
BESS 12.5MW for Frequency Regulation

e-mesh™ Power Store™ Modular Preliminary Offer

Prepared for : Transelec

End Customer : Transelec.

ABB Reference : **OPP-20-3685192**

Date : 28/05/2020

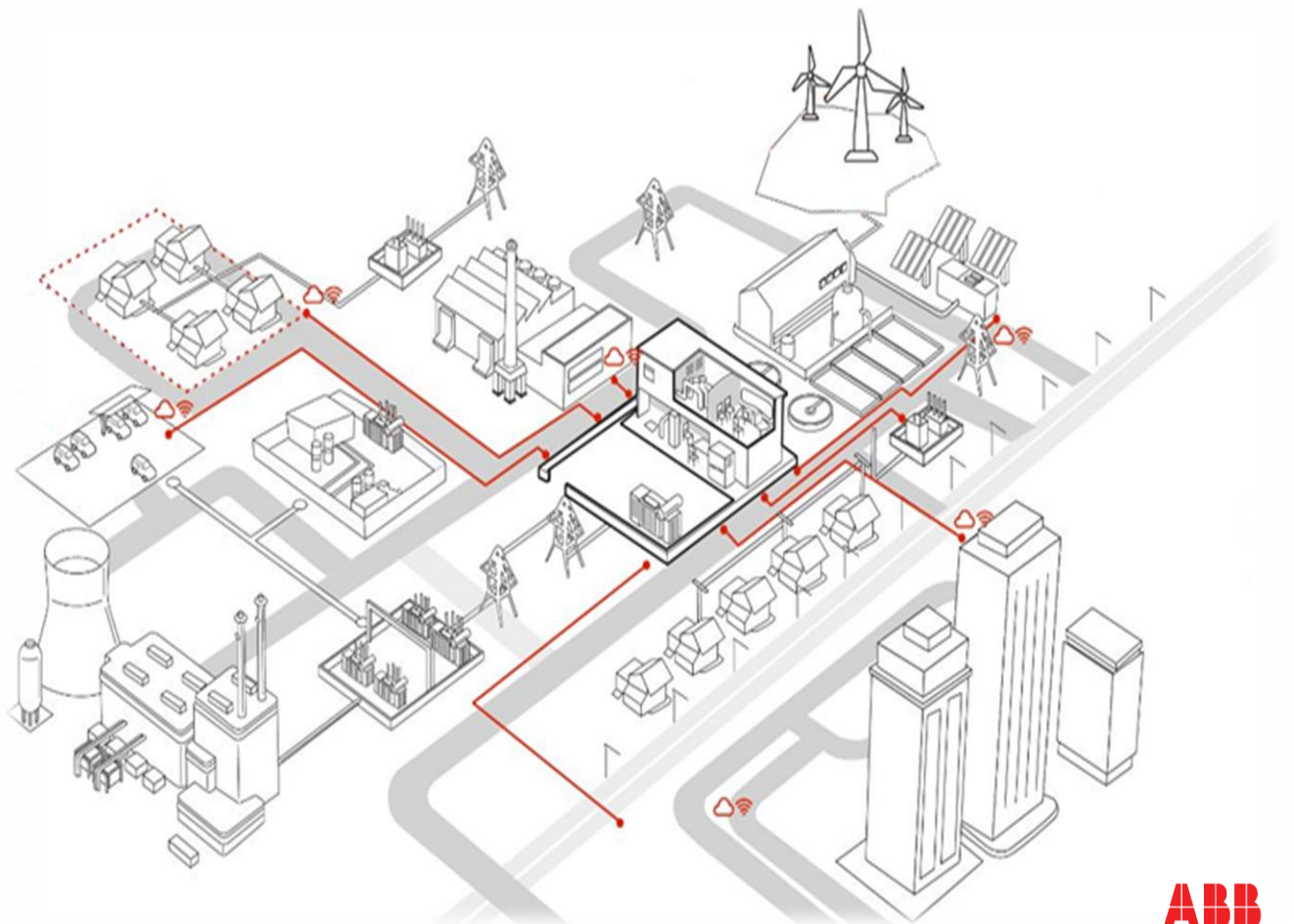


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Confidentiality Notice

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Important Notice

This ABB Offer 28/05/2020 is preliminary and not final and as such non-binding. It is tendered for discussion only, does not constitute an offer to sell and/or term to contract and ABB can, without notice, make any change in ABB's own discretion. Any contract to sell the subject matter of the proposal shall be subject to prior mutual arrangement as to price (which may be different than that shown herein), schedule, scope of works and terms.

Document Properties

Prepared for: Transelec
Prepared by: ABB Power Grids
Author: Romika D
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Table of Revisions

Revision	Description	Prepared	Date	Reviewed	Date
0	Budget offer	RD	30/04/20	RG	02/04/20

1 Introduction

On behalf of ABB Power Grids Ltd (referred as ABB, henceforth), we thank you for the opportunity to submit our e-mesh™ Power Store™ Modular Preliminary Offer for the supply of ABB's Battery Energy Storage System pre-engineered product called Power Store in combination with ABB's e-mesh™ automation solution to Transelec (referred as Customer, henceforth) for **BESS 12.5MW for Frequency Regulation**. We at Grid Edge Solutions are

As a pioneer in energy management and optimization, ABB is a trusted partner in the evolving global energy ecosystem.

ABB's Grid Edge Solutions are leading energy innovation and transition, from islands and remote communities seeking energy autonomy, to commercial and industrial sites aiming to unlock new economic opportunities, as well as utilities and service providers striving to effectively manage their increased portfolio of renewables and distributed energy resources.

Our e-mesh™ portfolio includes energy storage and digital automation solutions for energy optimization and management, advanced control, and monitoring. Our global footprint covers more than **500+ MW and 200+ references**.

ABB helps customers increase profitability and unlock new revenue streams by reducing energy cost, maximizing renewable integration and lowering CO₂, **while improving overall reliability**.

ABB has extensive experience stretching back 30 years in off-grid, remote, urban and utility scale projects and we are very well placed to work in this BESS project to deliver this project successfully.

2 Technical Offer

2.1 Scope of Supply and Service – Base offer

The table below provides the summary of the Equipment supplied within this offer.

NO	DESCRIPTION	QTY
1	Power Store – Power converter System	
	– 1100kVA PS1000 Power converter system (1500Vdc)	12 units
2	Battery energy storage Container	
	Supply of a 40ft. refrigerated Container including the following items:	
	– One (1) x 3108kWh, 24 racks Samsung Type batteries 1C	4 Unit
	– Four (4) x Battery Connection Panel	
	– HVAC System	
	– Fire Suppression System	
	– Internal Cable, Cable Trays, Lighting and accessories	
	– Earthing within container	
3	e-mesh™ - Control system	
	Supply of following control items:	
	– Eleven (12) x e-mesh™ - E Controller for BESS inverters	1 Unit
	– One (1) x e-mesh™ - N Controller for grid feeder control and frequency monitoring	
	– One (1) x SCADA Panel for accommodating SCADA and operator station	
	– One (1) X SCADA server with MicroSCADA license	
	– One (1) x Historian Server with Historian License	
	– One (1) x Operator Station	
	– One (1) x Panel mounted monitor for SCADA	
	– One (1) x Managed ethernet switch	
4	Engineering and Field Services	
	Supply of following engineering and field services	
	– Engineering of BESS equipment	1 Lot
	– Installation Supervision of BESS Equipment (Four (4) man weeks)	
	– Testing and Commissioning of BESS equipment (Eight (8) man weeks)	
	– Customer Training at Site (One (1) man week)	

2.2 Assumptions, Clarifications & Exclusions

General assumptions, clarifications and exclusions to the scope of supply are given below.

NO	Title	DESCRIPTION
1.	General	All product and services which are mentioned in this project meets the customers specifications. The offered e-mesh™ Power Store™ is a pre-engineered solution. Any modification on the design or materials and/or changes in standard functionality can be offered for future projects based on the detailed system specification.
2.	Features	Any features which are not specifically mentioned within this offer document are excluded.
3.	Cabling	All design and supply of all external Communication, AC or DC cabling except cabling within ABB supplied containers are excluded.
4.	Electrical protection	Any protection for equipment outside the ABB supplied equipment is excluded.
5.	Civil and structural works	ABB have excluded any site civil and structural works
6.	Earthing and lightning protection	Design and installation of earthing and lightning protection are excluded
7.	Commissioning equipment	Any equipment such as diesel generator, load banks, temporary power supply or any other special testing equipment are excluded.
8.	System Study	Any Power System study is excluded. ABB can provide our standard Power Store™ model and work with the customer/end customer's preferred consultant to model the Power Store™ Battery in the overall system. This support can be provided on a schedule of rates.
9.	Service Support	Service support are excluded from this offer.
10.	Remote Connection	ABB have considered standard interface with end customer SCADA through IEC-104 protocol. Any remote connection or SCADA equipment are excluded.
11.	Shipping	ABB have excluded shipping of any equipment to client site. Note that battery will be delivered within a refrigerated container. To maintain the battery warranty, temperature inside to be maintained within $23 \pm 5^{\circ}\text{C}$.
12.	Unloading	All unloading and installation of any equipment onsite are excluded.
13.	Permit	Any provision of permit (but not limited to site access, permit to work, etc.) are excluded
14.	Transformer and MV Switchgear	Transformer and MV Switchgear are excluded from our scope.
15.	Switchyard	Any MV/HV switchyard equipment and transformers except Control and Relay panel are excluded from ABB scope.
16.	Factory Acceptance Test	Standard FAT tests are considered for Inverter and Battery system. Simulation testing envisaged for Control system.

NO	Title	DESCRIPTION
17.	Site Works	Any site works (including but not limited to Site Survey, Installation and civil) are excluded.
18.	Site services	ABB have included site services as detailed in scope table. Any additional labour cost will be charged as per Schedule of Rates.

2.3 Factory Acceptance Testing

The FAT is a test carried out according to a predefined program approved by to confirm that the offered Power Store and e-mesh™ Control system performs within the offered scope and fulfils the demands stated in the contract. Those functions that cannot be built during the FAT for one reason or another are simulated and tested as close as possible in a manner corresponding to the final functioning. For identical or similar plant functions and functionality, the tests will not be repeated.

The Factory acceptance test will be executed in line with ABB's FAT documentation and program. Additional testing and duration outside of the agreed program and approved documentation shall be subject to additional costs. Schedule of rates is to be referred if deviation from approved documentation is required.

No provisions are made for the cost for the end user to witness the FAT. All related costs such as travel, accommodation, meals and other allowances will be the full responsibility of the client. If several testing sessions are required, the total related costs will be the full responsibility of the client.

ABB has considered following times for FAT tests:

- PowerStore and Control system FAT duration: **One (1) person** for **One (1) week**, business days, 8 hours per day.

2.4 Supervision of installation

ABB will support the on-time project execution by supervising the installation at site of the ABB components to smoothly prepare for the commissioning. ABB has considered following times for installation supervision:

- ABB supplied equipment installation supervision duration: **One (1) person** for **Four (4) weeks** Monday to Friday, business days, 8 hours per day.

ABB has included the travel costs as well as travel to and from site, accommodation and meals, the allowances of the engineers for the entire duration of the installation supervision. ABB should be informed well in advance before start of installation with site readiness assessment. ABB engineers will be deputed to site once site is ready in all aspects for installation

2.5 Commissioning and Site Acceptance Tests

The commissioning of the supplied systems and related equipment shall be under the responsibility of the commissioning engineers of ABB. ABB has considered following times for commissioning:

- ABB supplied equipment commissioning: **One (1) person** for **Eight (8) weeks**, Monday to Friday, business days, 8 hours per day.

ABB has included the travel costs as well as travel to and from site, accommodation and meals, the allowances of the engineers for the entire duration of the commissioning and SAT. Site acceptance tests will be performed in line with agreed test procedure finalised during engineering stage to meet functionality requested in RFP document. End Customer to ensure controllable load conditions and different operating scenarios for proper testing and commissioning.

2.6 Operational training

The course will be held on site, immediately after commissioning, once the system has been installed. It will be in **English**. The course will take place on site using the hardware already supplied when the system is installed. This course is designed for operations personnel. The objective is to acquire the skills to apply the proceeds to manipulate, interpret and control the process variables using the tools provided by the system. The recommended minimum academic standard is equivalent to Technical Specialist.

It is planned **Five (5) days** of 8 hours daily Monday through Friday common training for all site personnel. The provision is at the plant itself. The contents will be agreed prior to the training, and as a proposal it can cover following items:

General Functionality. Training can include one (1) day of theory covering the general functionality and operation of controller types and associated components that make up the System. The training will also cover the interplay between different types of controllers and methods used to optimizing the renewable integration.

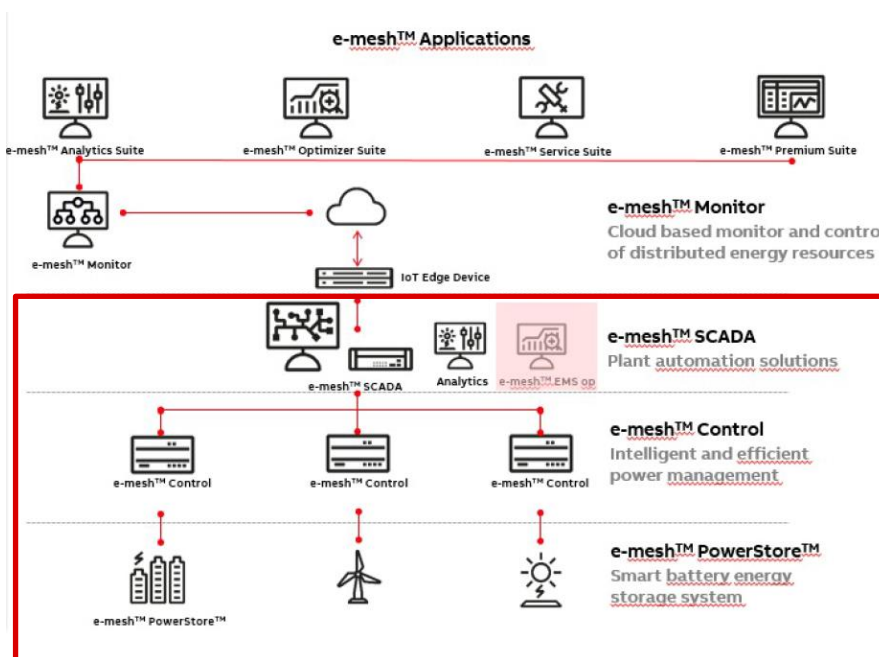
Experience on site. The theory will be accompanied by two (2) days of hands-on experience with the MicroSCADA on site. The purpose of this training is to give operators first-hand experience with the system that will be deployed. The training will cover operational topics of starting and stopping equipment and changing schedules, how to monitor the performance of the system and diagnose alarms for severity and possible causes. Also, how to access commissioning tools for system parameterization, diagnostics and upgrades.

Maintenance. These aspects of the system product will be covered over last two (2) days. This will include 50/50 theory and hands-on experience in all aspects in service and maintenance of equipment. Covering more detailed aspects of the design and the maintenance planning, tooling, and reporting requirements.

3 Technology Overview

3.1 ABB e-mesh™

ABB is a pioneer in energy management, with 30+ years of experience in microgrids and energy storage solutions and an installed base of more than 500MW+ across over 200+ installations globally. ABB Ability™ e-mesh™ is the distributed control system that offers high reliability and redundancy as well as ease of scalability and expansion. ABB e-mesh™ Portfolio offers end-to-end distributed energy solutions, combining advanced analytics, software technology and hardware system. For this project, we offer e-mesh™ PowerStore™, e-mesh™ Control and e-mesh™ SCADA from our e-mesh™ Portfolio (highlighted in the red box in the figure below) and can easily add on additional features and functionality. Below figure shows the architecture of e-mesh™ PowerStore™ main functionalities.



e-mesh™ PowerStore™ main functionalities

3.2 Converter system

The PowerStore™ utilizes a grid code compliant power conversion system (PCS), which is based on building blocks of 1000kW. This building block can be combined on an AC bus to create an aggregated PCS system of up to 4MW.

The PCS PS1000 scalable platform was specifically developed to offer a straightforward and simple solution to developers of Utility-grade energy storage systems. In ~1 MW blocks, the PS1000 platform offers a single modular system which is tailored to Utility systems of all sizes. The scalable power conversion system also boasts high-performance controls and system redundancy.

With world-class power density and an easy to install design, your energy storage system will be commissioned quickly and easily. The energy storage PCS has never been more flexible or straightforward.

Benefits and features of offered inverter system:



- 98% max efficiency
- Modular design with low component count
- ZVRT / LVRT / 4-quadrant high bandwidth control
- 1 MW blocks, up to 1500 VDC
- Configurable up to 4 MW
- Individual AC connections or combined throat
- Able to mix inverters & DC-DC in a single line-up.

3.3 Battery Energy Storage System

Through leading lithium ion battery energy storage manufacturers, a compliant battery energy storage system will be delivered. The batteries are based on reliable and proven Li-Ion technology from top tier suppliers. The ABB converters and controllers have already been configured to integrate with this battery type and therefore the resulting energy storage system is a field proven solution from reliable suppliers.

Battery System: Main components of the Battery Energy Storage System

1. Battery energy storage racks and BMS
2. Storage system Container including HVAC, firefighting, auxiliary power board

3.3.1 Battery energy storage racks and BMS:

From the top tier suppliers in the energy storage markets, lithium ion batteries are delivered as energy storage solutions. For this current tender, the following equipment will be delivered:

- M3f type Battery modules (352S String type-1C Rating)
- Switchgear with rack BMS.
- Battery rack frames
- System BMS.

3.3.2 Storage system container

ABB will deliver an engineered container to accommodate the required energy storage capacity at site. The container will integrate fire-fighting system and the required HVAC to enable safe operation of the battery energy storage system at site and at rated conditions.

The battery container system includes:

- Battery racks
- Battery modules
- HVAC
- Firefighting
- BCP
- Auxiliary panels

a) Battery shelters

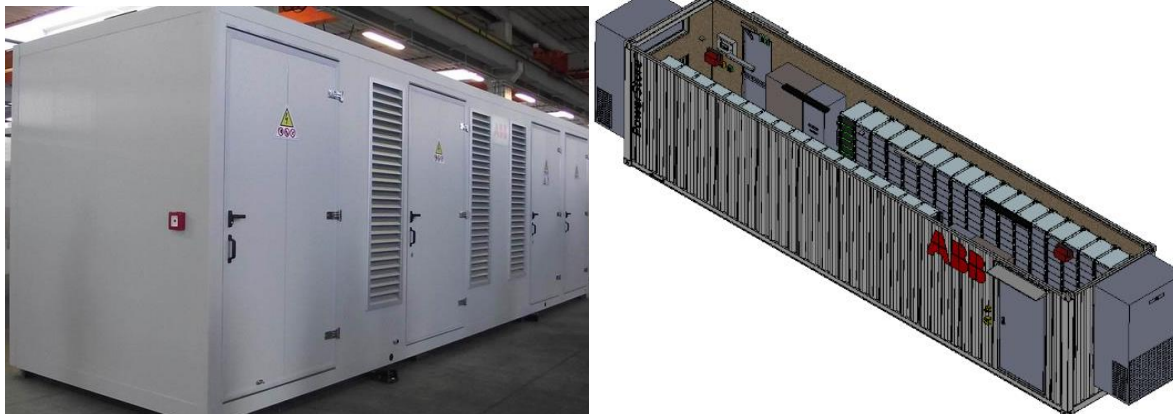
The Battery shelters are based on a steel or aluminium. The structural design will be studied, manufactured and reinforced to stand the structural requirements based on the Eurocode. Structural and HVAC studies will be performed to ensure and confirm that the components can perform under the local environmental conditions.

Suitable HVAC system will be provided to maintain required temperature and humidity inside the Battery compartment for efficient functioning of Batteries as recommended by the battery manufacturer. The ventilation system will be carefully designed to ensure the perfect operation of the equipment in the local environmental condition. From the ventilation grids, passing through the interior of the building, to the external hoods, every detail will be studied to obtain the perfect balance between the water protection, low pressure drop and adequate volume of air flow ventilation of the system.

The internal walls are “sandwich” panels with polyurethane core or wooden rock to ensure a high insulation of the container. The equipment inside the container will be ready for road transport. Additionally, the external wall

of the container is prepared with a C5M painting process (only in case steel containers) to ensure durability and low maintenance. Different colours are available, our standard is the RAL9010.

HVAC design will be performed to ensure and confirm that the components can perform under the local environmental conditions. It is designed as air closed circuit system so that no outside air comes in contact with the batteries, power conversion system or controls.



The internal walls are “sandwich” panels ensure a high insulation of the container. The equipment inside the container will be ready for road transport. It has a fire resistance greater than one hour.

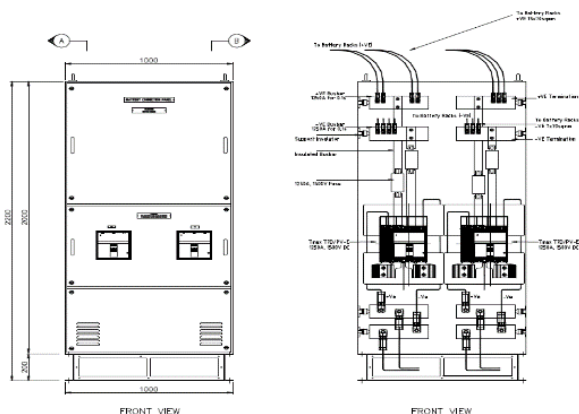
For the protection against external mechanical impacts, the PowerStore has a protection degree IK10 according to IEC 62262 (except ventilation grids and external ducts).

Other features:

- Internal support of equipment or installations to walls
- Supply and installation of interior insulation in the ceiling, walls and doors
- The insulation panel will be painted in the colour to be specified
- Benches necessary for accommodation of the equipment that carries the container inside.
- Two doors for access to the container with antipanic bar.

b) Battery connection panels (BCP)

Each line up with several racks is connected to a DC bus bar and terminated in the DC battery connection panel. The panel includes a current limiting main switch and suitable fuse protection, which provides isolation between the battery system and the power converter system. Below figure shows the sample BCP general arrangement and the dimensions.



BCP layout. (Not valid for construction)

The DC cables connecting the battery system with the power converter are entering the panel from the bottom.

c) AC auxiliary board

The auxiliary power for the battery system is connected to the AC panel. The AC cable enters the AC panel from the bottom. The AC panel distributes power to BMS, HVAC and FFS.

d) HVAC system

Battery Containers will be supplied with HVAC system to achieve +23°C to +/-5 °C indoor operation temperature. All the containers have their respective heat loads and HVAC dimensioning is carried out according to the heat loads.

HVAC system can be split type or indoor type (to be defined at detailed engineering stage). Hence, the outdoor units must meet the IP protection degree and protection from high humid environment.

- The required split units may be supplied either as a single unit or combination of multiple units.
- All split unit component (including external AC fan unit) will be concealed within the container. No equipment shall be installed outside the container for easy transportation.

e) Fire Fighting System (FFS)

The smoke detector will be mounted on the ceiling of the container. The smoke detectors are mounted with thermal detectors. The smoke detector will trigger the release of the fire suppression agent (aerosol) if they sense a thermal event and the thermal detector will operate with smoke detector to release the suppression agent if fire happens or emergency situation.

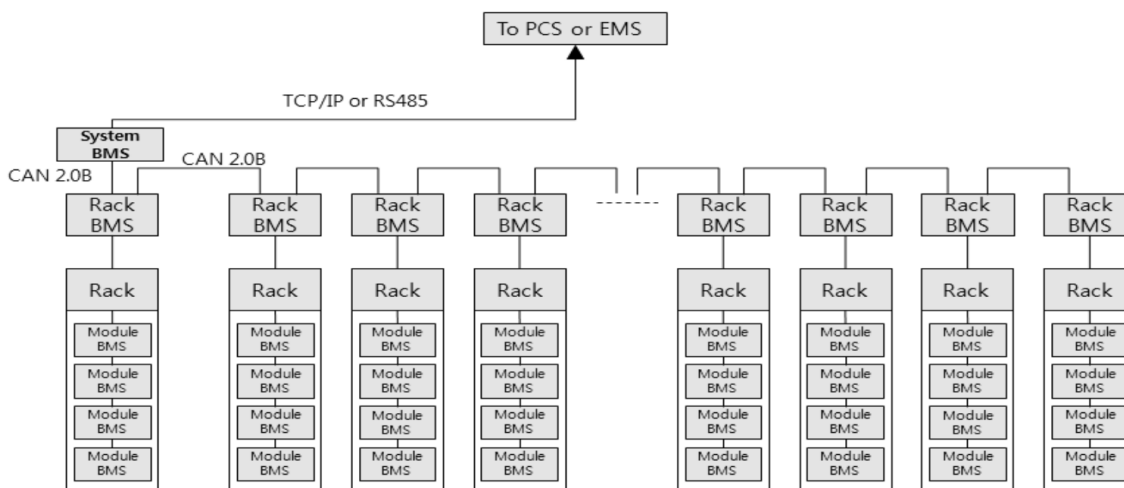
Each container will be equipped with:

- Fire Fighting System (FFS) by with aerosol generators
- 1 Fire detection panel
- 4 Fire detectors
- 1 Alarm beacon
- 5 Kg CO₂ fire extinguisher

Note that based on customer requirement, Novec fire-fighting system can also be provided at an additional price.

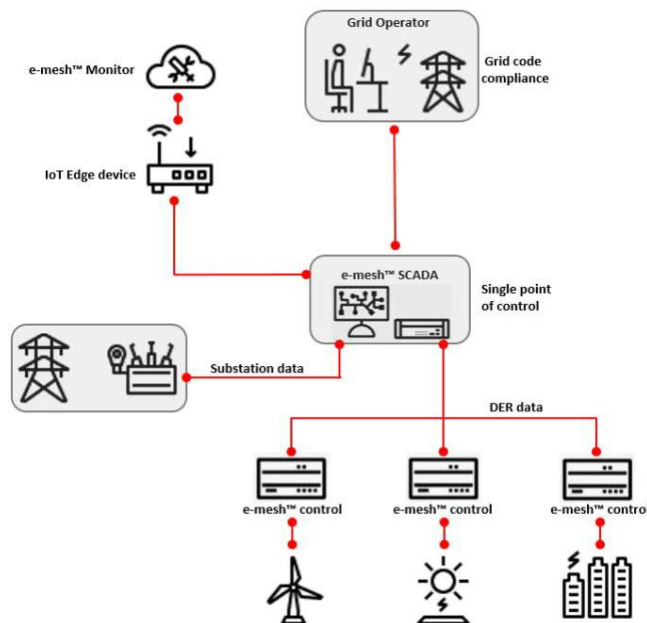
f) BMS block diagram

The below figure shows the connection diagram for the BMS (Battery Management System) with racks on every container.



Connection diagram for the BMS

3.4 e-mesh™ SCADA and Control



e-mesh™ SCADA Architecture

ABB’s energy storage controller is a networked control system to coordinate the energy flow and dynamic performance when integrating energy storage systems into the grid.

The controller is designed to allow communication between the battery converters and the grid connection allowing a harmonized response to frequency disturbances and operator set points. For scope details, refer to the sections above. The controller that will be integrated is the:

e-mesh™ -E-Controller - The energy storage / Power Store controller, is designed to integrate inverter-based energy storage systems into a grid through the provision of independent control and monitoring of the storage technology. The controller is designed to work with different battery storage technologies, which will be used to either provide grid stabilisation or energy storage auxiliary services or both in a grid.

e-mesh™ - N Controller- This controller provides information about the status of power system. The connectivity with customer power meters is performed through Modbus communication.

e-mesh™ SCADA is a purpose-made library package built on ABB`s flagship SCADA platform MicroSCADA Pro. e-mesh™ SCADA ensures the optimized control and reliable operation of your renewable assets, distributed energy resources (DER) including battery energy storage and microgrid by seamless integration and connectivity between different e-mesh™ controllers. It has intuitive and informative user interface which enables safe and fast real-time operations. An operator interface is provided with e-mesh™ SCADA Pro and server. The e-mesh™ SCADA provides a visual representation of data, historical data acquisition and storage of all monitored data points of the connected BESS system controllers to enable reporting, remote monitoring, service operator control requests and assistance in fault-finding. It is also the main interface to setup and commission the e-mesh Control System.

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Windows based, centralised or distributed SCADA system provides a wide range of functionality, including:

- HMI (Human Machine Interface): process displays with alarms and events, measurement reports and trends.
- Automation functions
- Communication services and gateway functionality
- Data logging.
- Seamless integration in several domains
- Ergonomic HMI
- Bi-directional e-mesh™ SCADA
- Easy reusability
- All elements of the grids are modelled
- Automatic process database connection
- No programming required.

Historian provides the following functionalities:

- High capacity data logging: event-based logging – don't miss fast transients: data compression with configurable accuracy
- Consolidation of data from several systems
- Flexible reporting and trending
- Customisable templates and displays
- Operator controlled reports and trends
- Drag and drop of variables to display for easy data analysis.

This data can be exported into a wide range of software, including Microsoft Excel for further analysis. The information is also available to be exported to upper level SCADA systems through a MODBUS/TCP communications interface.

The compact system, SYS600C provides proven e-mesh™ SCADA Pro functionality for real-time monitoring and control of primary and secondary equipment. Robust and compact, it offers an ideal solution for harsh and demanding environments in both transmission and distribution substations. Depend on it whenever real-time process information as well as state-of-the-art monitoring and control capabilities are crucial.

4 Commercial Offer

4.1 Price Schedule

As per the scope of work in Section 2.1

NO	DESCRIPTION	PRICE (USD ex GST)
1	e-mesh™ Power Store™, Battery System, e-mesh™ Control System, C&R Panel and Field Services	\$ 5,981,000
Total		\$ 5,981,000

4.2 Assignment

ABB may transfer or assign, directly or indirectly, all of its rights or obligations under this agreement without the prior written consent of the other party to another legal entity of ABB Group. This agreement, and the obligations hereunder, shall be binding upon the parties hereto, their successors and permitted assigns.

4.3 Technical Warranty

Except stated on the contrary in the Order/Contract, ABB considers a warranty period of **Twelve (12) months** from the provisional acceptance or **Eighteen (18) months** from notification of readiness/availability for final inspection of main equipment, whichever comes first, regardless of it being expressly (positive completion of applicable tests plus written acceptance) or tacitly (after fifteen (15) days have elapsed from notice of ABB to Customer without any express disagreement notice given by the Customer).

4.4 Delivery Time

a) Delivery Conditions

The applicable INCOTERM conditions for the delivery of the equipment is: **FOB-Italy**

b) Delivery time

ABB equipment estimated lead times from date in which the order/contract entry into force until delivery (as per stated INCOTERM) including designing phase, manufacturing and factory tests, supervision installation, commissioning: **10 months** excluding any performance test duration.

Any delay on customer activities will postpone subsequent activities in this project schedule and may affect pricing in case of significant changes.

Both ABB and customer are aware of the outbreak of a Coronavirus COVID-19 or any mutation of such virus which is impacting or may impact normal business. ABB hereby reserves the right to amend the delivery schedule, the price, the scope of supply, the scope of works and the terms and conditions of contract if any set out in this offer. Notwithstanding anything to the contrary, the forgoing paragraph is deemed to be incorporated into any subsequent concluded contract.”