored and recorded by permanent Project instrumentation using the Project SCADA to the greatest extent possible. The Contractor shall ensure that the use of permanent Project instrumentation shall in no way adversely impact the intended Performance Test accuracy and shall provide a pre-test uncertainty analysis based upon the intended instrumentation with the Test Procedure.

4.2.9.7 Additional precision grade test instruments and signal sources shall be supplied by the Contractor where necessary to comply with and to be used in accordance with the requirements of the appropriate test codes and must meet the accuracy requirements for carrying out the various Performance Tests as specified in the Test Procedures.

4.2.9.8 Measuring devices and test instruments shall be calibrated.

4.2.10 Preliminary Performance Testing

4.2.10.1 During commissioning, Contractor shall carry out and complete its own preliminary testing as determined necessary by the Contractor, as well as make and complete such adjustments to the Equipment as may be necessary.

4.2.10.2 Contractor shall furnish Owner with a description of its proposed preliminary performance testing program, together with calibration certificates for the test equipment, in advance of any such preliminary testing. Owner shall have full access to witness all calibrating and checking of instruments and other apparatus and all preliminary testing performed. Owner shall receive copies of all preliminary test reports as well as all raw test data for the preliminary tests collected within 48 hours of any such tests.

4.2.11 Performance Test Measurements

4.2.11.1 The method and the number and location of measurements, and the provision of and duties of observers, shall be mutually agreed by Contractor and Owner before the Performance Test.

4.2.11.2 The values used in performance calculations shall be the arithmetical average of the observations made and recorded during the Performance Tests adjusted for obvious errors which shall be excluded from the data set and shall be limited to no more than 5 percent of the available data. As much as practical, the Performance Test data shall be logged automatically on a data logger or in the Project SCADA at a rate in excess of one reading per minute. For parameters where this is not practical, data shall be taken during each Performance Test at regular intervals not exceeding five minutes.

4.2.12 Sound Emissions Tests -Near Field Noise Tests

4.2.12.1 Contractor shall perform acoustical noise testing in general accordance with ISO 10494 and ASME PTC-36.

4.2.12.2 No tolerance or margin in measurement instrumentation will be allowed in determining conformance to Noise Performance Guarantees. Only measurement uncertainty will be allowed.

4.2.12.3 The near field noise test shall validate that the near-field A-weighted sound pressure levels at a distance of three feet in the horizontal plane from the outermost surface of equipment, including piping, conduit, framework, barriers, mitigation measures, personnel protection devices, curbs, and fluid retainer basins, and five feet above grade shall be limited to sound emissions set forth in the Noise Performance Guarantees.

4.2.12.4 Corrections for background noise, building effects, and free-field conditions may be applied in determining the sound pressure level. Near field levels shall be measured while equipment is operating at base load, steady-state conditions, exclusive of transient events (including but not limited to startup and shutdown) and off-normal operating conditions.

4.2.13 Functional Guarantee Tests

4.2.13.1 Contractor shall be responsible for successfully completing the following Functional Guarantee Tests for the Work. These Functional Guarantee Tests must be performed and satisfied to achieve Substantial Completion as identified herein. The Functional Guarantee Tests shall be completed in conjunction with the Performance Tests.

4.2.13.2 The "Functional Guarantee Tests" to be performed for achievement of Substantial Completion are provided in Table 3.3 and are further defined in the following Articles:

4.2.13.3 Automated Control Operability

4.2.13.3.1 Ability of the control system to automatically place the Facility into service, remove the Facility from service and to react to, control, and interface with the Point of Interconnection.

4.2.13.4 Anti-islanding Capabilities

4.2.13.4.1 Ability of the system to perform Anti-islanding capabilities in the event of grid failure.

4.2.13.5 Relay Testing

4.2.13.5.1 Relay testing of the intertie relay and all other protective relaying devices.

4.2.13.6 BESS Voltage Support

4.2.13.6.1 Contractor shall conduct functional tests involving the manipulation or stabilization of the grid voltage as follows:

a) Volt / VAR Regulation: Test will be used to demonstrate that the BESS can functionally perform Volt-VAR regulation based on system voltage and allow assignment of a Pass/Fail designation for this test. Test procedures in ESIC Energy Storage Test Manual and Pacific Northwest National Lab Protocol for Uniformly Measuring and Expressing the Performance of Energy Storage Systems may be referenced.

b) Low /High Voltage Ride –through: Test is intended to verify that the BESS can comply with low/high voltage ride-through (LVRT/HVRT) and low/high frequency ride-through specifications and settings. The specific requirements for LVRT/HVRT curve settings may be based on a codes and standards (e.g. IEEE 1547, UL 1741) or utility interconnection requirements.

c) Power Factor: Test the ability of the system to control based on a fixed power factor set point and operate using autonomous power factor management based on inputs including voltage and watts. Refer to applicable Codes and standards IEEE 1547 and EPRI Technical document Common Functions for Smart Inverters, Version 3 December 2016, as appropriate.

4.2.13.7 Black Start Test

4.2.13.7.1 Contractor shall demonstrate the BESS system's Functional capability to provide black start of an Owner generation resource. If Owner's generation asset is unavailable during the Contractor's demonstration test, then load banks at a minimum capacity of 10MW for 20 minutes shall be utilized.

4.2.13.8 Power Quality

4.2.13.8.1 Ability of Contractor's system to deliver energy while satisfying the applicable Power Quality Standards required of the Owner's interconnection.

4.2.14 Workplace Sound Survey

4.2.14.1 Sound measurements, dB (A), shall be made during BESS rated discharge operation (i.e., after Substantial Completion of the Project).

4.2.14.2 A sound level meter conforming to the appropriate ANSI specifications shall be utilized. The measurement positions shall normally be at a height of five feet above grade, foundation, platform, or floor and at a minimum distance of three feet from the system/equipment surface. The number of measurement positions and their precise location shall be agreed by Contractor and Owner. The A-weighted rms sound level using the slow response of the sound level meter shall be recorded at each position.

4.2.14.3 Alternatively, the direct measurement of the equivalent continuous A-weighted sound pressure level may be made at each measurement position using an instrument complying with the appropriate ANSI specifications.

4.2.14.4 Instrument, calibration, and measurement details, where not specified herein, shall be determined from information given in the ANSI specifications.

4.2.14.5 Measurements shall be made during full load conditions. Sound levels greater than 80 dB(A) shall be reported to the nearest 1 dB(A).

4.2.14.6 For indoor spaces, the level shall also be measured at three feet from the walls at all column lines, and in all occupied spaces such as control rooms, offices, shops, and lockers. Roof top equipment shall also be measured. For these locations, octave or 1/3 octave spectra are required in addition to "A" weighted overall values.

4.2.14.7 The Contractor shall conduct an in-Project noise survey to identify the in-Project areas that may be exposed to A-weighted sound pressure levels exceeding the near-field noise guarantee during normal operation. To the extent such areas are identified, these areas shall be identified with warning signs prescribing hearing protection. The in-Project noise survey shall be conducted in accordance with the Test Procedures.

4.2.15 Control Systems

4.2.15.1 The Contractor shall perform control system testing to demonstrate the following:

a) Ability to restore control systems from back-up medium

b) Ability of the instrumentation and control systems to function as specified in a real operating environment

c) Ability of the instrumentation and control system to function in automatic from minimum stable load to full load

4.2.15.2 Control System Start-up Test

4.2.15.2.1 The Contractor shall demonstrate that the Project control systems are capable safely controlling the BESS during charging operations from minimum to maximum SOC, and subsequently during discharge from maximum to minimum SOC while all controllers are in automatic, all permissives are met, and redundant equipment are in a standby mode ready for service.

4.2.15.2.2 The Control System Start-up Test shall begin with the BESS at minimum SOC. The Project operator shall then manually initiate at the control system the charging process per standard operating procedures. Following this step, the BESS charging shall be automatically initiated from the Owner's remote control location and stop automatically at maximum SOC. After charging and with the BESS at maximum SOC, the Project operator shall then manually initiate at the control system the discharge process from Owner's remote control location per standard operating procedures. Following this step, the BESS discharge shall be automatically initiated and stop automatically at minimum SOC.

4.2.15.2.3 After initiation of the Control System Start-up Test, no controllers shall be placed in manual operation except unless otherwise approved by the Owner prior to initiation of the Control System Start-up Test.

4.2.16 System Back-up and Restoration

4.2.16.1 After Substantial Completion of the Project, Contractor shall make a back-up of all system and program files and then demonstrate to Owner the restoration of the system from the back-up medium. This shall include the SCADA and all other auxiliary and proprietary equipment supplied by the Contractor.

4.2.17 Functional Guarantee and Performance Test Results

4.2.17.1 Contractor shall submit the methodology by which it proposes to calculate the results based on the measured data to Owner.

4.2.17.2 Prior to the calculation of the test results, Owner's agreement will be required to the fundamental data obtained from the trials which shall not be unreasonably withheld.

4.2.17.3 Preliminary corrected performance figures shall be calculated at the completion of each test to allow the Owner and Contractor, as applicable, to judge if the test completed was satisfactory or whether it should be repeated.

4.2.17.4 A preliminary report of all Performance Tests shall be produced and three copies issued to Owner for approval within five business days of the completion of each Performance Test.

4.2.17.5 The form of calculation sheets and diagrams, which shall conform to the format agreed with Owner, shall clearly identify the values measured in the Performance Test.

4.2.17.6 A final and complete report of the Tests shall be produced and three copies issued to Owner for approval within five business days of receipt of the gas analysis.

4.2.17.7 The official test reports shall include, as a minimum, the following details:

4.2.17.7.1 Date and time of each test start and finish

4.2.17.7.2 Full procedure adopted

4.2.17.7.3 Instrumentation details and calibration data including signed and approved instrument calibration forms

4.2.17.7.4 Full schematic of the Work systems together with instrument locations

4.2.17.7.5 The standard to which the test was carried out and the Code of Practice followed, plus other reference data used

4.2.17.7.6 The operating conditions prior to the test

4.2.17.7.7 Variations in system frequency/generating unit speed

4.2.17.7.8 Summary of test readings, results and conclusions

4.2.17.7.9 Calculations

4.2.17.7.10 Pre-test uncertainty calculations

4.2.17.7.11 Copies of test data sheets or other raw data

4.2.17.7.12 Notes on any unusual observations, data or conclusions Attendance

4.2.17.7.13 Results of the test