Executive design, commissioning and installation of a Battery Energy Storage System in a university microgrid planned in University of Cyprus.

Guidelines for the Expression of Interest

FOSS Research Center, University of Cyprus

Table of Contents

Reference Documentation

Number	Document Title
[1]	Pegasus Project – Pilot of the University of Cyprus "Technical and economical evaluation"

Reference Standards

Number	Standard	Title
[1]	IEEE 1679.1-2017	IEEE Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications

[2]	IEC/EN 61968-1 to 9	Application integration at electric utilities - System interfaces for distribution management
[3]	IEC/TS 62257-5	Recommendations for small renewable energy and hybrid systems for rural electrification – Part 5: Protection against electrical hazards
[4]	IEEE 2030.7-2017	IEEE Standard for the Specification of Microgrid Controllers
[5]	IEEE 1187-2002	IEEE Standard for the Testing of Microgrid Controllers
[6]	IEC/TS 62257	Recommendations for small renewable energy and hybrid systems for rural electrification

1 Scope

This terms of reference (ToR) document defines the guidelines for the Expression of Interest related to the design, the design, construction, and commissioning of a battery energy system to be implemented as part of the University of Cyprus microgrid. It investigates all aspects of how a consultant or a team will conduct an evaluation. It defines the objectives and the scope of the commissioning, outlines the responsibilities of the consultant or team, and provides a clear description of the resources available to implement a microgrid system. The evaluation ToR document serves as the basis for a contractual arrangement with one or more evaluators and sets the parameters against which the success of the assignment can be measured.

This document applies to the installation of battery systems up to the terminals of power conversion equipment (PCE), such as inverters, charge controllers, etc. That is, the scope includes the following:

- Battery
- Battery Enclosure
- Cabling
- Switchgear (Protection & Isolation Devices)

- Auxiliary Equipment (eg. Battery Management System (BMS), and other equipment required by the manufacturer)

Additionally, this document covers the installation of pre-assembled integrated battery energy storage systems (BESS) which includes the battery system, cabling, switchgear, power conversion equipment and auxiliary equipment

2 The Contractor

University of Cyprus – Technical Services / Campus Development Office - University of Cyprus, Panepistimiou Avenue 1, P. O. Box 20537, 1678, Nicosia, Cyprus

3 Framework of the contract to be allocated

A feasibility study has been developed (reference document number [1]) within the scope of the PEGASUS project (Promoting Effective Generation and Sustainable Uses of electricity), in regards with the implementation of a microgrid system in the FOSS Research premises of the University of Cyprus.. This document has highlighted the importance of microgrids, their role in peak demand reduction in the future smart grid and the potential of distributed energy resources in building a sustainable and zero CO2 emission campus.

The University of Cyprus has developed a road map to a low-carbon campus. It is now in the process of building the infrastructure so that the energy needs of the new university campus can efficiently be met through a full functioning microgrid infrastructure – Moreover, the infrastructure will be developed with such architecture so that it can fulfil the requirements to be a test bed for related technologies and systems to facilitate development, offer training and education possibilities to the students of the university with state of the art technologies. This campus innovation will reinforce university leadership in and commitment to a sustainable future, including reducing energy use and emissions, In addition to institutional responsibility across operations, road maps will address universities' continued commitment to research and innovation, curriculum and education.

This ToR document provides a basic guide to University Technical services on commissioning and installation of Battery Energy Storage Systems as part of the implementation of a microgrid system, as well as the related technical assistance The research conducted in the frame of the PEGASUS project in

regards with a small microgrid system in the University Premises and the ToR document will serve as a guideline for the future implementation of large-scale microgrids in University of Cyprus, and other public buildings (i.e. hospitals, Government offices) or industries.

3.1 Pre-existing situation and sizing of the System installed

The FOSS Research Centre microgrid is located in Nicosia, Cyprus. The production of the nanogrid is based exclusively on a PV system of aggregated power equal to 34.9kWp, while the main electrical consumption of the FOSS microgrid corresponds to the building loads. The FOSS microgrid solution has been designed taking into consideration the special technical requirements and the purchase of equipment that is necessary for the implementation of the project's goals. Apart from the existing loads and RES, new equipment has been installed to facilitate minimum level of measuring and analysis capability, within the microgrid premises:

- Three 3-phase smart meters with associated Current Transformers (CTs) wiring and auxiliary equipment. The smart meters are able to measure, calculate and display the main electrical parameters for the 3-phase systems (balanced or unbalanced).
- Electrical load to facilitate alternative load capabilities and extend the investigation possibilities of the nanogrid set up Chroma 63800 Programmable AC & DC Electronic Load (3600W) It is designed for testing Uninterruptible Power Supplies (UPS), Off-Grid Inverters, AC sources and other power devices such as switches, circuit breakers, fuses and connectors. The Programmable load can simulate load conditions under high crest factor and varying power factors with real time compensation even when the voltage waveform is distorted. This special feature provides real world simulation capability and prevents over-stressing, which allows having reliable and unbiased test results.
- An EV charging/discharging station that is installed within the university campus along with a battery storage at the installation point of the EV station, that performs the discharging operation of the EV station.
- Central software management system with data collection infrastructure, analysis, platform and reporting capabilities. This management system sits at a higher level in the university Microgrid and is able to offer services to the FOSS microgrid.
- A 10 kWhr storage system with an associated energy management system that is coordinated with the local PV systems of approximate capacity of 35 kWp.

The measurements of the microgrid concern the active and reactive power (imported and exported), voltage magnitude for each phase and frequency at the Point of Common Coupling (PCC) of the microgrid with the main electrical grid of the university campus. For this reason, the three new smart bidirectional meters have been installed together with other complimentary sensors and accessories to ensure adequate observability. Table I details the different components of the FOSS Microgrid, while Figure 1 shows the functional schematic of the FOSS microgrid.

Table 1: FOSS Microgrid Components

COMPONENTS	**UNITS**
Real Systems	PV installations (34.9 kWp) Battery Energy Storage System (10 kWh) Controllable Electronic Load Schneider Electric PM 8240 Smart Metering Devices (3 units)
Semi-Emulated Systems	EV charging/ discharging station (EV discharging mode is emulated as there is currently no V2G capability)
Other Systems	Microgrid switch, static switch

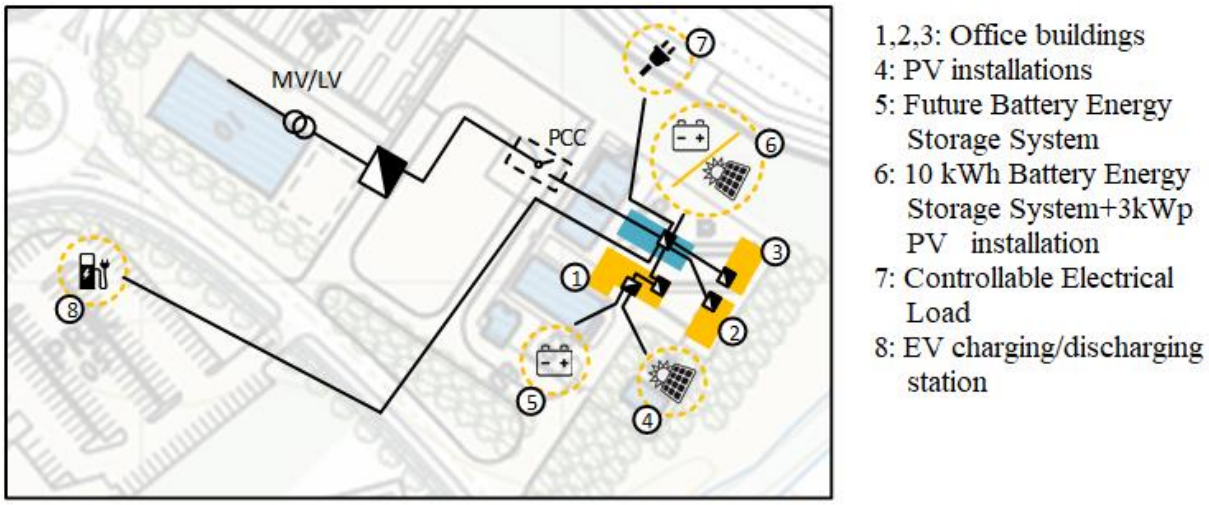

Figure 1. Functional schematic of FOSS microgrid

It needs to be noted that the general dimensioning of the Battery Energy Storage System has been carried out following the criterion of maximum economic benefit, having considered different Battery sizes.

3.2 Installation of a battery energy system into the existing Infrastructure

Battery energy storage systems (BESS) for homes or small commercial buildings are a serious safety risk if incorrectly installed, potentially leading to:

- electric shock
- fire
- flash
- burns
- explosion
- exposure to hazardous chemicals

Any business installing a BESS must ensure the safety of workers. The BESS must be safely installed and commissioned.

When considering the location of the BESS components in a domestic installation, the designer/installer should conduct a risk assessment to address the risks of the battery technology being used in that location. At a minimum, (the wiring rules and the supplier (the manufacturer/importer) instructions for installation should be followed. All BESS installations should restrict access by untrained people, children, pets or vermin.

After the installation, the BESS must be tested and commissioned in accordance with the manufacturer's instructions and relevant standards.

4 Subject of the contract to be allocated

4.1 Engineering

Engineering work for the subsequently listed services and other items as listed are included:

- System architecture design (Battery and inverter location, battery configurations)
- Installation and configuration of hardware and software for the proper operation of the Battery Energy system

- Programming and configuring of the software of the battery system
- Integration work: Communication over defined protocols, integration of the Battery System into the Microgrid

4.2 Hardware supply and installation

4.2.1Manufacturer's Instructions

The installation of all battery systems shall be in accordance with manufacturer's instructions.

4.2.2 Safety Data Sheet (SDS)

The installation of all battery systems shall be in accordance with the safety data sheet applicable to the battery chemistry and battery system/ pre-assembled BESS.

4.2.3 Restricted Access

Restricted access shall be provided to battery systems to prevent access by unauthorised persons. Restricted access may be achieved by the following:

- A dedicated battery room
- A dedicated enclosure
- A fenced off, and secure, section of a larger room

A pre-assembled integrated BESS may inherently include a suitable enclosure.

4.2.4 Environmental Effects

Pre-assembled BESS shall have an IP rating appropriate for the environment in which they are installed. All equipment exposed to the outdoor environment shall be at least IP 54 and UV resistant. Higher ratings should be considered for tropical locations. Connection of wiring, conduit and glands to IP rated equipment and/ or enclosures shall be installed so the minimum IP rating is maintained.

4.2.5 External Influences

BESS and battery systems shall be able to operate safely and function properly in the conditions in which they are likely to be exposed. Particular situations include:

- Solar radiation (direct sunlight)
- Ambient temperature

- External heat sources
- Presence of water or high humidity
- Presence of solid foreign bodies
- Presence of corrosive or polluting substances
- Impact
- Vibration
- Other mechanical stresses
- Presence of flora and fauna

4.2.6 Voltage Limits

For domestic installations, battery system DC voltages shall not exceed 600V. For non-domestic installations, DC voltages should not exceed 1500V.

4.2.7 Product Standards

At all times, batteries and battery modules should meet relevant product standards, which may include:

4.3. Commissioning

After installation, a battery system and pre-assembled BESS shall be commissioned in accordance with manufacturer's instructions and the requirements of this section. The following shall occur:

- Confirmation of the installation:
  - Labelling; and,
  - Signage
- Submission of documentation as per Section 7 (Documentation)
- Visual inspection including:
  - Basic protection (eg. cable insulation and conduit integrity, etc)
  - Fault protection (eg. installation of switchgear, appropriately insulated cable, etc)
  - Protection against hazardous parts (eg. shrouded terminals, battery accommodation restricting access to authorised persons, etc)
  - Protection against spread of fire
  - General condition and integrity of connected electrical equipment
- Check tightness of battery system terminals, links, intercell connections as per manufacturer's specified torque settings

- Ensure operational parameters are correctly set (eg. charge and discharge settings, communication, etc)
- Testing, including:
  - Polarity
  - Resistance between active conductors and earth, where relevant
  - Battery system voltage
  - Individual battery voltages, where relevant
  - Other relevant battery parameters, such as specific gravity, state of charge, etc
- Isolation in accordance with specified shut down procedure
- Confirmation of functioning charge and discharge cycle Note
- Testing and Confirmation of anti-islanding and emergency power supply mode
- Confirmation of functioning monitoring system(s), where relevant

5. Maintenance

Battery system and pre-assembled BESS maintenance will promote and prolong:

- Safety
- Reliability
- Performance

Only authorised persons shall perform battery system and pre-assembled BESS maintenance. Maintenance shall be conducted in accordance with:

- Manufacturer's:
  - Instructions
  - Safety Data Sheet
- System Manual
  - Recommended maintenance of the system
  - Maintenance procedure and timetable
- Work Health and Safety
  - Standard operating procedures
  - Safe work methods statement

Examples of battery system/ BESS maintenance include:

- Cleaning battery system terminals of dirt and electrolyte

- Ensuring electrical terminals are set to correct torque settings
- Ensuring battery accommodation integrity is maintained (eg. not damaged, free from debris/ rubbish; and, access is not obstructed)
- Ensure proper functioning of overcurrent and isolation devices
- Check charge and discharge parameters are correctly set
- Ensure correct ventilation has been provided and is maintained
- Check cable mechanical support, protection and penetration is maintained

6. Location

The following location requirements apply to battery systems and pre-assembled BESS. The following shall apply:

- Be installed in accordance with the manufacturer's specifications – including ambient minimum and maximum temperatures
- Not be installed:
  - In ceiling cavities
  - In ceiling spaces; or,
  - On roofs
- Not be installed in restricted locations for switchboards,
- Not be installed in damp situations, including:
  - Baths, showers and other fixed water containers
  - Swimming pools, paddling pools and spa pools or tubs
  - Fountains and water features
  - Refrigeration rooms
  - Sanitization and general hosing-down operations

The following should also apply:

- Not be located near heat sources such as sunlight, space heaters, etc
- Not be installed near combustible materials
- Not be located where electrolyte spillage contaminates water supply
- Not be installed under floors of a building envelope

7. Documentation

At the completion of the installation of a battery system or pre-assembled BESS, documentation shall be provided in accordance with the requirements of this section.

This documentation shall ensure that key system information is readily available to customers, inspectors, maintenance service providers and emergency service personnel. Additional documentation may also be required in accordance with:

• AS/ NZS 5033 - Installation and safety requirements for photovoltaic (PV) arrays

• AS/ NZS 4777.1 - Grid connection of energy systems via inverters Installation requirements

7.1 System Manual

A manual, complete with the following items, shall be provided:

- Installer address and contact details
- Battery system information, including:
  - kWh capacity
  - Voltage
  - UN code and chemistry
- Operating instructions (eg. a short description of the function and operation of all installed battery system equipment)
- Safety Certificate, where applicable
- Safety Data Sheet (SDS)
- A complete list of installed equipment, including model and serial numbers
- A list of actions to be taken in the event of an earth fault alarm, where applicable
- The shutdown and isolation procedure for emergency, maintenance, repairs and inspection
- A basic connection diagram that includes electrical ratings of the battery system and the ratings of all switchgear
- System performance estimate
- Recommended maintenance of the system
- Maintenance procedure and timetable
- Warranty information
- Manufacturer’s documentation, datasheets, handbooks, etc
- Recommendations on battery end-of-life recycling and disposal

8 Technical specifications

This section details the technical specifications refering to two different types of Battery Systems. In Section 8.1 the technical specifications for the installation of Battery Home Application systems can be found, while Section 8.2 details the technical specifications for the installation of

8.1 Home Application System

A.1 Approved System Types and offer statement

SYSTEM TYPE	DESCRIPTION
A.1	Storage system with 1PH 2.5-4kVA Battery Inverter, AC power at 45°C continuously with grid-tie functionality for home applications 8.5-12kWh(1) for AC-coupled systems.
A.2	Storage system with 3PH 3-8kVA Battery Inverter, AC power at 45°C continuously with grid-tie functionality for home applications 8.5-15kWh(1) for AC-coupled systems.
A.3	Storage system with 1PH 3-5kVA(2) Hybrid Inverter, AC power at 45°C continuously with grid-tie functionality for home applications 8.5-12kWh(1) for DC-coupled systems.
A.4	Storage system with 3PH 5-8kVA(2) Hybrid Inverter, AC power at 45°C continuously with grid-tie functionality for home applications 8.5-15kWh(1) for DC-coupled systems.

(1) Refers to the usable battery capacity, i.e. the battery has to be sized accordingly in order to meet the required cycle life as indicated in Section A.4.

SYSTEM TYPE	DESCRIPTION

(2) Refers to the grid power as indicated in Section A.3

(3) Specify the system type if offer is submitted for that part of the tender.

(4) Supply, installation and confirmation of proper functionality of the system are required.

A.2 Requested product: Battery Inverter (AC coupled)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer & Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1.	Support charging technology	Lithium Ion battery packs
2.2.	Nominal Power @ 45ºC, Continuous (kVA)	1PH: 2.5-4kVA or 3PH: 3-8kVA
2.3.	Nominal Voltage	1PH: 230VAC ±10% or 3PH: 400VAC ±10%
2.4.	Nominal Frequency	50Hz ±10%
2.5.	Total harmonic distortion	<= 5%
2.6.	Power factor (cos φ)	0.85 – 1

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
		inductive / capacitive
2.7.	Ingress protection	>= IP20 (indoor installation) or >=IP54 (outdoor installation)
2.8.	Inverter design	Transformerless
2.9.	Cooling	Regulated air cooling or natural convection
2.10.	Installation	Indoor or outdoor installation
2.11.	Permitted humidity (minimum range requirement)	5 – 85%
2.12.	Ambient temperature range (minimum range requirement)	+5°C to +30°C (indoor installation) or -10°C to +40°C (outdoor installation)
2.13.	AC Voltage Regulation (Batt. Mode)	1PH: 230VAC ± 5% or 3PH: 400VAC ± 5%
2.14.	Peak Efficiency	>= 90%
2.15.	Communication with EMS or external controller	Ethernet or CAN or RS485 (or anything compatible with the EMS)
2.16.	Communication with battery	Ethernet or CAN or RS485 (or anything compatible with the battery)
2.17.	Communication with electricity meter	RS485 (or anything compatible with the meter)
2.18.	Certificates and compliance with standards	These are the minimum required standards. If any are not met, alternative equivalent standards can be provided.

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
		EMC: EN61000-3-2 (harmonic current emissions) EN61000-3-3 (voltage fluctuations and flicker) EN61000-6-1 or EN61000-6-2 (immunity) EN61000-6-3 or EN61000-6-4 (emissions) **Electrical Safety:** EN50178 [replaced by EN62477-1] (power electronic converters and equipment) **Operation:** VDE4105
2.19.	Weight (kg)	YES
2.20.	Dimensions (WxHxD)	YES

A.3 Requested product: Hybrid Inverter (DC coupled)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer & Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1.	Support charging technology	Lithium Ion battery packs
2.2.	Nominal Grid Power @ 45ºC, continuous (kVA)	1PH: 3-5kVA or 3PH: 5-8kVA
2.3.	PV Power	1PH: >= 3kW or 3PH: >= 5kW
2.4.	Battery Power	1PH: >= 2.5kW or 3PH: >=3kW
2.5.	Nominal Voltage	1PH: 230VAC ±10% or 3PH: 400VAC ±10%
2.6.	Nominal Frequency	50Hz ±10%
2.7.	Total harmonic distortion	<= 5%
2.8.	Power factor (cos φ)	0.85 – 1 inductive / capacitive

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.9.	Ingress protection	>= IP20 (indoor installation) or >=IP54 (outdoor installation)
2.10.	Inverter design	Transformerless
2.11.	Cooling	Regulated air cooling or natural convection
2.12.	Installation	Indoor or outdoor installation
2.13.	Permitted humidity (minimum range requirement)	5 – 85%
2.14.	Ambient temperature range (minimum range requirement)	+5°C to +30°C (indoor installation) or -10°C to +40°C (outdoor installation)
2.15.	AC Voltage Regulation (Batt. Mode)	1PH: 230VAC ± 5% or 3PH: 400VAC ± 5%
2.16.	Peak Efficiency	>=90%
2.17.	Communication with EMS or external controller	Ethernet or CAN or RS485 (or anything compatible with the EMS)
2.18.	Communication with battery	Ethernet or CAN or RS485 (or anything compatible with the battery)
2.19.	Communication with electricity meter	RS485 (or anything compatible with the meter)
2.20.	Certificates and compliance with standards	These are the minimum required standards. If any are not met, alternative equivalent standards can be provided. **EMC:** EN61000-3-2 (harmonic current emissions)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
		EN61000-3-3 (voltage fluctuations and flicker) EN61000-6-1 or EN61000-6-2 (immunity) EN61000-6-3 or EN61000-6-4 (emissions) **Electrical Safety:** EN62109 (power converters for PV systems) **Operation:** VDE4105

A.4 Requested product: Battery Unit

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer & Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1.	Technology	Lithium Ion
2.2.	Usable Capacity	8.5-12kWh for 1PH system or 8.5-15kWh for 3PH system

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.3.	Nominal Voltage	48 VDC preferable (or any other voltage compatible with the inverter)
2.4.	Nominal Power	>= 2.5kW
2.5.	Ingress protection	>= IP20
2.6.	Cooling	Regulated air cooling or natural convection
2.7.	Installation	Indoor installation
2.8.	Permitted humidity minimum range requirement)	5 – 85%
2.9.	Ambient temperature range (minimum range requirement)	+5°C to +30°C
2.10.	Roundtrip Efficiency @ >=0.3C, 20-25°C	>= 90%
2.11.	Battery lifetime @ 20-25°C	>= 10 years
2.12.	Battery cycles @ >=0.5C, 100% DOD of usable capacity, 20-25°C	>= 4000
2.13.	Communication with inverter	Ethernet or CAN or RS485 (or anything compatible with the inverter)
2.14.	Certificates and compliance with standards	These are the minimum required standards. If any are not met, alternative equivalent standards can be provided. **Battery Safety:** IEC62281 or UN/DOT 38.3 (transportation testing for lithium batteries)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
		IEC62133 or UL1642 (safety test for lithium batteries) EN62619 (safety requirements for secondary lithium cells and batteries) **EMC:** EN61000-6-1 or EN61000-6-2 (immunity) EN61000-6-3 or EN61000-6-4 (emissions) **Electrical Safety:** EN50178 [replaced by EN62477-1] (power electronic converters and equipment)
2.15.	Weight (Kg)	YES
2.16.	Dimensions (WxHxD)	YES

A.5 Requested product: Battery Storage System (including Inverter, Battery and EMS)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer & Model	YES
2.	**SPECIFIC CHARACTERISTICS**	

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.1	Inverter Requirements	Battery or Hybrid Inverter Requirements (§A.2 or §A.3)
2.2	Battery Requirements	Battery Unit Requirements (§A.4)
2.3	Ingress Protection	>= IP20 applicable to system cabinet if the inverter and the battery are in the same cabinet
2.4	Additional certificates and compliance with standards	Please provide information about any relevant standards

A.6 System compliance with the required operational specifications

A/A	REQUIRED OPERATIONAL SPECIFICATIONS	REQUIREMENT
A	Increase self-consumption	Compulsory
B	Peak load shaving	Compulsory
C	Support DC-coupled and/or AC-coupled grid-tie operation as indicated in the table of section A.1	Compulsory
D	Fulfil the (in essence the complete system must be compatible with) Grid system operating parameters listed in section A.2,A.3 and A.5	Compulsory

A.7 System compliance with optional requirements

A/A	OPTIONAL REQUIREMENTS	WEIGHT
A	Make use of local weather forecasts to predict solar power generation.	10%
B	Be ready to support future communication standards for smart home applications.	10%
C	Be ready to provide the required logic to control all compatible household devices as well as heating, air conditioning and ventilation systems, integrating them into the energy management system.	30%

A/A	OPTIONAL REQUIREMENTS	WEIGHT
D	Maintain on-grid connectivity, subject to suitable parameterisation, during system frequency disturbance incidents in order to support the system frequency restoration effort.	20%
E	Support Time of Use (ToU) tariffs.	30%

8.2 Public Application System

B.1 Approved System Types and offer statement

SYSTEM TYPE	DESCRIPTION
B	Storage system with 3PH Battery Inverter 10-20kVA, AC power at 45°C continuously with grid-tie functionality for AC-coupled systems suitable for public applications 17-28kWh(1).

(1) Refers to the usable battery capacity, i.e. the battery has to be sized accordingly in order to meet the required cycle life as indicated in Section B.3.

(2) Specify the system type if an offer is submitted for that part of the tender.

(3) Supply, installation and confirmation of proper functionality of the system are required.

B.2 Requested product: Battery Inverter

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer & Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1.	Support charging technology	Lithium Ion battery packs

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.2.	Nominal Power @ 45ºC, continuous (kVA)	3PH: 10-20kVA
2.3.	Nominal Voltage	3PH: 400VAC ±10%
2.4.	Nominal Frequency	50Hz ±10%
2.5.	Total harmonic distortion	<= 5%
2.6.	Power factor (cos φ)	0.85 – 1 inductive / capacitive
2.7.	Ingress protection	>=IP20
2.8.	Inverter design	Transformerless
2.9.	Cooling	Regulated air cooling or natural convection
2.10.	Installation	Indoor or outdoor installation
2.11.	Permitted humidity (minimum range requirement)	5 – 85%
2.12.	Ambient temperature range (minimum range requirement)	+5°C to +30°C
2.13.	AC Voltage Regulation (Batt. Mode)	3PH: 400VAC ± 5%
2.14.	Peak Efficiency	>= 90%
2.15.	Communication with EMS or external controller	Ethernet or CAN or RS485 (or anything compatible with the EMS)
2.16.	Communication with battery	Ethernet or CAN or RS485 (or anything compatible with the battery)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.17.	Communication with electricity meter	RS485 (or anything compatible with the meter)
2.18.	Certificates and compliance with standards	These are the minimum required standards. If any are not met, alternative equivalent standards can be provided. **EMC:** EN61000-3-2 (harmonic current emissions) EN61000-3-3 (voltage fluctuations and flicker) EN61000-6-1 or EN61000-6-2 (immunity) EN61000-6-3 or EN61000-6-4 (emissions) **Electrical Safety:** EN50178 [replaced by EN62477-1] (power electronic converters and equipment) **Operation:** VDE4105
2.19.	Weight (kg)	YES
2.20.	Dimensions (WxHxD)	YES

B.3 Requested product: Battery Unit

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer – Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1.	Technology	Lithium Ion
2.2.	Usable Capacity	17-28 kWh
2.3.	Nominal Voltage	48 VDC preferable (or any other voltage compatible with the inverter)
2.4.	Nominal Power	>= 10kW
2.5.	Ingress protection	>= IP20
2.6.	Cooling	Regulated air cooling or natural convection
2.7.	Installation	Indoor or outdoor installation
2.8.	Permitted humidity (minimum range requirement)	5 – 85%
2.9.	Ambient temperature range (minimum range requirement)	+5°C to +30°C
2.10.	Roundtrip Efficiency @ >=0.3C, 20-25°C	>= 90%
2.11.	Battery lifetime @ 20-25°C	>= 10 years

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
2.12.	Battery cycles @ >=0.5C, 100% DOD of usable capacity, 20-25°C	>= 4000
2.13.	Communication with inverter	Ethernet or CAN or RS485 (or anything compatible with the inverter)
2.14.	Certificates and compliance with standards	These are the minimum required standards. If any are not met, alternative equivalent standards can be provided. **Battery Safety:** IEC62281 or UN/DOT 38.3 (transportation testing for lithium batteries) IEC62133 or UL1642 (safety test for lithium batteries) EN62619 (safety requirements for secondary lithium cells and batteries) **EMC:** EN61000-6-1 or EN61000-6-2 (immunity) EN61000-6-3 or EN61000-6-4 (emissions) **Electrical Safety:** EN50178 [replaced by EN62477-1] (power electronic converters and equipment)
2.15.	Weight (Kg)	YES
2.16.	Dimensions (WxHxD)	YES

B.4 Requested product: Battery Storage System (including Inverter, Battery and EMS)

A/A	CHARACTERISTICS - SPECIFICATIONS	REQUIREMENT
1.	**GENERAL CHARACTERISTICS**	
1.1.	Number of units	YES
1.2.	Manufacturer – Model	YES
2.	**SPECIFIC CHARACTERISTICS**	
2.1	Inverter Requirements	Battery Inverter Requirements (§B.2)
2.2	Battery Requirements	Battery Unit Requirements (§B.3)
2.3	Ingress Protection	>= IP20 applicable to system cabinet if the inverter and the battery are in the same cabinet *****
2.4	Additional certificates and compliance with standards	Please provide information about any relevant standards

* The cabinet is to be installed on a building terrace (3rd floor) inside a room with dimensions 210x177x180cm (H/W/D)

B.5 System compliance with the required operational specifications

A/A	REQUIRED OPERATIONAL SPECIFICATIONS	REQUIREMENT
A	Optimal power balancing through feedback from system parameters (voltage, current, power, frequency) locally at the connection point through all local sensors.	Compulsory
B	Support AC coupled grid-tie operation.	Compulsory

B.6 System compliance with optional requirements

A/A	OPTIONAL REQUIREMENTS	WEIGHT
A	Support remote supervision, telemetering and control by a centralised SCADA/DMS energy dispatch centre. Functionality must be available so that the system can accept operational settings and set-points under both normal as well as emergency system operating conditions. Tenderers should submit details of the supported functions and protocols.	20%
B	In addition to point A, the inherent support of IEC 60870-5-104 for direct SCADA communication integration will be considered an advantage.	10%
C	Time of use (ToU) tariffs.	20%
D	Increase self-consumption	30%
E	Peak load shaving	20%

9 Procurement procedures

The Tenderers must have proven and extensive experience in the execution of Contracts of similar nature and value, home and abroad and must submit evidence that they have previously performerd installations to the specified standards.

9.1 Payment Conditions

Please note that the project proposal is closely linked to the PEGASUS project and can be considered as a functional step in developing the use case of a microgrid capable of operating in both grid-connected and islanded modes..

Therefore, the optimal way for nesting the project should be considered and agreed by both parties.

However, the proposed effective payment conditions are the following:

- 30% when order is placed (down payment)
- 60% when the system is delivered on site
- 10% when system is installed, the System Acceptance Testing is made and final acceptance – taking-over signed