

Battery Energy Storage Systems (BESS) (BESS Projects)

Minimum Technical Requirements

Household/home use

1. Codes and standards

All the equipment and installation shall comply with local electrical codes and safety regulations. In cases where local codes do not exist, internationally recognized standards apply.

2. System requirements

Residential PV systems (Large and Small Residential Systems/Equipment) should be designed for safe and reliable operation in residential environments. The system should be suitable for daily operation/operation (cycles) and easily integrated with existing PV installations and systems.

Basic requirements

- Safe operation in residential environments
- Minimal maintenance requirements
- Simple monitoring and control interface
- Compliance with local electrical and building codes
- Acoustic emissions do not exceed 40 dB at a distance of 1 meter

System components

PV unit configuration

Residential PV systems shall be pre-designed, certified systems that include a battery management system (BMS), a power conversion system (PCS)/inverter, a system controller with monitoring capabilities, safety switches and protective devices, as well as an enclosure appropriate for the installation environment (indoor/outdoor).

Battery system requirements

Battery characteristics:

- Lithium-ion technology only (LiFePO₄ preferred for safety)
- Modular design that allows for increased capacity



- Integrated MCU with cell balancing
- Self-discharge rate is less than 5% per month
- Operating temperature range: -10°C to +45°C
- IP rating: at least IP54 for outdoor installation

Energy conversion system

Requirements for the UPS/inverter

- Minimum 90% efficiency at nominal power
- Standby power consumption less than 5W
- Grid-connected with isolation protection
- Power factor control
- Built-in voltage drop protection

Security Systems

Key Security Features:

- Automatic shutdown in case of failure
- Extinguishing or suppressing fire (if required by local regulations)
- Emergency shutdown function
- Ground fault protection
- Protection against accidental failure (if necessary)

Installation requirements

Installation must be performed by qualified electrical contractors in accordance with local electrical codes, manufacturer's installation instructions, local permit requirements, and utility connection standards.

Basic installation requirements

- Sufficient ventilation for thermal management
- Weather protection (if available)
- Accessible/convenient location for maintenance
- Proper grounding and connection
- Clear labeling and identification

Documents

The required documents include the PV installation manual, user operating manual, warranty information, system commissioning/first start protocol, electrical wiring diagrams, as well as local permits and inspection certificates.

3. Testing and commissioning

Basic testing requirements

The following basic tests shall be performed:

1. Visual inspection of all components
2. Electrical connection check
3. Ground fault protection fault check
4. System start-up and shutdown check
5. Basic functionality check (charge/discharge)
6. System safety check
7. Monitoring system check

All tests shall be documented and validated by the installer.

4. Product warranties

Minimum warranty requirements:

- Battery system: 5-year product warranty with a 10-year performance guarantee
- Electronics: 2-year product warranty
- System Integration: 2-year manufacturing quality warranty
- Performance guarantee: at least 80% productivity maintained in 10 years.

The warranty includes free repair or replacement of defective components, technical support and troubleshooting, as well as access to software updates.

5. Performance requirements

Main performance (productivity) criteria:

- Two-way efficiency: 85%
- Availability: minimum 95% annual availability
- Cycle life: minimum 4000 cycles at 80% discharge level
- Calendar life expectancy: minimum 10 years



The installer shall ensure performance verification (verification) through basic testing and manufacturer certification.

6. Maintenance and operation

User responsibilities

- Regular visual inspection (monthly)
- Keep the installation area clean and free
- Monitor the system operation via the provided interface
- Report any unusual situations to the installer/manufacturer

Professional service

- Annual system inspection by a qualified technician
- Software updates recommended by the manufacturer
- Replacement of components if necessary
- Productivity checks every 2 years

7. Security considerations

The system shall be installed by a licensed electrical contractor. All electrical work shall be locally inspected. Emergency contact information shall be clearly posted. The user manual shall include safety warnings and emergency procedures. The system shall automatically disconnect from the grid during utility service outages (unless specifically designed for backup power). Children and unauthorized persons shall not have access to electrical components.

The system shall be designed to provide safe shutdowns and minimize risk to residents and property.

Small business application

Codes and standards

All engineering, design, construction, testing, etc., of all plant components and their assembly, including all supporting structures and systems, shall comply with the latest national regulations, standards and legislation. If such national documents do not exist, internationally recognized regulations and standards shall be used as a reference. If neither national nor any international regulations and standards exist, other relevant national or industry regulations and standards shall be used.

According to the rules and standards of good engineering practice, standards such as IEC, UL, ISO, etc. should be applied for the design, installation, testing and operation of the plant.

Program (project)

1. General requirements

The plant shall ensure full productivity in all environmental conditions and ensure a daily cycle. It must comply with environmental protection and technical standards and ensure efficient maintenance and operation. Maintenance shall be scheduled outside peak hours in accordance with the manufacturer's requirements. The installer shall provide basic operation and maintenance strategies and ensure that all monitoring equipment is calibrated.

In addition to meeting the technical requirements of the site, the plant must be based on commercially proven, high-efficiency and reliable technology, designed and documented using best engineering practices, international standards (including SI units) and appropriate classification systems, and all design documents, such as plans, diagrams and technical specifications, must be provided by the installer.

The installer shall ensure that the PV is sized to meet the system requirements for input/output power and guaranteed energy capacity at the reference point, providing the required performance (performance) under all foreseeable conditions, unless otherwise specified in the installation contract or purchase order.

The installer shall ensure that the design and implementation of the plant complies with all environmental protection laws, including proper storage and disposal of hazardous materials according to legal and industry standards, as well as containment measures such as ventilation and fire safety, and shall limit sound emissions to a maximum of 55 dB at the nearest sensitive receptor.

2. Basic requirements for PV components

The selection and integration of equipment for the PV should take into account the general requirements of system engineering, electrical engineering, product safety, electromagnetic compatibility and network compliance.

The PV shall be designed and constructed in full compliance with the following requirements:

- IEC 62485-5,
- The battery-related hazards specified in IEC 61427-2 shall be taken into account.

IEC block type



Each IEC block (unit) shall be a modular, certified system that includes a power conversion system (PCS), associated battery system, block controller, HVAC system or liquid cooling, auxiliary power supply, enclosures, and all auxiliary systems and components of the plant equipment, with the additional inclusion of a medium/low voltage transformer as required. All PCS units shall be identical in design, components and operation, except for up to two types of PCS Skids, and shall operate independently without shared infrastructure or interdependencies, ensuring that any outage or safety incident in one unit does not affect the others. Each unit shall also be clearly identified and labelled to prevent confusion, particularly during maintenance, and shall be commissioned and tested by the manufacturer in advance.

Energy Conversion System (ECS)

The installer shall select and integrate ECS meeting the operating characteristics of the plant, that allow simultaneous charging (rectifier mode) and discharging (inverter mode) within a single device and independently provide dynamic reactive power, unless alternative methods are justified. ECS units shall exceed the California Energy Commission (CEC) efficiency of 95% at nominal power, limit self-consumption to 0.1%, and provide standby mode with no-load losses of less than 0.05% and a transition time of less than five seconds. Each ECS shall include overvoltage protection, lockable DC and AC circuit breakers (or equivalent) and be designed considering system engineering, safety, electromagnetic compatibility, and grid compliance. If an internal isolation transformer is not used, appropriate mitigation measures should be specified. The ECS units shall comply with the IEC 62477-1 (or alternative) standard, the IEC 61000-6-2 and -6-4 electromagnetic compatibility standards, and have a certificate of compliance with the grid code, including harmonics, the ability of the equipment to remain connected and operational during voltage drops due to grid faults (fault ride-through), and protection functions.

Battery system and its components

The battery system shall consist of modular racks with battery modules connected in parallel to the UPS, meeting safety, performance and compliance standards. Each rack has DC circuit breakers, fuses, IP2X protected terminals and fault isolation capabilities. The modules require a module-level battery management system (BMS) for diagnostics and balancing, temperature sensors, and easy installation. Battery cells must use reliable materials, have a self-discharge rate of less than 5% per month, and meet quality standards for capacity and resistance. The system's ICU shall handle start/stop, monitor state of charge, battery condition, voltage, current and temperature, as well as provide fault isolation and monitoring system integration. Compliance with IEC 63056, IEC 62619, IEC 61000 EMC standards, fire spread testing (UL 9540A or IEC 62619) and transportation/performance standards (UN 38.3, IEC 62620) is required.

IEC block manager

Each IEC block shall have its own IED block manager. This manager can be a standalone device or part of another device in the IEC block, such as an EPC or a MCU.

3. Environmental, social, health and safety requirements

The installer shall comply with the requirements of the applicable EHS and all the related laws. In general, it must be possible to practically and safely implement the five safety rules on the medium and low voltage sides.

Sufficient lighting is required for the operation of switchgear and for fault detection. All the accessories and notices necessary for the operation of switchgear must be accessible. These include, among others:

- Shift rods and gear levers
- Keys
- Grounding rod
- Storage facilities
- Wall mounts
- Necessary spare parts (consumables)
- Technical documentation
- Signs
- First aid equipment
- Personal protective equipment (PPE)

The installer shall develop an EHS plan and health, safety and environmental (HSE) documents in accordance with all applicable laws and standards. This includes policies, procedures, risk assessments, emergency plans, hazardous materials management and environmental management systems. The installer is fully responsible for implementing and enforcing all safety procedures, as well as ensuring their adherence by all personnel throughout the project life cycle.

4. Technical documents and information

The installer shall provide the technical documentation of the project in accordance with the scope of work.

All the documentation shall meet quality and usability standards. Equipment names must match the labels installed on site. The documentation shall be clear, consistent, and concise. The owner shall have the right to use, modify, and distribute all documents without copyright or confidentiality restrictions.

5. Checkings and tests

The performance evaluation of a battery energy storage system (BESS) involves a series of tests to verify energy capability, rating accuracy, and functional reliability, which is primarily governed by the

IEC 62933-2-1 standard. The energy capability test requires full-discharge cycles at nominal capacity, with energy measurements corrected for temperature variations. Available energy valuation tests evaluate the accuracy of system internal energy predictions during both charging and discharging using limited accuracy ratios. Additional tests include assessments of the plant's maintenance and uninterrupted power supply capabilities, as well as active and reactive power assessments to ensure compliance with operational specifications. Factory testing and manufacturer certification are required, while system integration testing (SIT) validates the coordinated operation of the key components of the IMS under real project conditions. The HIP shall follow an agreed procedure and include start-up, error handling and functional compliance, including any critical failures that require retesting at the installer's expense. It is the installer's responsibility to develop and propose inspection and test plans (ITPs), as well as appropriate test procedures and checklists, in accordance with the requirements of the installation contract and this document.

- a. The owner shall not accept the results of tests performed by the installer using test schedules not approved by the installer.
2. It is not permitted to change any parameters of the plant or equipment for testing purposes. This includes, but is not limited to the following:
 - a. Switching equipment to states (modes) in which it will not be in continuous operation,
 - b. Changing the set values of control loops, for example, the water management system,
 - c. Changing the alarm system and shutdown settings,
 - d. Suppression of warning and alarm messages.
3. All the equipment used for measurements during the testing shall be calibrated. Copies of valid calibration certificates shall be submitted as part of each test document.
4. All the tests shall be performed automatically and shall not require manual interaction unless otherwise specified.
5. The owner has the right to request that the test be conducted in different parts of the station in turn.
 - a. The test results are then combined by a reasonable calculation, for example, by means of a sum of actual energy efficiency or a weighted average of actual efficiency.

6. Product warranties

The installer must provide a warranty for the main equipment and the station in the format specified below:

Product warranties must be transferred to the owner at the delivery time. The value of the warranties shall be reflected in the purchase order price.

- The battery energy storage system (BES) shall meet a set of minimum warranty and operating requirements to ensure long-term operation and cost predictability.

- A minimum 3-year product warranty is required for the battery system, which can be extended up to 10 years.
- Spare parts must be available for at least 5 years, and an additional capacity maintenance contract must be offered.
- Similarly, the battery system housing, including all supporting components, shall have a 3-year warranty, with the option of extending it to 10 years.
- The Energy Conversion System (ECS) also requires a 3-year warranty, which can be extended to 10 years, and 5 years of spare parts availability.
- A 3-year latent defects warranty is required for the IEC block (unit), with the possibility of extension up to 10 years.

7. Performance (productivity) guarantees

The following two types of potential losses associated with non-performance should be calculated for the project:

- Damages related to the energy efficiency guarantee,
- Damages related to the availability guarantee.

The installer shall provide a guarantee of energy efficiency and availability to meet the requirements of the guaranteed values. The guaranteed values must at least correspond to the values specified in the system specifications.

Battery energy storage systems

Codes and standards

All engineering, design, construction, testing, etc. of all plant components and their assembly, including all supporting structures and systems, shall comply with the latest national regulations, standards and legislation. If such national documents do not exist, internationally recognized regulations and standards shall be used as a reference. If neither national nor any international regulations and standards exist, other relevant national or industry regulations and standards should be used. The priority order shall correspond to the specific project requirements.

According to the good engineering practices and project-specific requirements, codes and standards such as IEC, UL, ISO, etc. are applied for the design, installation, testing and operation of the plant.

The following standards are applied for the design, installation, testing and operation of the plant, among other codes and standards according to the good engineering practice and project-specific requirements:

General equipment standards

- IEC 60068 Environmental Exposure Testing - Part 1: General and Guidance
- IEC 60721-3-3 Classification of environmental conditions (permanent use in weather-protected locations)
- IEC 60721-3-4 Environmental conditions classification (stationary use in locations not protected from the weather)

Electrical installation works

- IEC 60364 (all low voltage electrical installations parts) (all parts)
- IEC 61936-1 kV_{p.h.} high-power power plants - Part 1. General rules
- IEC 62305 (all Lightning protection parts)
- IEC 60076 Power Transformers - Part 1. General
- IEC 60376 Specification for technical grade sulfur hexafluoride (SF6) for use in electrical equipment
- IEC 60947 Low voltage distribution and control equipment (all parts)
- IEC 60439 Low-voltage switchgear and controlgear assemblies
- IEC 60479 The effect of current on humans and animals (all parts)
- IEC 60071 In the insulation system - Part 1: Definitions, principles and rules
- IEC 61869 Instrument transformers (all parts)
- IEC 60044 Instrument transformers (all parts)
- IEC 60099 Surge arresters
- IEC 61000 Electromagnetic compatibility

Note: Appropriate criteria for industrial and material environments should be selected.

IEC systems

- IEC 62485-1 Safety requirements for secondary batteries and battery installations - Part 1: General safety information
- IEC 62485-2 Safety requirements for the installation of secondary batteries and batteries to meet safety requirements related to installation, use, inspection, maintenance and disposal
- IEC 62485-5 Safety requirements for secondary batteries and battery installations - Part 5: Safe operation of stationary lithium-ion batteries (if released on time)
- IEC 62933-1 Electrical Energy Storage (EES) Systems: Terminology
- IEC 62933-2-1 Electrical energy storage (EES) systems. Unit parameters and test methods. General specifications
- IEC 62933-2-1 Efficiency test without output starting voltage without power supply
- IEC 62933-3-1 Electrical energy storage (EES) systems. Design and installation: general technical conditions
- IEC 62933-4-1 Electrical energy storage (EES) systems. Guidance on environmental issues - General technical requirements
- IEC TS 62933-5-1 Electrical energy storage (EES) systems. Safety considerations for grid-integrated EES systems. General technical specifications
- IEC 62933-5-2 Electrical energy storage (EES) systems - Part 5-2: Safety requirements for grid-integrated EES systems - Electrochemical based systems
- IEC 61660 Short-circuit currents in direct current installations for auxiliary needs of power plants and substations. Calculation of short-circuit currents
- FM Global 5-33:2020-07 Global Property Loss Prevention Fact Sheets - Electrical Energy Storage Systems

IEC special equipment

If equipment intended for IEC performs similar roles and functions as IEC installations (e.g. prefabricated containers for a battery system), it must also comply with the rules and standards applicable to electrical installations.

- IEC 62477-1:2012 + A1:2017 Safety requirements for power electronic converter systems and equipment.
- IEC 62109 Safety of power converters for use in PV power systems.

- IEC 61683 Photovoltaic systems. Voltage converters. Efficiency measurement procedure.
- IEC 62619 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries used in industrial applications.
- IEC 63056 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries used in industrial applications.
- UL 9540A Test method for assessing fire spread under the influence of thermal leakage current in battery energy storage systems.

Environmental, social, health and safety requirements

- Health and safety regulations and policies According to local codes and regulations such as:
Occupational Health and Safety Law
Industrial safety and health decision
"Technical Rules for Operational Safety (TRBS), in particular TRBS 2131 "Electrical Hazards""
- Environmental management regulations According to local regulations and rules
- Environmental impact assessment regulations According to local regulations and rules
- Fire protection According to local regulations and rules
- SPS (Proxy System Sanitization) cybersecurity instructions According to local regulations and rules

Security

- IEC 62443 Security of industrial automation and control systems

- ISO/IEC 27001 Information technology – Security techniques – Information security management systems – Requirements
- ISO 27017 Information technology - Security techniques - Information security control code of practice based on ISO/IEC 27002 for cloud services
- ISO 27018 Information Technology - Security Techniques - Code of Practice for the Protection of Personally Identifiable Information (PII) in Public Clouds Acting as PII Processors.

Other standards

- ISO 9001:2015 Quality management systems - requirements
- IEC/IEEE 82079-1:2019 Preparation of product information (instructions for use) - Part 1: Principles and general requirements

Program (project)

General requirements

The plant shall provide full productivity under all environmental conditions and ensure daily cyclicity. It shall comply with environmental and technical standards and allow for efficient maintenance and operation. Maintenance shall be scheduled outside peak hours in accordance with the manufacturer and employer's requirements. The contractor shall provide detailed operation and maintenance strategies and ensure that all monitoring equipment is calibrated.

In addition to meeting the site data requirements, the plant shall be based on commercially proven, high-efficiency and reliable technology, designed and documented using good engineering practice, international standards (including SI units) and appropriate classification systems, with all design documents such as layouts, diagrams and technical specifications provided by the Contractor.

The Contractor shall ensure that the UPS meets the project-specific requirements in terms of parameters for nominal input/output power and guaranteed energy capacity (capacity) at the specified reference point, providing the required performance under all foreseeable conditions, unless otherwise specified in the contract or the Employer's requirements.

The Contractor shall ensure that the design and implementation of the plant complies with all environmental protection laws, including proper storage and disposal of hazardous materials in accordance with legal and industry standards, as well as containment measures such as barriers,



ventilation and fire safety, and shall limit noise emissions to a maximum of 45 dB at the nearest sensitive receptor.

Basic requirements for IEC system components

When selecting and integrating equipment for IEC, it is necessary to take into account the general requirements for system design, electrical engineering, product safety, electromagnetic compatibility and network compliance.

The IEC must be designed and constructed in full compliance with the following requirements:

- IEC 62485-5,
- The battery-related hazards specified in IEC 61427-2 must be taken into account.

IEC block type

Each IEC block (unit) shall be a modular, certified system that includes a power conversion system (PCS), associated battery system, block controller, HVAC system or liquid cooling, auxiliary power supply, enclosures, and all auxiliary systems and components of the plant equipment, with the additional inclusion of a medium/low voltage transformer as required. All PCS units shall be identical in design, components and operation, except for up to two types of PCS Skids, and shall operate independently without shared infrastructure or interdependencies, ensuring that any outage or security incident in one unit does not affect the others. Each unit shall also be clearly identified and labelled to prevent confusion, particularly during maintenance, and shall be pre-commissioned and system integration tested.

Energy Conversion System (ECS)

The Contractor shall select and integrate EPR units that meet the operating characteristics of the plant, which enable simultaneous charging (rectifier mode) and discharging (inverter mode) within a single device and independently provide dynamic reactive power, unless alternative methods are justified. The EPC units shall exceed the California Energy Commission (CEC) efficiency of 97% at rated power, limit their own consumption to 0.05%, and provide standby mode with no-load losses of less than 0.01% and a transition time of less than five seconds. Each UPS shall include overvoltage protection, lockable DC and AC circuit breakers (or equivalent) and be designed considering system engineering, safety, electromagnetic compatibility, and grid compliance. If an internal isolation transformer is not used, appropriate mitigation measures should be specified. The EPR units shall comply with the IEC 62477-1 (or alternative) standard, the IEC 61000-6-2 and -6-4 electromagnetic compatibility standards, and have a certificate of compliance with the grid code, including harmonics, the ability of the equipment to remain connected and operational during voltage drops due to grid faults (fault ride-through), and protection functions.

Battery system and its components

The battery system shall consist of modular racks with battery modules connected in parallel to the UPS, meeting safety, performance, and compliance standards. Each rack must have DC circuit breakers, fuses, IP2X protected terminals, and fault isolation capabilities. The modules require a module-level battery management system (BMS) for diagnostics and balancing, temperature sensors, and easy installation. Battery cells shall use reliable materials, have a self-discharge rate of less than 5% per month, and meet quality standards for capacity and resistance. The system's ICU shall handle start/stop, monitor state of charge, battery condition, voltage, current and temperature, as well as provide fault isolation and monitoring system integration. Compliance with IEC 63056, IEC 62619, IEC 61000 EMC standards, fire spread testing (UL 9540A or IEC 62619) and transportation/performance standards (UN 38.3, IEC 62620) is required.

IEC block manager

Each block of the IED must have its own IED block manager. This manager can be a standalone device or part of another device in the IED block, such as an EPC or a MCU.

Environmental, social, health and safety requirements

The installer shall comply with the requirements of the applicable EHS and all related laws. In general, it must be possible to practically and safely implement the five safety rules on the medium and low voltage sides.

- Sufficient lighting is required for operation and troubleshooting of switching equipment.
- All accessories and notices necessary for the operation of switching equipment must be available. These include, among others:
 - Shift rods and gear levers
 - Keys
 - Grounding rod
 - Storage facilities
 - Wall mounts
 - Necessary spare parts (consumables)
 - Technical documentation
 - Signs
 - First aid equipment
 - Personal protective equipment (PPE)

The Contractor shall develop an EHS plan and health, safety and environmental (HSE) documents in accordance with all applicable laws and standards. This includes policies, procedures, risk assessments,



emergency plans, hazardous materials management and environmental management systems. The Contractor shall be fully responsible for implementing and enforcing all safety procedures and ensuring that they are adhered to by all personnel throughout the project life cycle.

Technical documents and information

The Contractor shall provide the technical documentation of the project in accordance with the Scope of Work.

All the documents shall meet quality and usability standards, be integrated into a quality management system, be recorded in a document registry, be version controlled, and be reviewed by someone other than the author. Equipment names shall match the labels on site. Documentation must be clear, consistent, and concise, meet project-specific language requirements, and be machine-readable. The employer must have unrestricted rights to use, modify, and distribute all documentation, free from copyright or confidentiality restrictions.

Inspections and tests

General provisions and testing

The performance evaluation of a battery energy storage system (BESS) involves a series of tests to verify energy capability, rating accuracy, and functional reliability, which is primarily governed by the IEC 62933-2-1 standard. Energy capacity testing requires full charge-discharge cycles at nominal capacity, with energy measurements corrected for temperature variations. Available energy estimation tests evaluate the accuracy of system internal energy predictions during both charging and discharging using limited accuracy ratios. Additional tests include assessments of the plant's maintenance and uninterrupted power supply capabilities, as well as active and reactive power assessments to ensure compliance with operational specifications. Factory testing and manufacturer certification are required, while system integration testing (SIT) validates the coordinated operation of the key components of the IMS under real project conditions. The HIP shall follow an agreed procedure and include start-up, error handling and functional compliance, including any critical failures that require retesting at the installer's expense.

6. It is the Contractor's responsibility to develop and propose Inspection and Test Plans (ITPs), as well as appropriate test procedures and checklists, in accordance with the requirements of the installation contract and this document.
 - a. The Employer is not obliged to accept the results of tests carried out in accordance with test schedules not approved by the Contractor.
7. It is not permitted to change any parameters of the plant or equipment for testing purposes. This includes, but is not limited to, the following:

- a. Switching equipment to states (modes) in which it will not be in continuous operation,
 - b. Changing the set values of control loops, for example, the water management system,
 - c. Changing the alarm system and shutdown settings,
 - d. Suppression of warning and alarm messages.
8. All the equipment used for measurements during testing shall be calibrated. Copies of valid calibration certificates shall be submitted as part of each test document.
 9. All the tests shall be performed automatically and shall not require manual interaction unless otherwise specified.
 10. The employer has the right to require that the test be conducted in different parts of the station in turn.
 - a. The test results are then combined by a reasonable calculation, for example, by means of a sum of actual energy efficiency or a weighted average of actual efficiency.

Product warranties

The Contractor shall provide a guarantee for the main equipment and the plant in the format specified below:

Product warranties with a term of more than 2 years must be transferred to the Employer after 2 years of operation and maintenance. The costs of warranties shall be reflected in the contract price.

- The battery energy storage system (BES) must meet a set of minimum warranty and operating requirements to ensure long-term operation and cost predictability.
- A minimum 5-year product warranty is required for the battery system, which can be extended up to 15 years.
- Spare parts must be available for at least 10 years, and an additional capacity maintenance contract must be offered.
- The energy conversion system (ECS) also requires a 5-year warranty, which can be extended to 15 years, and spare parts availability for 10 years.
- A 5-year latent defects warranty is required for the IEC block (unit), with the possibility of extension up to 15 years.

Performance (productivity) guarantees

The following three types of potential losses associated with non-performance should be calculated for the project:

- Damages related to the energy efficiency guarantee,
- Damages related to the availability guarantee.
- Damages related to the guarantee of effectiveness.



The contractor shall provide a guarantee of energy capacity, availability and efficiency to meet the requirements of the guaranteed values. The guaranteed values must at least meet the values specified in the system specifications.