Project Technical Specification for the Installation of Battery Energy Storage Systems (BESS) at Kimberley Airport and George Airport
RA 8018-2026RFP

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Table of Contents

Abbreviations and Acronyms

AC	alternating current
LA	Local Authority (Municipality)
BESS	battery energy storage system
IEC	International Electrotechnical Commission
IFC	International Fire Code
kW	kilowatt
kWh	kilowatt-hour
NFPA	National Fire Protection Association
O&M	Operations and Maintenance
SOW	Scope of Work
UL	Underwriters Laboratories
GRG	George Airports Company South Africa
KIM	Kimberley Airport

1. Generally Applicable Requirements

1.1 Install Battery Energy Storage System (BESS)

1.1.1 The Contractor shall design and build a minimum of: -

1.1.1.1 **George Airport:** 750kWp Battery Power and a Useable Capacity of 1 400kWh behind-the-meter Lithium-ion Battery Energy Storage System (BESS). The Contractor shall provide all labor, material, equipment and engineering to design, install, commission, and interconnect a BESS as required herein.

1.1.1.2 **Kimberley Airport:** 500kWp Battery Power and a Useable Capacity of 1 000kWh behind-the-meter Lithium-ion Battery Energy Storage System (BESS) . The Contractor shall provide all labor, material, equipment and engineering to design, install, commission, and interconnect a BESS as required herein

1.1.2 Electricity from the BESS must be provided at: -

1.1.2.1 Kimberley Airport:
50 Hertz and at the appropriate voltage for electrical interconnection to the Site at 380/400VAC 3-phase on the electrical distribution system. The BESS will interconnect at interconnect at a DB point on the airfield side of Kimberley Airport

1.1.2.2 George Airport:
50 Hertz and at the appropriate voltage for electrical interconnection to the Site at 380/400VAC 3-phase on the electrical distribution system. The BESS will interconnect at a DB point on the airfield side of George Airport

1.1.3 The BESS, and associated equipment, shall be provided in self-contained enclosure(s) rated for the site conditions. BESS enclosures will be installed on a concrete pad or piers constructed by the Contractor at George Airport and Kimberley Airport specific locations as shown in the Site Information. Contractor provided thermal conditioning systems shall maintain ambient temperature within BESS warranty requirements.

1.1.4 BESS components and associated ancillary equipment shall have working space clearances required by local code, and electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of environment.

1.1.5 The Contractor shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems are in proper working condition. The Contractor shall commission the BESS and provide a commissioning report documenting BESS performance during normal grid-tied operations and during grid failure, if applicable. Commissioning shall comply with the applicable local codes and standards.

1.1.6 The Contractor shall provide a bid for a 60month maintenance and services plan for consideration by ACSA.

1.1.7 The Contractor is responsible for all permits, approvals, environmental compliance, freight, procurement, monitoring, site inspection, and incidentals as necessary to design, construct, and interconnect the complete BESS, described hereinafter.

1.1.8 The Contractor shall provide and install all safety systems as required by the applicable local codes and standards. This includes but is not limited to explosion control system(s); fire, smoke, and gas detection system(s); and fire suppression systems where applicable.

1.2 Existing Feasibility Studies and Engineering Studies Done by Others

The Contractor is responsible for ascertaining relevant site conditions to determine project feasibility and final BESS size, subject to the specified minimum size constraints, according to the terms of this solicitation. If any existing engineering studies or facility conditions reports are provided through this solicitation with the site information package or from an ACSA representative, the Contractor shall independently verify all information provided.

1.3 Codes, Standards, and Regulations

The Contractor shall be in compliance with one of the nationally recognized model building codes and with other applicable national, and local codes. The latest edition of the local and nationally recognized codes and any updated supplements in effect at the time of the contract award shall be used throughout the project design and construction. Codes and standards applicable to the BESS project can be found below.

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

1.3.1. All work must follow current requirements and Grid interconnection standards, as applicable to the project as a whole:

a. Electricity Regulation Act 4 of 2006 as amended by the Electricity Regulation Amendment Act 28 of 2007 (ERA)
b. South African Grid Code (all parts)
c. South African Distribution Code (All parts)
d. South African Battery Energy Storage Facility (BESF) Grid Code
e. Grid Connection Code for Renewable Power Plants Connected to the Distribution System in South Africa
f. South African National Standards SANS 10142-1
g. South African National Standards SANS 10142-1-2
h. Other applicable SANS Standards
i. Municipal policy and legislation (Municipal by-laws)
j. National Environmental Management: Waste Act 59 of 2008

1.3.2. Battery cell:

UL 1642 - “Standard for Lithium Batteries”

1.3.3. Battery module:

UL 1973 - “Batteries for Use in Light Electric Rail Applications and Stationary Applications”

1.3.4. Battery system:

a) UL 9540 - “Energy Storage Systems and Equipment”

b) UL 9540A - “Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems”

1.4 Interconnection to Electrical Distribution Systems

It is the sole responsibility of the Contractor to meet Eskom interconnection requirements. The Contractor shall provide supporting documentation or drawings required by Eskom. Any local codes required by utility interconnection laws and regulations shall be followed by the Contractor.

ACSA-Owned Electrical Distribution System Requirements:

a) Modifications or upgrades to the ACSA-owned electrical system required to interconnect the BESS are the responsibility of the Contractor (e.g., service panel, generator coordination). The Contractor is responsible for the proper circuit sizing, overcurrent protection, and coordination of the circuit(s) beyond the point of interconnection to ACSA distribution system, including modifications to the site’s electrical equipment and circuits. Any needed upgrades or modifications to existing ACSA electrical distribution systems must be included in the review and approval process outlined in the submittal section herein.

Eskom Electrical Distribution Systems Interconnections:

a) The Contractor shall provide for interconnection of the behind-the-meter BESS with the Eskom-owned electrical distribution system and take actions to ensure that the ACSA and Utility-owned systems are compatible. Modifications or upgrades to the Eskom electrical system for interconnection are the responsibility of the Contractor. The Contractor will assume the costs of these modifications. Any modifications to the approved BESS design that would affect the electrical distribution system shall require the written approval of ACSA.

b) The Contractor is responsible for complying with all Eskom interconnection requirements, including upgrades, providing all necessary BESS details for the interconnection applications, and funding any required interconnection studies to be performed by or on behalf of the electric utility. The Contractor is responsible for gaining approval from Eskom for interconnection and any Eskom required upgrades.

1.5 Work Planning

The Contractor shall notify the ACSA of any Contractor-planned Eskom service interruption not later than five (5) working days prior to beginning the scheduled work that requires Eskom service interruption. ACSA shall coordinate all Eskom outages and secure a final date when the outage may proceed. Every reasonable attempt shall be made to secure the Contractor’s requested date. Under no conditions shall the Eskom service be interrupted by the Contractor without prior written approval by the ACSA.

1.6 Permits and Licensing

The Contractor shall be responsible for:

a) Preparing all permitting and licensing applications for the project

b) Paying all fees and complying with all requirements

c) Providing any supporting documentation, data, and information that may be required for permitting

d) Coordinating and acting as the primary liaison with permitting and licensing agencies.

1.7 Local Authority Having Jurisdiction Involvement

The Contractor shall involve the Local Authority (Municipality) responsible for fire protection to provide permitting (where locally required), and design review and approval. The Contractor shall submit all required construction documents, as applicable, for Local Authority review. The installation shall not proceed until Local Authority approval has been granted.

The Contractor shall coordinate emergency planning and training. This may include inviting local firefighters as well as facility staff to an on-site training where attendees will be shown how the BESS works, be trained on BESS safety systems, and review the emergency operations plan and any agreed upon response procedures. The emergency operations plan shall be developed by the Contractor and made available for use by facility personnel, maintenance personnel, and first responders. The Contractor shall coordinate with the local fire department on BESS setback requirements, first responder training, and posted instructions for shutoffs.

1.8 National, Provincial, and Local Rebates and Incentives

The Contractor shall complete and submit in a timely manner all documentation required to qualify each system for available rebates and incentives. Tax incentive eligibility due diligence shall be the responsibility of the Contactor and not ACSA.

2. Engineering and Construction

2.1 BESS Project Description

2.1.1 The design and engineering phase is crucial in the implementation of a Battery Energy Storage System (BESS) as it ensures that the system is sized and tailored to meet specific project requirements of the Airport. This phase involves creating design documents that comply to technical specifications upon assessing the site for optimal equipment sizing and placement and ensuring compatibility between the solar PV plant and the BESS. By addressing these aspects, the design and engineering phase helps shall maximize the system's performance, reliability, and integration with existing infrastructure, ultimately supporting the project's goals of reducing grid dependency, lowering operational costs, and enabling smart grid functionalities. The system design will also be cognisant to the energy demand of the airport over the lifecycle of the installation. The Contractor shall include BESS submittals in the proposal phase, including:

2.3. A site plan showing the BESS footprint, including the location and layout diagram of the room or area in which the BESS is to be installed, including anchoring and/or structural support points.
2.4. Electrical schematic diagrams (interconnection, system one-line diagrams)
2.5. Usable energy storage capacity (kWh)
2.6. Rated power (kW AC)
2.7. Round trip efficiency (including auxiliary loads)
2.8. Cycle life
2.9. Annual degradation factor
2.10. Ambient temperature control system
2.11. Details on fire suppression, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration prevention and/or venting systems, if provided
2.12. Alarm hierarchy, integration, and monitoring design as approved by the AHJ
2.13. Location and content of required signage

2.14. Manufacturer's specifications, ratings, and listings of BESS and associated equipment
2.15. Fire and explosion testing data, hazard mitigation analysis (HMA), and calculations or modeling data to determine adequacy of explosion control, where required by applicable codes and standards
2.16. Equipment manufacturers and product names
2.17. Battery Management System provider and sequence of operations
2.18. Maintenance requirements
2.19. Commissioning and decommissioning plans.

2.1.2 The Contractor shall identify an appropriate location for the balance of system enclosure(s), and related components and environmental control systems that will meet the following criteria:
a) Ease of maintenance and monitoring
b) Efficient operation
c) Low operating losses
d) Secured location and hardware
e) Compatibility with existing facilities
f) Minimum vegetative and landscape impact
g) Minimum clearances around BESS and balance of system.

2.1.3 All balance of systems (wiring, component, conduits, and connections) shall be suited to the conditions for which they are to be installed.

2.2 Performance

2.2.1 Grid outage scenario: Integrate the BESS with the PV Solar Plant at Kimberley Airport and George Airport and automatic transfer switch (ATS). Install a microgrid control system and modify the existing ATS as necessary to provide electricity to the building upon grid failure. The Contractor shall include the creation of a critical power circuit, including rewiring of the critical loads and installation of critical power switchgear, in the scope of the work.
a) Consider the following site-specific parameters in the system design. Configure BESS to provide seamless transition between Eskom power and microgrid. Optimize system to minimize generator use to conserve fuel.
b) The BESS shall be demonstrated to perform on a recurring basis to ensure the ACSA's desired site resilience and energy assurance. This interval testing frequency shall occur approximately every 12 months following final acceptance to ensure provision of power to the site in the event of a utility-provided power outage or interruption. This activity requires pre-coordination with the Eskom in accordance with the approved interconnection agreement, and that coordination shall be led by the Contractor in consultation with the ACSA's Maintenance and Engineering Management staff for each airport. This periodic demonstration shall stagger months, seasons, load, time of day, and weather variabilities, but shall be conducted at least every 12 months. Periodic testing will be the responsibility of George and Kimberley Airport Maintenance and Engineering Managers. In the event of an actual Eskom power interruption exceeding five (5) working days, the BESS's performance will satisfy this requested demonstration, thereby resetting the interval to 12 months prior to the next required demonstration. Any deficiencies or anomalies beyond expected design parameters, in an actual event or demonstration event, are to be reported to the ACSA within 48 hours in writing, with recommended remediation or corrective steps to prevent recurrence.

2.2.2 Demand control scenario: Integrate the BESS to provide grid electricity usage and demand control/peak shaving to limit demand (kW) to programmed setting. The BESS shall have a method for forecasting the peak load and automatically dispatching the battery or scheduling the charge/discharge in advance.

a) Time of Use Charge Reduction: Integrate the BESS to discharge during on-peak hours in accordance with the site's rate tariff.
b) A BESS-level control system shall be provided to control the charging and discharging of the equipment. The BESS control system shall be field programmable by connecting with a laptop and viewing/editing on a locally hosted web browser. Programming instructions and setpoints shall be shared with ACSA Maintenance and Engineering Management staff at each Airport.
c) BESS shall maintain a round-trip efficiency greater than 70% AC-in to AC-out (confirmable by operation over a single round-trip cycle from 0% state of charge to 100%, and back to 0% at standard conditions specified by the manufacturer), including thermal losses and auxiliary loads, over 10 years.
d) The Contractor shall guarantee annual BESS savings as established in the proposal. Savings will be generated by discharging the battery during on-peak periods, as well as during peak billing demand periods. The Contractor shall propose a methodology to calculate optimal savings, subject to review by the ACSA.

2.3 Thermal Management

The Contractor shall provide all components to operate the BESS within acceptable operating temperatures. Provide any thermal management systems and operating strategies required to maintain the BESS and inverter temperatures within manufacturer's recommendations at all times, including during shipment and prior to commissioning.

2.4 Arc Flash and Coordination Studies

The Contractor will perform arc flash and coordination studies of the system to ensure safety during operation in parallel with the grid.

2.5 Professional Engineer and Licensed Design Professionals

All engineering services shall be performed by professionally registered design engineer/s with the Engineering Council of South Africa.

2.6 Professional Registration

Each submitted final design drawing, calculation document, and specification manual shall be signed and dated by, bear the seal of, and show the Professional Registration (Pr.) Number of the Engineer who prepared the document and is responsible for its preparation.

2.7 Coordination of Professional Services

The Contractor shall be responsible for the professional quality, technical accuracy, and coordination of all investigations, evaluations, drawings, testing, cost estimates, submittals, written reports, construction, operations, and all deliverables, as required by this document or as required to complete the work of this contract.

2.8 Coordination of Subcontractors' Credentials

The Contractor shall ultimately be responsible for the completeness, accuracy, coordination, and submission of all submittals described above. Contractor may delegate the preparation of

submittals to subcontractors or suppliers as long as the intent of Sections 2.5, 2.6, and 2.7 of this specification is met.

2.9 Modifications and Alterations of ACSA Property

Modifications, alterations, and/or additions to existing facilities shall be designed and certified to satisfy applicable requirements of this Scope of Work (SOW) document and the governing codes and standards referenced in this SOW document. ACSA shall coordinate with building occupants and approve all modifications, alterations, and/or additions prior to completion of design.

2.10 Grounding

A suitable equipment grounding system shall be designed and installed for the BESS. The grounding system shall provide personnel protection for step and touch potential. The system also shall be adequate for the detection and clearing of ground faults within the BESS.

2.11 Structural

The vendor shall furnish the design for the structural components of the BESS, concrete pads/foundations as required, and conduit required for the complete BESS. All final (Issued for Construction) drawings, specifications, and calculations shall be stamped by a professionally registered Civil/Structural Engineer. The vendor is responsible for Geotechnical surveying if required.

2.12 Conduit and Preventing Water Intrusion

Conduit routing and fittings must be selected to prevent water intrusion into inverter enclosures, combiner boxes, switchgear, and transformers. Conduits are to provide fittings to allow water to drain prior to entering the electrical enclosure. Any exterior PVC conduit must be Schedule 80.

2.13 Locating Equipment

Major electrical components, including the inverter, isolation transformer, and metering, shall be installed in code-compliant enclosures. BESS location shall be above the 100-year flood plain and surge levels and shall be elevated higher than any pull vaults and conduit not sloped toward any BESS electrical component to prevent equipment flooding. BESS shall include a thermally conditioned enclosure. Site design should include egress for staff or other people onsite and access for emergency responders.

2.14 Expected Service Life

Unless noted otherwise, all materials furnished for the project shall have an expected service life of ≥15 years @80% DOD for George and Kimberley Airports.

2.15 Site Service Conditions

Materials shall be designed to withstand the year-round temperatures and conditions to which they are exposed (sunlight, heat, humidity, rain, wind, sand/dust, seismic activity, salt air, fog, marine corrosiveness, etc.).

2.16 New Equipment

The ACSA shall not accept used, reconditioned, after-market, or grey-market products or equipment. Any offeror supplying used, reconditioned, after-market, or grey-market products may be held responsible for damages to ACSA.

2.17 Markings (Labeling)

Strict conformance to system marking requirements of BESS and their components is crucial for the safety of operators, service personnel, emergency responders, and others. Include all required and desired labeling language in the design drawings for ACSA review. Provide all required markings, including but not limited to:

a) Electrical equipment and components used in BESS shall have markings that identify the manufacturer, size, type, ratings, hazard warnings, and other specifications.
b) Labelling shall include posted instructions for tasks that site staff may need to perform, such as system shutdown during an emergency.
c) All disconnects shall be clearly labelled, indicating operating system voltage, current, and system rating.
d) Equipment markings should never be removed and should be able to withstand the environmental conditions in which the equipment is installed (e.g., “UV rated” for outdoor labels, or on an embossed steel placard, designed for outdoor use and fastened with adhesive and rivets).
e) Markings must be visible or easily accessible during and after installation. The Contractor shall be responsible for all field-applied markings as required by local, state, and federal codes.

2.18 Battery Warranties

The Contractor shall provide the following performance warranties:

a) Full turnkey system warranty for two years from successful completion of the commissioning. The Contractor shall respond within three days if maintenance is required.
b) The batteries shall maintain their specified performance in line with Original Equipment Manufacture’s specification throughout its lifecycle

2.19 Operations and Maintenance

The Contractor or designated O&M provider shall conduct annual O&M and continuous monitoring to verify that the BESS is performing as intended per the proposed battery storage strategy and manufacturer recommendations and submit an annual report to the ACSA. The Contractor shall perform all required maintenance to the BESS to ensure that the system is performing as expected. Additionally, the Contractor shall:

2.19.1. Provide O&M training and supporting manuals to ACSA personnel
2.19.2. Perform updates to the BESS control system dispatch strategy if required due to rate tariff or major site load profile changes
2.19.3. Ensure that all system firmware is up to date and meets ACSA cybersecurity requirements.
2.19.4. Provide an annual O&M Report, including:
    a) Use case performance
    b) Battery outages with root cause summary and start and end time periods
    c) Summary of all O&M operations; repair and replacements
    d) Summary of safety incidents, causes, and resolutions.

2.20 Data Acquisition and Monitoring

The Contractor shall provide a turnkey data acquisition and display system that allows the ACSA to monitor, diagnose, and track the charging, discharging, and operating data of the BESS. A minimum requirement is the provision of a web-based monitoring and tracking system. The

Contractor shall provide an internet connection to the BESS, distinct from ACSA internet. Monitoring and tracking systems shall include a historical database and real time data portal capturing the data in 15-minute intervals. A minimum of 36 months of data shall be stored by the Contractor and be made available for ACSA download via the web portal. The data shall, at a minimum, comprise the following information and frequency of collection:

a) Date, time
b) Apparent power (kVA)/phase, real power (kW) and Volts on each phase; recorded in 15-minute intervals
c) BESS state of charge
d) BESS temperature, hourly average at hourly intervals
e) The web-based monitoring system shall report actual system performance and an estimate of expected performance

The system shall allow the Contractor to interact with the BESS control system to update settings and modify setpoints. Updates should be incorporated into the monitoring system throughout the contract term.

2.21 BESS Safety

2.21.1. The BESS shall have a data acquisition/monitoring/alarm system. The system shall be described in the offeror's proposal and shall include:
   a) Full monitoring of electrical power and related operational data, including voltage, current, and system temperature
   b) Visual and audible alarm if potential safety hazard exists
   c) Notification when preventive maintenance is needed
   d) System level alerts shall be provided by the manufacturer over customer interface.

2.21.2. The BESS shall contain protective relays, circuit breakers, or fuses which self-protect the BESS in the case of internal electrical faults. Set and adjust circuit protection devices according to a short circuit and coordination study.

2.21.3. A detailed plan surrounding battery cell thermal runaway detection and mitigation systems in the BESS will be included in the submittal process including temperature monitors and smoke detection equipment, and gas monitoring equipment capable of detecting thermal runaway.

2.21.4. A visible disconnect will be installed that isolates BESS in accordance with utility interconnection requirements.

2.21.5. All electrical equipment, enclosures, disconnects, and overcurrent devices shall be clearly marked and identified. Markings shall reference the same designations called out in the final design drawings.

2.21.6. Develop posted instructions for tasks that site staff may need to perform, such as system shutdown during an emergency.

2.21.7. Ensure site design is informed by an emergency preparedness strategy coordinated with local emergency management officials.

2.21.8. Contractor shall perform a safety risk assessment to include inverters, battery management systems, and energy management systems. This risk assessment shall include guides for ventilation and thermal management; for installation, maintenance, and operations; and for managing electrical, fire, and shock hazards.

2.22 Severe Weather

2.22.1 Flooding/Other Water Intrusion Considerations

a) Develop a comprehensive site stormwater management and drainage plan that encompasses location of BESS out of the path of stormwater flows.
b) In addition to code requirements, the design shall prevent scouring of soils in and around BESS to prevent loss of foundation integrity.

2.22.2. Wildfire —The Contractor is responsible for removing any vegetation adjacent to the BESS. Areas within 3 m on each side of an outdoor BESS shall be cleared of combustible vegetation and combustible growth. To limit the risk of wildfire damage, ensure the system is set back from flammable objects (trees, buildings) and ensure that a fire defensible perimeter is maintained. Coordinate vegetation management plan and defensible perimeter with the Local Authority to ensure adequate setbacks and mitigate fire risk.

2.23 The key deliverables for Design and Engineering phase shall include:

a) **Site Assessment:** Conduct a thorough site assessment to determine optimal size and placement of BESS, to determine the security requirements, as well as the balance of plant and the balance of power requirements. This shall include the validations of ACSA's defined use cases per airport.
b) **System Design:** Develop detailed designs (site layout, equipment enclosures, design drawings and design documents covering at a minimum the design methodology, underlying assumptions, and safety margins) for integrating the solar PV plant with the BESS and the implementation of the uses per airport. The existing grid-tied inverters shall be decommissioned and replaced by hybrid inverters to enable the flexibility to operate in both grid-tied and off-gird modes. The current performance of the Solar Plant will need to be assessed in line with the OEM performance guarantee and shall be augmented by at least 10% or more depending of the outcomes of the assessment at each site.
c) **Technical Specifications and Data Sheets/catalogues**: Define technical specifications for all components, including solar panels, inverters, batteries, and control systems. Thereafter, produce a detailed bill of quantities (BOQ) in preparation for the procurement phase and for approval by ACSA.

3 Procurement and Supply

The Procurement and Supply for a Battery Energy Storage System (BESS) involves sourcing high-quality components such as batteries and inverters in line with the approved designs and technical specifications, managing vendor relationships, organizing logistics for safe and timely delivery, maintaining inventory records, and ensuring all equipment meets quality standards. ACSA should be supplied with a performance guarantee for all key components that contribute to the overall performance of the system.

This also includes Factory Acceptance Testing (FAT) to verify that the BESS meets design specifications and functions correctly in a controlled environment before shipment. FAT involves a thorough review of technical documents, hardware inspections, functional and confirm performance testing, guarantees, design capacity, and safety checks. Additionally, visual inspections shall be conducted to identify any physical defects or deviations from design specifications, ensuring that all components are defect-free and assembled correctly before delivery. These steps are crucial to minimize the risks and to ensure the long-term reliability and performance of the BESS.

4 Construction and Installation

The Construction and Installation phase for a Battery Energy Storage System (BESS) entails preparing the site, including any necessary groundwork and the installation of electrical wiring, cabling, and terminations to ensure proper integration with existing infrastructure.

This shall also include Balance of Plant (BoP) by ensuring adequate ventilation based on the climatic conditions of the relevant Airport and implementation of the security measures in line with National Key Point Guidelines. The Contractor proposal will be reviewed and as required additional security measures authorised to be part of the final design. This phase ensures that all components are correctly installed and connected, laying the foundation for efficient and safe operation of the BESS.

Balance of Power shall also be taken into consideration by ensuring the energy stored is efficiently converted and distributed in line with the identified use cases. This includes the installation power conversion systems compatible with the identified uses cases, as well as implementation of the Battery Management System (BMS) and Energy Management System (EMS).

Key deliverables:

- Final Design philosophy
- As-built drawings
- Final Design documents
- Asset breakdown structure for purpose of capitalization
- Installed BESS system and auxiliary equipment as per the approved design ready for commissioning and testing

5 Inspections and Commissioning

5.1 Commissioning

The Commissioning and Testing phase for a Battery Energy Storage System (BESS) involves testing to ensure the system operates efficiently, as per design conditions, and safely. There should also be tests to demonstrate the design capacity of the full installation. This includes verifying the performance of the integrated solar PV and BESS against design specifications, conducting functional tests in line with the use cases, safety tests, and ensuring all components work seamlessly together. The phase also involves calibrating control systems, performing load tests, and validating the system's ability to meet operational goals. Successful commissioning confirms that the BESS is ready for reliable operation and integration with the existing infrastructure.

The contractor shall coordinate with a third-party Commissioning Agent on the following tasks. A commissioning plan shall be provided by the Contractor and approved by the ACSA prior to proceeding with inspection and commissioning:

a) After Eskom provides permission (interim for testing) to operate in parallel with the grid, the Contractor shall complete commissioning in accordance with Agency safety and Commissioning Agent’s commissioning plans, its own quality control plan, manufacturer's recommendations, and franchise utility interconnection requirements. The Contractor shall work with the Commissioning Agent to document all performance measurements.

b) The Contractor shall perform all work required for testing, start-up, and commissioning, under Commissioning Agent review and supervision.

c) The BESS shall be commissioned per the South African Energy Storage Commissioning Guideline Standards, or by a similar standard reviewed and approved by the ACSA.

d) The Contractor shall give the ACSA and Commissioning Agent 10 business days' advance notice prior to starting commission. ACSA Project Manager or representative may request to be present during any or all phases of the start-up, commissioning, and testing activities.
e) All subsystems and components shall undergo functional performance tests to demonstrate correct installation and operation.
f) The system shall be started-up and tested in accordance with the regulations of the applicable interconnection standards. All anticipated modes of operation shall be tested.
g) The Contractor shall request and coordinate system acceptance testing with the utility and ACSA for acceptance and certification of the BESS and permission to operate, after commissioning and final inspections are complete.
h) Commissioning shall include the Contractor's data acquisition system, fire alarm system testing, gas detection/ventilation system testing, testing any system interconnections, and enclosure thermal conditioning system testing.
i) A commissioning report shall be provided to the ACSA and Local Authority prior to final inspection and approval.

The BESS system performance shall be performed through a combination of testing and monitoring processes. The following steps shall collectively ensure that the BESS performs as expected:

- **System Testing**: Comprehensive testing of the integrated system to ensure it operates efficiently and safely.
- **Performance Verification:** Verification of the performance of the system against design specifications and operational goals/use cases.
- **Performance Metrics monitoring:** Assessment of the key performance indicators (KPI) such as round-trip efficiency, response time, and useable energy capacity.
- **Real-time monitoring:** Continuous monitoring of the BESS during normal operation over a time (an agreed upon reliability testing duration) to track the performance over time. This shall include monitoring of KPIs, state of charge (SoC), temperature, power outputs, and other critical parameters to be provided by ACSA and to be agreed upon during the design phase.

Key deliverables:

- Factory Acceptance Testing Procedure & Report
- Commissioning and acceptance plan, procedure & report
- BESS Operations and Maintenance Manuals
- Individual Components Operations and Maintenance Manuals

5.2 Inspections

a) The third-party Commissioning Agent is responsible for verifying that the BESS is installed, functionally tested, and capable of being operated and maintained to perform in conformity with the design intent and local codes and regulations. The Contracting Officer or the delegated Contracting Officer's Representative may inspect the systems at any time during construction or after the systems have been put in operation. The Contractor may be ordered to stop work or shut the systems down if unsafe conditions or code violations are noted.
b) An initial inspection for Substantial Completion will be made when the work is complete to the point that the Commissioning Agent is ready to begin starting, testing, and commissioning the system. Following this inspection, the Agency will provide the Contractor with a punch list

describing any incomplete work that must be completed prior to the Contractor's request for final inspection.

c) The Contractor shall give the Contracting Officer ten (10) business days' advance notice, in writing, of the date the work will be ready for initial inspection.
d) A final inspection of all systems shall be made only when all construction is complete in accordance with the terms and conditions set forth in the Contract and all punch list items identified in the initial inspection are complete. If, upon examination by the Contracting Officer and/or ACSA inspection personnel, the project is determined not sufficiently completed to have warranted a final inspection, the Contractor may be charged for any additional cost of re-inspection.
e) The Contractor shall give the Contracting Officer ten (10) business days' advance notice, in writing, of the date the work will be fully completed and ready for final inspection.
f) The Contractor's request for final inspection will not be approved unless documentation below, at a minimum, has been provided to, and accepted by, the ACSA Project Manager, in addition to all other contract requirements:
    - Final as-built drawings (record drawings), meeting as-built requirements
    - Preventive maintenance work schedules and procedures
    - Operations and maintenance manuals (electronic and hardcopy)
    - Training manuals (electronic and hardcopy)
    - Equipment documentation and spare parts lists
    - Certificates of Local Authority inspections
g) After commissioning is complete, the Contractor shall instruct and train ACSA designated personnel on normal system operation and how to shut down the system in the event of an emergency. ACSA may reasonably request additional training, and the Contractor will conduct such training at the Contractor's expense. Training may take place over multiple sessions to accommodate ACSA's staff availability. The training session(s) may be recorded.
h) As soon as practicable, following final inspection, the ACSA Project Manager will inform the Contractor, in writing, of any discrepancies and/or omissions noted at the final inspection. The Contracting Officer shall also state the time allowable for replacement of material and performance or re-performance of any unsatisfactory work necessary before written notification of system acceptance testing.
i) Upon written notification that all deficiencies identified during the final inspection have been corrected, the ACSA Project Manager may schedule a follow-up inspection to confirm all corrected work is acceptable. The Contractor shall then coordinate with the Commissioning Agent, Eskom, ACSA, and Local Authority to schedule system acceptance testing.

5.3 Summary of Process

In summary, inspections and commissioning will follow the following sequence:

a) Initial inspection for Substantial Completion of construction.
b) Pending successful initial inspection, commissioning may begin.
c) Final inspection may be scheduled following completion of commissioning and approval of all documents shown in Section 3.2(6) of this specification.
d) The Contractor will be responsible for completing any re-work identified in the Final inspection prior to scheduling system acceptance testing.

6 Final Acceptance

6.1. The Contractor shall notify the Commissioning Agent and ACSA not less than ten (10) business days prior to the anticipated date of system acceptance testing. The ACSA shall have the right, but not the obligation, to be present at and observe the system acceptance testing, at ACSA's sole cost.

6.2. The system acceptance testing shall be witnessed by the electric utility if required for interconnection approval, and the Contractor shall meet the utility's test notification requirements.

6.3. In addition to utility and ACSA system acceptance test standards, the test shall include, at a minimum, the following:

6.3.1. While connected to grid power, start up the BESS until it achieves the minimum specified performance requirements. The acceptable productive power output will be measured in kW (AC) at the building electrical interconnection point and must be consistent with the specifications for the system.

6.3.2. The Contractor shall demonstrate the operation of one full charge/discharge cycle of the BESS and report on system performance.

6.3.3. Ensure that all subsystems and components work under foreseeable operating conditions.

6.3.4. Review a complete record of all pre-functional tests, equipment startups, and functional performance verification tests.

6.4. Approvals as required by the Local Authority and local electric utility will be a pre-requisite for acceptance and for authorization to energize the system(s).

Upon successful completion of system acceptance testing, the Contractor shall send a Completion Notice and a copy of the system acceptance test report to the ACSA Project Manager so that ACSA can complete their final acceptance. ACSA and Commissioning Agent shall have ten (10) Business Days after receipt of the Completion Notice to review the system acceptance testing results and verify that the system installation is complete, safe, aesthetically acceptable, functional, constructed to all code requirements, does not interfere with ACSA or tenant operations, and otherwise meets all other requirements. The ACSA Project Manager will notify the Contractor in writing of Final Acceptance.

If any of these requirements are not met, then ACSA shall provide the Contractor with a detailed notice of such failure (a "Rejection Notice") within the ten (10) business day period, with details regarding the required remedy (including repetition of either partial or full system acceptance testing, if appropriate, at the discretion of the ACSA Project Manager or ACSA Project Manager's Representative, and the time allowed to complete remedy. The Contractor shall promptly remedy, at Contractor's cost, the items identified in the Rejection Notice and conduct any additionally required system acceptance testing (if required by the Rejection Notice) until the system acceptance testing indicates that the system meets the contract requirements. In each such case, the Contractor shall send a new Completion Notice to ACSA with a copy of the results of the new system acceptance testing as provided above and the foregoing procedures shall be repeated.

Written acceptance shall be final and conclusive except as regards latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards ACSA's right under any warranty or guarantee, subject to the system performance warranty.

In summary, the following requirements must be fulfilled before final acceptance:

a) System acceptance testing has been completed, with the system and all subsystems and components having operated at specified performance for one full charge/discharge cycle with power production levels consistent with proposed system's estimated production with 100% system availability, measured with applicable instruments and meters.
b) The system has been approved for interconnected operation by the electric utility (with signed interconnection agreement).
c) Submission of as-built drawings and all documents required prior to final inspection described in Section 3.2 of this specification.
d) Training fulfillment documentation.
e) Commissioning report provided to ACSA.

7 Disposal

The contractor shall provide disposal guidelines for all the equipment of the Battery Energy Storage Solution including batteries, invertors amongst other components.

8 Maintenance

BESS solution to be provided with comprehensive maintenance plan that will ensure efficient, safe and compliant way to operate and upkeep the battery energy storage system. The recommended maintenance plan to be converted into maintenance activities and cost that will form part of the Total Cost of Ownership (TCO) for the entire solution.

9 Minimum Technical Requirements/Specifications

Table below outlines the minimum requirements based on the available information. The contractor shall conduct a site assessment, energy audit, take necessary measurements, and perform necessary engineering work to come with a design and to specify the information that is not specified in the table below. The specified requirements shall be reviewed and accepted by ACSA. The contractors shall also test assumptions where requirements are specified.

ANNEXURE A: Battery Energy Storage Minimum Technica l Requirements / Specifications

Airport	GRJ	KIM	Bidder Proposal	Notes / Comments
Parameter	**Specification**	**Specification**		
Battery Technology	Lithium-ion	Lithium-ion		
Inverter Technology	Hybrid	Hybrid		
Rated Power Capacity (kWp)	750	500		
Minimum Useable Capacity(kWh)	1400	1000		
Voltage Range (V)	380/400VAC 3-phase	380/400VAC 3-phase		
Grid Frequency (Hz)	50	50		
Depth of Discharge	≥80%	≥80%		
Service Life	≥15 years @80% DOD	≥15 years @80% DOD		
Response Time	Milliseconds to seconds	Milliseconds to seconds		
Round-Trip Efficiency	Supplier to specify	Supplier to specify		
Self-Discharge	Supplier to specify	Supplier to specify		
Technological Maturity	Commercialized/mature	Commercialized/mature		
Site Location	Supplier to specify	Supplier to specify		
Form Factor	Supplier to specify	Supplier to specify		
Container Dimensions/Size	Supplier to specify	Supplier to specify		
Key Features	• Thermal Management • Battery Management System Energy Management System Fire Detection and Suppression		•	•
Applications/Use Cases	• Load shifting • Energy Arbitrage • Peak Shaving	• Load shifting • Energy Arbitrage • Peak Shaving • Solar PV Integration	•	•

	• Solar PV Integration			