Exhibit A-1

Scope of Work BESS

Contents

1.0 General

1.1 Definitions

1. **"AC"** shall mean alternating electrical current.
2. **"AHJ"** shall mean the Authority Having Jurisdiction for the Project, which is Arecibo County, Puerto Rico.
3. **"Applicable Standards"** means the minimum standards and industry codes applicable to equipment and work by Contractor. Detailed in Section 6.0 Codes and Standards.
4. **"Auxiliary Power"** shall mean power not directly associated with power generation or transmission losses. These include, but are not limited to, inverter power, Energy Management System (EMS) system power, thermal management system, and communications equipment loads. Auxiliary Power is separately metered.
5. **"Battery System"** shall mean a set of battery racks, containing battery modules, within an enclosure integrated with onboard thermal management, Battery Management System (BMS), Fire Protection System (FPS), internal protection, monitoring and other systems as needed within the ESS enclosure(s), certified with applicable codes and standards in Section 6.0 Codes and Standards, connected to a single Power Conversion System (PCS) or inverter.
6. **"Battery System Supplier"** shall mean the party responsible for the supply of the Battery System or Power Unit(s) if a different party than the Contractor.
7. **"BESS Equipment"** shall mean the Battery System including without limitation, the PCS and Medium Voltage Transformer (MVT).
8. "**BESS Facility**" shall mean all the equipment and services to produce a fully operational Battery Energy Storage System (BESS) from the medium voltage (MV) AC connection point at the Substation, through the PCS and to the DC/Battery energy storage system.
9. **"BESS Facility EMS"** shall mean the control system including but not limited to the Energy Management System (EMS) control hardware, software, communication, networking, cybersecurity, SCADA and PPC utilized to send power commands to, monitor and store data for the Project.
10. **"Battery Management System" or "BMS"** means an electronic system that manages a rechargeable battery (cell or battery pack), such as by protecting the battery from operating outside its safe operating area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and/or balancing it.
11. **"Commercial Operation Date" or "COD"** shall mean the date the on which BESS Facility first achieves Commercial Operation. Commercial Operations shall mean satisfaction of performance test requirements set forth Exhibit F-5 BESS Substantial Completion Testing and, in a certificate, issued by the Owner in Exhibit U-3 Commercial Operation ate Certificate.
12. "**Communications System"** means the supervisory, control, and data acquisition system for the interconnecting substation equipment (including all breakers, switches, transformers, relays, and meters), BESS, EMS, as well as all communications cabling and supporting devices.
13. **"Control Mode"** shall mean the programmed control setting of the EMS as defined in Exhibit A-2 Scope of Work EMS/PPC.
14. **"Contract"** shall mean the Equipment Supply Agreement to which this Appendix is attached.
15. **"Contractor"** means the person, firm, or corporation with whom Owner has entered into the Contract. For the purposes of this Appendix, "Contractor" means the BESS Equipment, Integration and EMS/PPC Contractor.

16. **“DC”** shall mean direct electrical current.

17. **“Emergency Response Plan” or “ERP”** means a pre-incident plan for use by personnel responding to emergencies to assist personnel in effectively managing incidents and events for the protection of responding personnel, property, and the environment.

18. **“Energy Management System” or “EMS”** shall mean the control system including but not limited to the Energy Management System (EMS) control hardware, software, communication, networking and cybersecurity, utilized to send power commands to, monitor and store data for the BESS Facility and Project.

19. **“EMS Control Hardware”** shall mean all the hardware including but not limited to EMS controllers, network switches, field network enclosure (FNE), communications and networking infrastructure, power supplies, uninterruptable power supplies (UPS) required for the EMS system design.

20. **“EMS Provider”** shall mean the EMS vendor if a different party than the Contractor.

21. **“EMS Service Agreement”** shall mean the software and services agreement from the EMS Provider, if it is a different party than the Contractor, and the Contractor’s respective Service Level Agreement (SLA).

22. **“Failure Modes and Effects Analysis” or “FMEA”** means a systematic, proactive method for evaluating a process to identify where and how it might fail and to assess the relative impact of the different failures, to identify the parts of the process that are in need of change.

23. **“Hazard Mitigation Analysis’ or “HMA”** means an approved hazard mitigation analysis required by IFC and NFPA 855 to evaluate the consequences of various failure modes.

24. **“HMI” or “Human Machine Interface”** shall mean the EMS Web User Interface that shall be used by Supervisory Control and Data Acquisition (SCADA), Owner or PREPA to interface with EMS. The primary EMS HMI shall be located in the Substation control enclosure with an additional first responder HMI and fire control panel located beyond the Minimum Approach Distance as determined by the HMA.

25. **“HV”** shall mean high voltage.

26. **“HVAC”** shall mean heating, ventilation, and air conditioning, if applicable.

27. **“Hertz”** or “Hz” shall mean hertz.

28. **“kV”** shall mean kilovolts.

29. **“kW”** shall mean a measure of instantaneous power as measured in kilowatts. If not specified it shall be assumed to be in AC.

30. **“kWh”** shall mean kilowatt-hours. If not specified it shall be assumed to be in AC.

31. **“LV”** shall mean low voltage.

32. **“Medium Voltage Transformer”** or **“MVT”** shall mean a ground-mounted power distribution transformer in a locked steel cabinet mounted on a concrete pad.

33. **“MTR” or “Minimum Technical Requirements”** shall mean the application / functionality requirements of the EMS as defined in Exhibit A-2 Scope of Work EMS/PPC.

34. **“MV”** shall mean medium voltage.

35. **“Owner”** shall mean Pattern Puerto Rico Renewables Development LLC

36. **“Owner-Supplied Equipment”** shall mean MV Switchgear, 115 kV GSU Transformer, MV and HV Engineering, Procurement and Construction (EPC) for all Projects. Owner-Supplied Equipment for the

Barceloneta Solar + Storage (MTR) Project shall also include Solar PV modules, racking, trackers, Solar PV controls.

37. **"POI" or "Point of Interconnection"** shall mean the meter located on the primary side of the 115 kV GSU Transformer inside the PREPA Project substation as shown in the SLD in Exhibit D-1 Single Line Diagram.

38. **"Power Unit"** shall mean a single PCS (bi-directional grid-connected power electronic converter) connected to a Battery System and associated control system. A Power Unit is able to charge and discharge independently.

39. **"PPC" or "Power Plant Controller"** shall mean the site-level Master Power Plant Controller used to control the solar PV and BESS Facility as a single resource at the Point of Interconnection (POI). The PPC and related scope are only applicable to the Barceloneta Solar + Storage (MTR) Project and is excluded from other standalone BESS Projects.

40. **"Project"** shall mean the BESS Facility and all the equipment and services to produce a fully operational BESS up to the POI, capable of meeting technical specifications in Section 2.0 and Substation equipment. "Project" for the Barceloneta Solar + Storage (MTR) site shall mean the BESS Facility and Solar PV, and all and services to produce a fully operational Solar + Storage facility up to the POI.

41. **"Project Data"** shall mean the data made available to the EMS from the BESS Facility, Solar PV (if applicable) and Substation equipment that is captured and stored according to requirements in this Exhibit and Exhibit A-2 Scope of Work EMS/PPC.

42. **"Project Site"** means "Site", as defined in the Contract.

43. **"Purpose Built Enclosure" or "(PBE)"** means the weather-proof battery equipment enclosure that can contain the batteries, battery racks, BMS, fire protection and detection system internal to the enclosure, thermal management system, control systems, UPS and power distribution systems.

44. **"Raceway"** means all conduit (rigid and flexible), underground duct, wireway, cabinets and boxes, and all materials and devices required to install, support, secure, and provide a complete system for support and protection of electrical conductors.

45. **"Site Controller"** shall mean the EMS controller that monitors the Unit Controller health and capability and distributes proportional P/Q commands.

46. **"Submittal Schedule"** means the schedule for Contractor's delivery of submittals, as set forth in Appendix M-1 - Contractor Deliverables.

47. **"Substation"** shall mean the facility which collects the feed from the Project and transforms the voltage (as required) for electrical interconnection to the transmission provider.

48. **"SCADA"** shall mean the supervisory control and data acquisition system and shall include all monitoring/control hardware and software, field instrumentation, and communication devices.

49. **"State of Charge"** or **"SOC"** means for any time of determination the amount of Stored Energy at such time expressed as a percent of the Maximum Storage Energy.

50. **"Unit Commissioning Test Procedures"** shall mean the performance test procedures in Exhibit F-4 BESS Unit Commissioning Test Plan.

51. **"Unit Controller"** shall mean the EMS controller that interfaces with both the Battery System and PCS, together known as a "Power Unit," reads the charge/discharge limits from each BMS and passes them to the PCS, ensures PCS adheres to the BMS current and power limits, and sequences the turn ON/OFF of Power Units.

52. **"UPS"** means Uninterruptible Power Supply.

53. Abbreviations listed in the Table below.

1.2 Abbreviations

Table 1 - Abbreviations

AC	Alternating Current
AGC	Automatic Governor Controls
AHJ	Authority Having Jurisdiction
BESS	Battery Energy Storage System
BMS	Battery Management System
BOS	Balance of System
CP	Continuous Power
CVE	Common Vulnerability and Exposures
DC	Direct Current
DDP	Delivery to Warehouse Duties Paid
DSM	Dynamic System Monitoring Equipment
EMS	Energy Management System
EPC	Engineering, Procurement and Construction
FAT	Factory Acceptance Testing
FACP	Fire Alarm Control Panel
FNE	Field Network Enclosure
FPS	Fire Protection System
FRT	Frequency Ride Through
GPS	Global Positioning System
HMI	Human Machine Interface
HSSE	Health, Safety, Security, and Environment
IA	Interconnection Agreement
IFC	Issued for Construction
I/O	Input and Output
LOTO	Lock Out / Tag Out
LTC	Load Tap Changers
LVRT	Low Voltage Ride-Through Requirement
LEL	Lower Explosive Limit
LTC	Load Tap Changers
MPC	Master Plant Controller
MTR	Minimum Technical Requirements
MV	Medium Voltage
MVT	Medium Voltage Transformer
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
NTP	Network Time Protocol
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OVRT	Over Voltage Ride-Through Requirements
PCS	Power Conversion System
PF	Power Factor
POI	Point of Interconnection
POD	Plan of the Day
POM	Point of Measurement
PPA	Power Purchase Agreement
PREPA	Puerto Rico Electric Power Authority (aka Utility)
QA/QC	Quality Assurance/Quality Control
RTAC	Real Time Automation Controller –SEL 3530 device or equivalent

RTE	Roundtrip Efficiency
RTU	Remote Terminal Unit
SAT	Site Acceptance Testing
SCADA	Supervisory Control and Data Acquisition
SCR	Short Circuit Ration
SLA	Service Level Agreement
SLC	Single Line Circuit
SLD	Single Line Diagram
SOC	State of Charge
SOH	State of Health
SVC	Static Var Compensators
TSP	Transmission Service Provider
UPS	Uninterrupted Power Supply
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
VRS	Voltage Regulation System
WebUI	Web User Interface

#	Document Name	Version
1	Exhibit J-1 Project Schedule	1
3	Exhibit A-2 Scope of Work EMS/MPC	1
4	Exhibit A-3 Division of Responsibilities	1
5	Exhibit M-1 Contractor Deliverables	1
6	Exhibit B-1 Owner Supplied Equipment	1
7	Exhibit C-1 Site Description	1
9	Exhibit F-4 BESS Unit Commissioning Test Plan	1
10	Exhibit F-5 Substantial Completion Test Plans	1

1.3 Scope Overview

The Contractor shall:

1. Provide BESS equipment, integration and commissioning of the BESS Facility up to and including the MVT to include:
   A. Battery System
   B. BESS Facility EMS/PPC
   C. PCS
   D. Reactive Power Loading Requirements at PCS
   E. MVT

F. Integration

G. Warranty

H. Performance and Delay Guarantees

I. Equipment Cold and Hot Commissioning

J. Commissioning and Substantial Completion Testing for the BESS Facility (all Projects)

K. Commissioning and Substantial Completion Testing for the PPC and Project (Barceloneta Solar + Storage (MTR) Project only).

L. Service Level Agreement (if Applicable and Required for Warranty and Performance Guarantees)[1]

M. Delivery to site (DDP)

2. Refer to Exhibit A-3 Division of Responsibilities for a detailed matrix providing supplemental detail with regards to scope of work delineation. Contractors are encouraged to issue Requests for Information, if needed, prior to bidding to clarify any details or expectations. This matrix shall govern in case of any conflicts or ambiguities within the Contract documents.
3. Coordinate with the Owner to optimize the design, layout, and integration of the BESS within the overall Project, and to minimize any conflicts, gaps, or inefficiencies in the scope of work.
4. Provide all necessary documentation, drawings, calculations, and test reports to demonstrate compliance with the Contract requirements and applicable codes and standards as detailed in Exhibit M-1 Contractor Deliverables.
5. Participate in regular Project meetings, status reports, and design reviews with the Owner, and shall promptly address any issues, questions, or changes that arise during the Project execution.
6. Provide a dedicated project manager, engineering lead, and quality assurance/quality control (QA/QC) lead for the duration of the Project, with the necessary qualifications, experience, and authority to ensure successful delivery of the BESS.
7. Comply with all applicable safety, environmental, and security requirements, as further defined in the Contract and the Project's Health, Safety, Security, and Environment (HSSE) Plan.
8. Not utilize subcontractors unless pre-approved by the Owner.
9. Provide training and knowledge transfer to the Owner's personnel, including operation and maintenance manuals, on-site demonstrations, and classroom sessions, to ensure safe and effective use of the BESS throughout its lifecycle.

2.0 Technical Specifications

2.1 Design Specifications Barceloneta Solar + Storage (MTR)

Specifications	Description
Project Name	Barceloneta Solar + Storage (MTR)
Locations	°25'53.80" N, 66°35'29.15" W
COD	12/15/2026
Guaranteed Delivery Date	Bidder to provide guaranteed delivery date, no less than ten (10) months prior to COD.
Configuration	AC Coupled Solar + Storage

[1] SLA must be with same business entity, subsidiaries not accepted.

Specifications cont.	Description
Useable Power - AC Power at the Point of Interconnection (POI)	31.5 MW
Useable Energy (useable at the POI) net of Station Power usage) at Continuous Power (CP)	10.5 MWh
POI	Project Substation at 115 kV
Loss Assumptions	Bidder to assume 1.5% losses from primary side of the MVT to the POI.
Power Factor at POI	0.85 lagging to 0.85 leading
Maximum Annual Cycles	365 (0% to 100% state of charge)
Degradation Management	See Minimum Capacity Schedule (Table 2)
Augmentations	Option to specify oversizing, AC or DC augmentations
System Design Life	20 Years

Table 2 - Minimum Capacity Schedule

Year	Minimum Energy MWh
Year 0	10.50
Year 1	10.50
Year 2	10.50
Year 3	10.50
Year 4	10.50
Year 5	10.50
Year 6	10.50
Year 7	10.50
Year 8	10.50
Year 9	10.50
Year 10	10.50
Year 11	10.50
Year 12	10.50
Year 13	10.50
Year 14	10.50
Year 15	10.50
Year 16	10.50
Year 17	10.50
Year 18	10.50
Year 19	10.50
Year 20	10.50

Specifications cont.	Description
Application / Use Case	Bidder to account for PREPA Minimum Technical Requirements (MTR) in proposed design, EMS /PPC algorithm, BESS sizing and pricing. Requirements detailed in Exhibit A-2 Scope of Work EMS/PPC Section 2.4.1 Applications: • Voltage Regulation System (VRS) • SOC Balancing

	• Reactive Power Capability and Minimum Power Factor Requirements • Frequency Response / Regulation • Ramp Rate Control • Auto-Curtailment
Additional Technical Requirements for Power Electronics	Bidders to account for the following PREPA MTR in the design and pricing for power electronics: • Low Voltage Ride-Through (LVRT) • Overvoltage Ride-Through (OVRT) • Frequency Ride Through (FRT) • Ramp Rate Control • Short Circuit Ratio (SCR) Requirements • Power Quality Requirements
Roundtrip Efficiency	Bidders must design / propose the highest RTE possible.

Specifications cont.	**Description**
System Frequency	60 Hz
Altitude	90-95m Barceloneta, 20-25m Santa Isabel
Seizmic Zone	Design Category D, Zone 3
Corrosion Class	C5
Max / Min Temperature	Figure 1
Noise	Per NEMA Standards TR-1
THD	<5% THD as a system

Climate data for Ponce, Puerto Rico (1991–2020 normals, extremes 1898–present) [hide]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °F (°C)	98 (37)	95 (35)	96 (36)	96 (36)	96 (36)	99 (37)	100 (38)	100 (38)	99 (37)	98 (37)	100 (38)	98 (37)	100 (38)
Mean daily maximum °F (°C)	87.8 (31.0)	87.7 (30.9)	87.6 (30.9)	88.8 (31.6)	89.5 (31.9)	91.2 (32.9)	91.5 (33.1)	91.8 (33.2)	91.4 (33.0)	90.8 (32.7)	89.8 (32.1)	88.4 (31.3)	89.7 (32.1)
Daily mean °F (°C)	75.1 (23.9)	74.9 (23.8)	75.0 (23.9)	76.7 (24.8)	78.3 (25.7)	80.2 (26.8)	80.3 (26.8)	80.5 (26.9)	80.0 (26.7)	79.4 (26.3)	77.9 (25.5)	75.9 (24.4)	77.8 (25.4)
Mean daily minimum °F (°C)	62.5 (16.9)	62.1 (16.7)	62.5 (16.9)	64.6 (18.1)	67.0 (19.4)	69.2 (20.7)	69.1 (20.6)	69.3 (20.7)	68.7 (20.4)	67.9 (19.9)	66.0 (18.9)	63.5 (17.5)	66.0 (18.9)
Record low °F (°C)	49 (9)	51 (11)	50 (10)	53 (12)	55 (13)	60 (16)	58 (14)	60 (16)	58 (14)	61 (16)	56 (13)	52 (11)	49 (9)
Average precipitation inches (mm)	0.73 (19)	1.21 (31)	1.87 (47)	2.26 (57)	4.18 (106)	2.16 (55)	2.84 (72)	4.56 (116)	6.94 (176)	5.38 (137)	3.94 (100)	1.45 (37)	37.52 (953)
Average precipitation days (≥ 0.01 in)	6.0	6.5	7.0	8.7	10.1	7.8	8.2	10.3	12.1	12.7	10.1	7.4	106.9

Source: NOAA[150][151]

Figure 1 - Project Weather / Temperature Considerations

2.2 Design Specifications Barceloneta Storage, Santa Isable Storage 1, and Santa Isabel Storage 2

Specifications	**Description**		
Project Name	Barceloneta Storage	Santa Isable Storage 1	Santa Isabel Storage 2
Locations	18°25'53.80" N 66°35'29.15" W	17°58'55.01" N 66°24'04.51" W	17°58'55.01" N 66°24'04.51" W

COD	12/15/2026	02/15/2027	02/15/2027
Guaranteed Delivery Date	Bidder to provide guaranteed delivery date, no less than ten months prior to COD for Barceloneta Storage; nine months prior to COD for Santa Isabel Storage 1 and 2		
Configuration	Standalone Storage		

Specifications cont.	**Description**		
Useable Power - AC Power at the Point of Interconnection (POI)	50.0 MW	50.0 MW	80.0 MW
Useable Energy (useable at the POI) net of Station Power usage) at Continuous Power (CP)	200.0 MWh	200.0 MWh	320.0 MWh
POI	Project Substation at 115 kV		
Loss Assumptions	Bidder to assume 1.5% losses from primary side of the MVT to the POI.		
Power Factor at POI	0.85 lagging to 0.85 leading		
Maximum Annual Cycles	365 (0% to 100% state of charge)		
Degradation Management	See Minimum Capacity Schedule (Table 2)		
Augmentations	Option to specify oversizing, AC or DC augmentations, as needed		
System Design Life	20 Years		

Table 3 - Minimum Capacity Schedule

Year	Barceloneta Storage Minimum Energy MWh	Santa Isable Storage 1 Minimum Energy MWh	Santa Isabel Storage 2 Minimum Energy MWh
Year 0	200	200	320.00
Year 1	187.8	187.8	300.48
Year 2	182.4	182.4	291.84
Year 3	178.1	178.1	284.96
Year 4	174.4	174.4	279.04
Year 5	171.2	171.2	273.92
Year 6	168.2	168.2	269.12
Year 7	165.4	165.4	264.64
Year 8	162.8	162.8	260.48
Year 9	160.4	160.4	256.64
Year 10	158.1	158.1	252.96
Year 11	155.8	155.8	249.28
Year 12	153.7	153.7	245.92
Year 13	151.6	151.6	242.56
Year 14	149.6	149.6	239.36
Year 15	147.7	147.7	236.32
Year 16	145.8	145.8	233.28
Year 17	144	144	230.40
Year 18	142.2	142.2	227.52
Year 19	140.5	140.5	224.80
Year 20	138.8	138.8	222.08

Specifications cont.	Description
Application / Use Case	Bidder to account for PREPA Minimum Technical Requirements (MTR) in proposed design, EMS /PPC algorithm, BESS sizing and pricing. Requirements detailed in Exhibit A-2 Scope of Work EMS/PPC Section 2.4.1 Applications: • Frequency Control and Regulation • SOC Balancing • Rapid Spinning Reserve and Fast Frequency Response • Dispatchable Generation Source • Voltage Regulation and Control • Fast Dynamic Reactive Power Reserve and Voltage Support • Reactive Power Capability and Minimum Power Factor Requirements • Black Start Capability • Reactive Power Capability and Minimum Power Factor Requirements
Additional Technical Requirements for Power Electronics	Bidders to account for the following PREPA MTR in the design and pricing for power electronics: • Full Functional Voltage and Frequency Operational Range and Ride-Through Capability • Frequency Ride Through (FRT)
Roundtrip Efficiency	Bidders must design / propose the highest RTE possible.

Specifications cont.	Description
System Frequency	60 Hz
Altitude	90-95m Barceloneta, 20-25m Santa Isabel
Seizmic Zone	Design Category D, Zone 3
Corrosion Class	C5
Max / Min Temperature	Figure 1
Noise	Per NEMA Standards TR-1
THD	<5% THD as a system

3.0 Equipment and Materials

3.1 Battery System

3.1.1 Battery Cells

1. All Battery Cells shall be traceable to the point of origin for the purpose of addressing safety, manufacturing and forced labor issues.
2. Battery Cells shall have completed independently verified cycle testing prior to consideration, with guaranteed cycle- and calendar-based degradation comparable (within 10 %) to its peer Tier 1 battery suppliers.

3.1.2 Battery Modules

1. Battery Modules must be field replaceable as discrete modules.
2. Labeling of the batteries shall include manufacturer’s name, cell type, nameplate rating, date of manufacture, and unique serial number for each serviceable unit, in fully legible characters.
3. Replacement modules of the same design or of a directly compatible design shall be readily available from the manufacturer for a minimum of 5 years such that rack modifications are not required.

4. Battery Modules shall be pre-populated in Battery Racks/Packs inside the Battery Systems.

3.1.3 Battery Management System

1. Primary BMS functions shall include, but are not limited to:
   A. Monitoring at Battery Cell, Battery Module, and Battery Rack Level:
      i. SOC
      ii. State of Health (SoH)
      iii. Voltage/Current
      iv. Temperature
      v. Status
   B. Protection of the Battery Cell, Battery Module, and Battery Rack from:
      i. Overcurrent
      ii. Over/under-voltage
      iii. High/low temperatures
   C. Charge/discharge management
   D. Battery Cell, Battery Module, and Battery Rack Balancing
   E. Warning and alarms
   F. Internal protective measures
   G. Any other data relevant to battery warranty
   H. Thermal management system operating status, setpoints, warnings, and alarms
   I. Logs of operations
   J. Management of any software versions
   K. Safety assurance and monitoring for each site
   L. Power limiting functionality

2. Additional BMS Requirements shall include:
   A. The Owner shall have the ability to access all data provided by the BMS through the BESS Facility EMS.
   B. The BMS shall monitor the data points listed in the following table at an interval of at least once per second.
   C. The BMS shall monitor all data points required and store data a minimum of 24 hours before and after any BESS Facility alarm or event, or longer, if required by the battery Original Equipment Manufacturer (OEM) for root cause / postmortem analysis and warranty claim disposition. Data points shall also be transmitted to the Site Controller / EMS Historian for long-term data storage and retrieval.
   D. Rack BMS to System BMS communication protocol shall be manufacturer standard.
   E. System BMS to Site Controller communication protocol shall be Modbus TCP/IP or alternate as approved by the Owner.

Table 4 – Minimum BMS Monitored Parameters

Each Battery Rack or String	Rack Voltage
	Rack Current
	Rack SOC
	Rack SOH
	Rack Fault Status
	Rack Alarm Status

	Maximum Cell Voltage Value
	Maximum Cell Voltage Position
	Minimum Cell Voltage Value
	Minimum Cell Voltage Position
	Maximum Cell Temperature Value
	Maximum Cell Temperature Position
	Minimum Cell Temperature Value
	Minimum Cell Temperature Position
	Rack DC Switch Status
Battery System	All electronic or monitoring points for system voltages, currents, temperatures, alarms, switch / breaker / contactor status, cooling system operation, fire system operation, deflagration, etc.

F. Rack and System BMS should provide the following protections and supply associated alarms and warnings as applicable:
   i. Overcurrent
   ii. Over/under-voltage
   iii. High/low temperatures
   iv. Communication issues
   v. Other abnormalities

G. The Contractor shall manage all software/firmware versions of the installed devices during system and project integration and provide associated point maps for the delivered system revision to the project integrators. No software/firmware updates are allowed without informing the Owner and EMS provider.

3.1.4 Battery Enclosure

1. All components shall be contained within a non-occupiable, weatherproof, tamper resistant, containers or purpose-built enclosures suitable for mounting outdoors on a concrete, fiberglass or equivalent pad with a minimum NEMA 3R or IP54 rating if installed in a standalone outdoor application, or within a shelter that meets all seismic, safety, environmental controls, thermal management and fire resistance requirements stated in this specification and as required for the operation of the BESS Facility.
2. Enclosures must not have a history of water egress caused by manufacturing defect.
3. Enclosure shall include all internal DC and AC systems necessary for the operation of the BESS Facility to address thermal management, control power, fire detection, fire suppression and deflagration as applicable to the Battery System design.
4. Battery Systems should be shipped fully assembled to the extent practical to maintain compliance with UL 9540 certification.
5. Where multiple doors in one enclosure are required, doors arranged and that open in pairs are preferred, with latch at center and left door swinging to user’s left side and right door swinging to user’s right, to provide best access to Battery Racks and subsystems.
6. Enclosure Type to be a “containerized” or prefabricated enclosure and sub-system. No custom structures can be built at the site.

7. Environmental cooling / heating / humidity control systems, as required for the operation of the BESS Facility and to maintain temperature within warranty conditions. EMS shall be capable of starting and stopping the environmental control system and adjusting system setpoints, within parameters allowed by the Battery System warranty.
8. All Battery System components shall be fully accessible for maintenance and inspection, within the enclosure, and design shall include means for safely removing battery modules and other components.
9. Container-level, module and Battery System monitored points, warnings and alarms should include:
   - Fire Alarms
   - FPS
   - Deflagration Gas Sensor Alarms
   - Automatic Deflagration Venting Systems
10. The BMS should provide identifying information to localize the warnings and alarms and have deterministic documentation of the time of the event(s).
11. Enclosures shall be suitable for mounting outdoors on a concrete pad, piling, piers or other structure as required by OEM.

3.1.5 Thermal Management

1. The thermal management systems shall be provided to ensure equipment OEMs recommended warranty conditions are always met.
2. The thermal management equipment and systems shall be heavy-duty, industrial grade design, construction, and installation designed to provide a minimum 20-year life expectancy.
3. The thermal management system should adhere to American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) design requirements.
4. Design calculations shall include cooling load calculations, heating load calculations, ventilation calculations, psychometric calculations, and pressure drop calculations.
5. Cooling equipment capacity shall be sized based on end-of-life battery state-of-health (70-80%) heat dissipation coincident with maximum design ambient heat gain.
6. The thermal management equipment shall be arranged to provide maximum efficiency of operation and to provide easy access for performing routine maintenance.
7. Equipment redundancy shall be provided such that failure of a single unit does not result in loss of more than 50% cooling capacity.
8. The thermal management control system shall monitor any equipment failures resulting in loss of cooling capacity. Diminished cooling capacity shall be interlocked with the Site Controller to limit battery charging/discharging rate as necessary to avoid cooling system overload. Battery state of health should be taken into consideration when developing charge/discharge rate limit.
9. The thermal management systems shall interface with fire protection systems, in accordance with NFPA, other applicable codes, and the results of UL9540A.
10. All temperature data points recorded in site data historian shall be functionally verified for proper operation, accuracy and calibration.
11. After installation, HVAC systems, if utilized, shall be functionally tested by NEBB-certified technicians to verify proper operation.

3.1.6 Fire Protection System

General

1. Fire and smoke heat detection, suppression, management, isolation, etc. shall be as designed and provided to satisfy NFPA 855, UL 9540 certification and UL 9540A performance test approvals (see <u>Section 6.0 Codes and Standards</u>).
2. Contractor should specify the detection method(s) integrated into the Battery System enclosure. This can include but not limited to off-gas, ionizing, laser, aspiration, and/or heat-based detection systems.
3. System to include all components, connections, programming and equipment to provide a complete, automatic fire protection and detection system including, but not limited to, fire alarm panels / modules, detection devices, annunciation devices, suppression piping and / or agents, as needed.
4. Deflagration systems shall be based on gas production demonstrated in UL 9540A, and shall meet either NFPA 68 or 69. If NFPA 68 is used, then calculations demonstrating that the venting is adequate for the gas production measured in the UL 9540A shall be provided. Similarly, if active venting per NFPA 69 is used, calculations demonstrating that the Lower Explosive Limit (LEL) is maintained below 25% shall be provided.
5. Heat, smoke, and gas detectors shall be part of the FPS to meet NFPA 72 and other applicable codes and standards.
6. Active Venting shall be provided and integrated into controls if required for compliance with <u>Section 6.0 Codes and Standards</u>. Venting shall have the option to be activated manually, and with provision for natural ventilation when power is not available.
7. Notification audible horns, visual lights and other notifications must be visible from nearest site access road.
8. Clean Agent systems, if utilized, shall be in accordance with the prevailing versions of NFPA 2001 and NFPA 855. A clean agent fire suppression system shall be FM200, NOVEC 1230, or equal. CO_2 systems are not acceptable.

<u>Fire Detection and Alarm</u>

1. Each independent FPS shall be designed to provide fire detection and annunciation in each of the areas affected.
2. Each detection control panel shall continuously monitor its detection systems for fire or trouble condition and activate the appropriate fire or trouble alarm(s). These detection and alarm functions shall be performed independently of any other plant equipment or facility.
3. Fire detection or fire alarms at any Battery System shall shut down the affected BESS Facility, and the PCS unit associated with the affected BESS Facility to prevent possible supply of additional energy to the affected unit.
4. All FPS wiring installed above ground shall be installed in ridged metallic conduit. All fire system wiring shall be installed in dedicated raceways, above and below ground.

<u>Addressable Fire Alarm Panels / Modules</u>

1. Local control Fire Alarm Control Panels (FACP) shall be furnished and installed to monitor distributed sensors and control units.
2. Main fire panel shall remotely transmit and annunciate all Fire, Trouble and Supervisory conditions to the BESS Facility EMS, and to a manned location as designated by the Owner if required per applicable codes, standards, and local requirements.
3. Each local control panel shall be named and identifiable and be capable of operation as a stand-alone system with its own internal secondary power via battery backup. Each remote device shall be addressable and communicate to local panel via Signal Line Circuit (SLC).
4. The addressable local control panel(s) shall monitor and announce alarms, trouble, and supervisory signals for each of the fire protection and detection devices and systems. The panel shall be of modular construction and in an accessible location.

5. The panel for each clean agent or pre-action sprinkler system shall also continuously monitor the systems to ensure the availability and proper operation of each system and to annunciate distinctly supervisory and trouble alarms.
6. Provision shall be made for extending the FACP to all planned BESS Facility augmentation units, if applicable, over the lifetime of the project.
7. Each local control panel shall continuously monitor its associated fire suppression and/or detection system(s) for fire alarms, supervisory signals, and circuit trouble signals.
8. Auxiliary shutdown functions, where required, shall be designed, furnished, and installed, as a minimum, per applicable codes, standards, and local requirements.
9. FPS wiring shall include surge protection, per applicable codes, standards, and local requirements.
10. Upon receipt of any fire alarm signal the local alarm panel shall activate interior and exterior fire alarm horns/strobes.

Testing

1. The Contractor's representative shall coordinate and provide final testing for FPS. The Contractor shall be responsible for costs associated with initial testing as well as costs to correct deficiencies and retest.
2. The Contractor shall notify Owner and Authority Having Jurisdiction (AHJ), if required, at least 5 days in advance of beginning of each test. Final FPS acceptance shall be determined by the Owner.
3. Documentation of the inspections and tests shall be maintained by Vendor and furnished to Owner.
4. Defects found by these inspections and tests shall be re-inspected following repair by the same method and technique which originally identified the defect.
5. Acceptance shall be based on identical acceptance criteria.
6. Inspection and tests shall be in accordance with NFPA as a minimum.
7. All parties necessary to sign off on test results shall be obtained.

3.1.7 Protection and Isolation

1. The design of the protection and isolation systems shall accord with the applicable codes, standards and regulations in Section 6.0 Codes and Standards.
2. Each party providing equipment for the BESS Facility is responsible for the design and implementation of the necessary protection coordination schemes and systems for their respective equipment.
3. Each DC bus shall have a lockable, load-break, two-pole, disconnect switch for the main DC power. The means of disconnection shall be visible and shall be capable of being locked in the open position (lockout).
4. Each Battery Rack section (or pair of sections if applicable) shall include a load-rated disconnecting means, to allow isolation of the Battery Rack's modules from the DC bus by the BMS.
5. All live conductors shall be insulated and/or covered such that no part of any live conductor shall be possible to touch by any person.
6. All exposed conductive elements shall be grounded in accordance with applicable codes, standards and regulations.
7. The polarities of all connections (Battery Cell, Battery Module, etc.) shall be marked and clearly visible.
8. Arc flash hazard arising from modules and racks partially and fully assembled shall be calculated and the incident energy exposure for those assembling or maintaining the BESS Facility minimized.
9. Any door providing access to an enclosure containing battery modules and ancillary equipment shall be lockable, with locks and keys supplied. Doors, locks and keys shall be permanently labelled with a coherent and logical identification system and prevent unauthorized access.

10. The Battery System shall have self-protective and self-diagnostic features to protect itself from damage due to failure of another component in the BESS Facility or excursion of operating parameters outside of permitted ranges.
11. The Battery System shall have self-protective capability that in an event of loss of mains and auxiliary loads, the Battery System shall shut down and protect itself from excessive energy capacity drain from the cells and state of charge falling below safe design limits. On return of mains connection, the Battery System shall be capable of returning safely to operation automatically or via remote control.
12. All electrical connections shall be designed to withstand the electromagnetic forces exerted upon them during short-circuit conditions. This shall be evidenced by calculation.
13. The Battery System shall meet applicable codes and standards for chemical storage, usage and spill containment, and the Contractor shall deliver all associated documentation to the Company.
14. The battery system shall be able to withstand all reasonably-foreseeable mechanical shock loads including transport and installation.
15. The Contractor shall deliver a Battery System capable of topping up battery charge (using a portable generator or otherwise) to prevent damage to battery cells during a period of prolonged downtime at the POI.

3.1.8 Design and Technical Support

1. The Contractor shall provide design and technical support for design and development of associated components by the EMS Provider, if a different party than the Contractor, and the EPC to include:
   A. DC cabling between the Battery System units and the PCS DC terminals.
   B. Auxiliary electrical distribution system and cabling.
   C. Interface with or connection to fire alarm system at the project site.
   D. Modbus TCP or DNP3 support and parameter mapping to all supplied equipment and components, to support EMS integration.
   E. Grounding grid requirements.
   F. Documentation in Exhibit M-1 Contractor Deliverables.
2. As it pertains to Scope of Supply, calls and meetings may be necessary to coordinate with other project design teams, suppliers, or trouble shoot issues through the course of the project, and the Contractor is expected to participate in these meetings.

3.2 Power Conversion System

3.2.1 Overview

1. The PCS shall consist of inverters, medium voltage transformers, protection, thermal management and isolation devices, close-coupled as a complete skid-mounted assembly. A combination PCS/MVT skid is also acceptable.
2. Contractor shall ensure the inverter and transformer design are adequate to perform the intended functions specified herein, and with utility operating requirements.
3. Contractor shall ensure the selected inverter is optimized to maximize power and energy generation for the environmental design requirements specified.

3.2.2 Technical Requirements

1. Active power (MWac) output shall be rated in accordance with the following design conditions:
   A. For ambient temperatures up to the Annual Cooling Design Temperature and DC voltages within the manufacturer-rated range, the inverters shall be capable of continuous operation without any de-rate in output. The manufacturer shall provide the de-rating curves for both temperature and voltage outside of the specified range.
   B. For ambient temperatures up to the Extreme Annual Dry Bulb Temperature and DC voltages within the

manufacturer-rated range, the inverters shall be capable of continuous operation at unity power factor at the POI without any de-rate in output. A gradual de-rate will be experienced in case the conditions exceed its rated DC voltage or the Annual Cooling Design Temperature. The manufacturer shall provide the de-rating curves for both temperature and voltage.

2. Apparent power (MVA) output shall be rated in accordance with the following design condition:
    C. For ambient temperatures up to the Extreme Annual Dry Bulb Temperature and DC voltages within the manufacturer-rated range, inverters shall be capable of operating continuously at reactive power requirements specified in the project technical description can be maintained at the project POI, without any de-rate in output power (this may be a greater or lesser than the power factor stated, in order to overcome losses and effect in medium voltage equipment and connecting lines.
3. Preference for 600 V primary voltage output.
5. Inverter shall be designed to Applicable Codes, including IEEE 2800 (2022).
6. Inverters shall be programmed in accordance with the requirements of the Interconnection Agreement and within the permissible range of the inverter control parameters.
7. Inverter shall have voltage and frequency ride-through capabilities that are in accordance with IEEE IEEE 2800 (2022), NERC Reliability Guidelines on BPS Connected Inverter-Based Resources (2018), and in accordance with pending ERCOT Inverter Based Resource (IBR) requirements per Nodal Operating Guide Revision Request (NOGRR) 245.[2]
8. Provisions to be provided to allow for unit removal and replacement.
9. Inverter shall be compatible with the SCADA System described below and should have the option for remote control of real power output. This shall be accomplished by Owner's EMS through an on-site RTU.
10. Owner shall reserve the right to attend factory witness testing of PCS.
11. Inverter shall provide ground / ground fault monitoring, protection and alarms for the grounded or ungrounded DC bus and collection systems.
12. Inverter shall provide DC disconnecting means required in NEC code.

3.2.3 Design and Technical Support

1. The Contractor or equipment provider shall provide design and technical support for design and development of associated components to include:
    A. AC cabling, bussing or other connection from PCS to PCS MVT units.
    B. DC cabling between the Battery System units and the PCS DC terminals.
    C. Auxiliary electrical distribution system and cabling.
    D. Interface with or connection to fire alarm system at the project site.
    E. Automation and control, including Modbus TCP or DNP3 support and parameter mapping to the control units in all supplied equipment and components.
    F. Grounding and ground grid requirements.
    G. Documentation in Exhibit M-1 Contractor Deliverables.
2. Provider to support conferences, meetings, submittals, etc. as may be necessary to coordinate with other project design teams, suppliers, or to trouble shoot issues through the course of the project.

3.3 Medium Voltage Transformers

3.3.1 Overview

[2] https://www.ercot.com/files/docs/2023/01/11/245NOGRR-01%20Inverter-Based%20Resource%20(IBR)%20Ride-Through%20Requirements%20011123.docx

1. The Contractor will be responsible for the design, engineering, procurement, shipping, and installation of the MV Power transformers. Contractor shall ensure transformer units proposed are compatible with transformer specifications outlined below:
    A. Primary voltage: as shown in project description and project diagrams.
    B. Secondary Voltage: The secondary voltage shall match the output AC voltage of the PCS units(s).
    C. Power ratings: Coordinate with the nominal and maximum outputs of the PCS units, for the project environmental conditions indicated.

3.3.2 Technical Requirements

1. High efficiency: 98.5% minimum, at 100% of nameplate MVA rating.
2. Oil level, pressure/vacuum and oil temperature gauges. Oil level gauge, oil temperature and pressure instruments to be furnished with alarm contacts.
3. Compartmental pad-mount design, dead front, loop feed conforming to IEEE/ANSI C57.12 series standards for the type (liquid-filled or dry-type) and MVA rating of the transformer proposed.
4. The design shall provide minimum clear working space in front of transformers conforming to NEC Table 110-34(A). The equipment shall also conform to all applicable standards of ANSI, NEMA, UL, NEC, NESC, and IEEE C57.12. UL certification must be performed at manufacturer level, not on site.
5. Design life: 35 years from Substantial Completion
6. Ratings: As required by the inverter configuration to equal or exceed the MVA rating of the inverter(s). Impedance 7% or lower; Cooling class = ONAN/KNAN or better.
7. BIL ratings: Winding configuration should match eventual Owner specifications.
8. Temperature ratings: 65 °C average winding rise/65°C top oil rise/85°C hot spot rise. Peaking transformers may be utilized.
9. Ambient temperatures: As required, according to Site conditions and as described in Section 2.0.
10. Other environmental conditions as required by Project location.
11. Aluminum or copper windings.
12. Hook stick, load-break disconnect switch externally accessible.
13. Overcurrent protection via current limiting fuse/expulsion fuse pair (or VFI) and current limiting fusing. Bay-O-net fuses are preferable (in-take fuses prohibited). Dry contact alarms acceptable.
14. Insulating fluid shall contain less than 1 PPM PCBs and the nameplate shall be marked accordingly. Secondary containment of transformer insulating fluid, if required, shall be provided and designed in compliance with all applicable environmental regulations.
15. Owner shall reserve the right to attend factory witness testing of MV step-up transformers.
16. Electrical cable to the substation shall be run in an underground system.
17. Features shall include:
    A. Drain valve with oil and dissolved gas analysis sampling provisions on the exterior of the transformer main tank.
    B. Automatic pressure-relief valve.
    C. The Facility layout design to accommodate the installation of oil containment, ensuring that the insulating oil (mineral, vegetable or other) within the units doesn’t leave the site. Oil containment is required for this site and should be communicated and documented in the site SPCC Plan.
    D. Oil level sight glass.
    E. NEMA 2-hole ground terminal pads.
    F. Surge arrestors shall be provided on one set of medium voltage bushings of the last transformer of each radial feeder and shall be connected by a copper ground bus to ground pads at base level. Surge arrestor class shall be dictated by the short-circuit study. Alternatively, surge protectors may be installed on the first and last transformers on the chain.

G. Steel divider between MV and LV compartments.

H. The secondary compartment door catches shall be caught at the three points and the handle shall be capable of being padlocked, and a penta-head bolt shall provide additional means of securing the door. The penta-head bolt shall be spring loaded to hold it in a retracted position unless threaded into the nut. The handle shall not be capable of being padlocked until the penta-head bolt is seated. The high voltage compartment shall be secured in place with one or more captive penta-head bolts.

I. Both compartment doors shall be equipped with stops for holding each door in a minimum 90° position. The stops shall be captive to prevent loss of the device and for convenience. Each door shall include a factory-installed flexible ground conductor connecting the door to the compartment.

J. Lifting lugs and corresponding lifting plan.

3.3.3 Design and Technical Support

1. The Contractor or equipment provider shall provide design and technical support for design and development of associated components by the provided transformer Provider to include:
   A. AC cabling, bussing or other connections from PCS, and to Project MV wiring system.
   B. Auxiliary electrical distribution system and cabling.
   C. Interface with or connection to fire alarm system at the project site.
   D. Automation and control, including Modbus TCP or DNP3 support and parameter mapping to the control units in all supplied equipment and components.
   E. Grounding and ground grid requirements.
   F. Documentation in Exhibit M-1 Contractor Deliverables.
2. Provider to support conferences, meetings, submittals, etc. as may be necessary to coordinate with other project design teams, suppliers, or to trouble shoot issues through the course of the project.

3.4 EMS / PPC and Integration

1. Contractor shall procure, install, integrate, commission, and test the EMS/PPC system so that it shall be a fully functioning and integrated EMS system.

2. Refer to Exhibit A-2 Scope of Work EMS/PPC for requirements.

3.5 Spare Parts

1. Contract to provide Owner with a list of required spare parts included in the warranty and performance guarantees. Spare parts can be housed in an onsite O&M building at Project.

4.0 Commissioning and Testing

The Contractor shall:

1. Supply installation and commissioning plans and procedures, for review / comment / acceptance by the Owner. Plans shall be customized and specific for the actual project and equipment provided to that BESS Facility, and shall include de-energized, energized and full power inspections and commissioning.

3 Provide the FAT test plan and results for major equipment. The Owner shall reserve the right to attend factory witness testing of Battery Cell, Battery Module, Battery System, PCS, MVT, Power Unit or Full System FAT.

4 Provide and perform the Battery System, PCS and MVT Cold Commissioning process. Hot Commissioning cannot begin until the Cold Commissioning process is completed.

5 Shall provide the test plan and perform the Battery System, PCS and MVT Hot Commissioning. Successful completion of Hot Commissioning shall be validated through the BESS Facility EMS HMI.

6 Provide inspection and certification of the BESS Facility FPS and FACP.

7 Perform Power Unit Commissioning Testing (see Exhibit F-4 BESS Unit Commissioning Plan). Contractor may provide a suitable substitution for approval by the Owner. Successful Unit Commissioning Testing shall be validated through the BESS Facility EMS HMI and meter readings prior to the start of Substantial Completing Testing.

8 Perform Substation Completion Testing (see Exhibit F-5 Substantial Completion Test Plan) of the BESS Facility. Successful Substantial Completion Testing shall be validated in the BESS Facility EMS HMI and by main meter at the POI.

5.0 Contractor Deliverables

1. Refer to Exhibit M-1 Contractor Deliverables for document deliverable requirements.

6.0 Codes and Standards

The Contractor shall:

1. Design and manufacture all equipment and perform all work in accordance with any codes, standards, or requirements set forth in any Applicable Law, including any applicable federal, state or local code, the latest standards of the Institute of Electrical and Electronic Engineers (IEEE), National Electrical Manufacturer's Association (NEMA), American Concrete Institute (ACI), American National Standards Institute (ANSI), International Code Council Code (ICC), National Fire Protection Association and the North American Electric Reliability Corporation (NERC), as well as the latest editions of the National Electrical Code and the National Electrical Safety Code (NESC), to the extent not inconsistent with the foregoing, in each case as modified from time to time.
2. Follow codes, standards, regulations and test plans listed below based on adopted versions at Notice to Proceed (NTP). The following list is not exhaustive, and the Contractor is responsible for following all state, local, federal and AHJ requirements and best practices at all times.

General

NESC	National Electrical Safety Code
ANSI C2	National Electrical Safety Code
ANSI Z535	Product Safety Signs and Labels
ASHRAE 169	Climatic Data for Building Design Standards
EPA	EPA Clean Water Act
EPA	EPA Clean Air Act
EPPA	Puerto Rico's Environmental Public Policy Act
IEEE 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE 519	Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
IEEE C37	Surge withstand capabilities, whenever applicable
IEEE C57	Transformer Standards, whenever applicable

IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 400.2	VLF Withstand Test Voltages for Sinusoidal and Cosine-Rectangular Waveforms
IEEE 1584	Guide for Performing Arc-Flash Hazard Calculations
IFC	International Fire Code 2021 (chapters 9 and 12)
NFPA 1	Fire Code
NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 68	Standard on Explosion Protection by Deflagration Venting
NFPA 69	Standard on Explosion Prevention Systems
NFPA 70	US National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response

Battery System

IEEE 2030.2.1	Guide for Design, Operation, and Maintenance of Battery Energy Storage Systems, both Stationary and Mobile, and Applications Integrated with Electric Power Systems (2019)
IEEE 2030.3	Standard Test Procedures for Electric Energy Storage Equipment and Systems for Electric Power Systems Applications
NFPA 68	Standard on Explosion Protection by Deflagration Venting
NFPA 69	Standard on Explosion Prevention Systems
NFPA 70	US National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 855	Standard for the Installation of Stationary Energy Storage Systems (2023 Edition)
NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems (2002)
UL 1642	Standard for Lithium Batteries (Cells), 6th Edition
UL 1973	Batteries for Use in Light Electric Rail Applications and Stationary Applications (Modules), 3rd Edition
IEC 62619	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications.
UL 9540	Energy Storage Systems and Equipment, 3rd Edition
UL 9540 A	Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, 4th Edition
UN 38.3	Energy Storage Installation. Standard. Transportation Testing for Lithium Batteries

PCS

UL 62109-1	Safety of Power Converters for Use in Photovoltaic Power Systems - Part 1: General Requirements
IEEE 2800 (2022)	Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems

IEEE 519 (2022)	Harmonic Control in Electric Power Systems

Enclosure

UL 50E	ESS Enclosure

Control Equipment and Communications

ANSI/IPC D30OG	Printed Board Dimensions and Tolerances
ANSI/IPC A610B	Acceptability of Printed Boards
IEEE P2688	Recommended Practice for Energy Storage Management Systems in Energy Storage Applications
NECA/BICSI 607	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
UL 1778	Uninterruptible Power Systems (UPS) for up to 600V A.C.

Fire Suppression

NFPA 2001	Standard on Clean Agent Fire Extinguishing Systems

Instrument Transformers

IEEE C57.13	IEEE Standard Requirements for Instrument Transformers
IEEE C57.13.2	IEEE Standard Conformance Test Procedures for Instrument Transformers

Cybersecurity

E.O. 13920	Department of Energy Executive Order Securing the United States Bulk-Power System, May 2020
ISO/IEC 27001	Information Security Management
NIST 800-82	Guide to Industrial Control Systems (ICS) Security
NIST 800-53	Security and Privacy Controls for Federal Information Systems and Organization

PREPA

PREPA Protection and Control Design Criteria
PREPA Substation Design Criteria
PREPA Transmission Design Criteria
PREPA Distribution Design Criteria
PREPA Drawings and Specifications Design Criteria
PREPA Telecommunication Design Criteria