Modular Systems, EPDS

Compact Energy Storage Module
Product overview
ABB Power Products in energy storage
Portfolio coverage

Stationary

- Load leveling
- Spinning reserve
- Integration of renewables
- Peak shaving
- Load leveling
- Frequency regulation
- Solar PV time shift
- Integration of renewables (CSS)

Application Focus

- Behind-the-meter
- Peak Shaving
- Solar PV time shift
- Integration of renewables (CSS)
- Power Quality

Modular Systems Offering

Compact Energy Storage Module (CESM)
From 25 to 100 kVA

Containerized solutions (ESM)
From 25kVA to 2 MVA
From 50kWh to 4 MWh

Data centers

Behind-the-meter
- Peak shaving
- Load leveling
- Integration of PV
ABB Compact Energy Storage Module – CESM
Schematic drawing and applications

LOADS
- Highly varying
- Inductive
- Capacitive
- Peak demanding
- Non-linear

GENERATION
- Highly varying

Energy storage device

AC bus

GRIND

Supervisory control
- Peak shaving
- Capacity firming
- Load leveling
- Power quality

Peak shaving

Capacity firming

Load leveling

- Highly varying
- Inductive
- Capacitive
- Peak demanding
- Non-linear

SCADA

HMI

Portable devices
ABB Compact Energy Storage Module – CESM Applications

Applications
- Load shifting
- Peak shaving
- Capacity firming (Renewable integration)
- Power quality
  - Reactive power compensation
  - Harmonics mitigation
Load leveling involves storing power during periods of low demand on the system and delivering it during periods of high demand. Benefit:

- Postponement of investments in grid upgrades or in new generating capacity.
Peak shaving

Peak shaving is similar to load leveling, but may be for the purpose of reducing peak demand and for economy of operation. The goal is to avoid the installation of capacity to supply the peaks of a highly variable load. Peak shaving installations are often owned by the electricity consumer, rather than by the utility.

![Graph showing load, supply power, absorb power, charge, and discharge over time.](attachment:image_url)
Capacity firming
The variable, intermittent power output from a renewable power plant, such as wind or solar, can be maintained at a committed (firm) level for a period of time. The energy storage system smoothens the output and controls the ramp rate (kW/min) to eliminate rapid voltage and power swings on the electrical grid.
Power quality
Reactive power compensation:
Energy storage with reactive power capability can provide voltage support and respond quickly to voltage control signals.

Harmonics mitigation:
Energy storage as active filter with harmonics compensation up to 50th harmonic. Reduction of THD.

Load balancing:
Balance the currents between phases.
ABB Compact Energy Storage Module – CESM

Main components

Integrated solution: inverter, batteries, protection and control in one cabinet:

- ABB PQF ESI-M power converter
- Batteries and the battery management system (BMS) from recognized supplier
- ABB controller
- ABB HMI
ABB Compact Energy Storage Module – CESM

Characteristics

<table>
<thead>
<tr>
<th>Technical data</th>
<th>Compact ESM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Up to 100 kW</td>
</tr>
<tr>
<td>Energy</td>
<td>Up to 65 kWh in one unit</td>
</tr>
<tr>
<td></td>
<td>Up to 200 kWh in extended unit</td>
</tr>
<tr>
<td>Connection method</td>
<td>3-phase</td>
</tr>
<tr>
<td>AC voltage</td>
<td>400 Vac</td>
</tr>
<tr>
<td>Network frequency</td>
<td>50 Hz – +/- 5%</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt;96% (converter)</td>
</tr>
<tr>
<td>Reactive power compensation: target cosΦ</td>
<td>From 0.6 (inductive) to 0.6 (capacitive)</td>
</tr>
<tr>
<td>Harmonic mitigation</td>
<td>Up to 50th harmonic</td>
</tr>
<tr>
<td>Load balancing characteristics</td>
<td>Balance the currents between phases</td>
</tr>
<tr>
<td>Energy storage medium</td>
<td>Lithium ion battery modules</td>
</tr>
<tr>
<td>DC voltage range</td>
<td>576 ÷ 787 Vdc</td>
</tr>
<tr>
<td>Cycle life</td>
<td>4000 cycles</td>
</tr>
<tr>
<td>Calendar life</td>
<td>10 years</td>
</tr>
<tr>
<td>Dimensions (W x D x H)</td>
<td>1800 x 600 x 2000 mm</td>
</tr>
<tr>
<td>Approximate weight</td>
<td>1100 kg</td>
</tr>
<tr>
<td>Enclosure protection degree</td>
<td>IP 21</td>
</tr>
<tr>
<td>Control options</td>
<td>Load leveling, power quality</td>
</tr>
<tr>
<td>Communication protocols</td>
<td>Modbus TCP/IP, IEC 61850, CAN, DNP 3.0 (optional)</td>
</tr>
<tr>
<td>Redundancy</td>
<td>Master/master or master/slave arrangement</td>
</tr>
<tr>
<td>Modularity</td>
<td>Maximum 32 ESM racks can be combined</td>
</tr>
<tr>
<td>Room ambient temperature</td>
<td>23 °C is recommended</td>
</tr>
<tr>
<td>Humidity</td>
<td>60% non-condensing</td>
</tr>
<tr>
<td>Altitude</td>
<td>Indoor installation in clean environment up to 1000 m.a.s.l.</td>
</tr>
<tr>
<td>CT requirements</td>
<td>Only required for power quality features (not in the scope of delivery)</td>
</tr>
<tr>
<td>Power converter</td>
<td>UL-508, IEC 60439-1, IEC 61000-6-2, IEC 61000-6-4</td>
</tr>
<tr>
<td>Batteries</td>
<td>UN 38.3</td>
</tr>
</tbody>
</table>
ABB Compact Energy Storage Module – CESM Modularity

- Two sets of CESM connected in parallel at the AC bus:
  - Increase in the power: 100=>200kW
  - Increase in the capacity kWh: 65=>130kWh
- Operation in Master-Slave configuration.
- Inverter + protection according to the ratings of the batteries. No need of retrofitting in case of upgrade.
- Communication between the two units needed.
ABB Compact Energy Storage Module – CESM
Modularity – Option 2

- Two or more sets of batteries connected in parallel at the DC bus of the inverter:
  - Constant in the power: 100kW
  - Increase in the capacity kWh: 65=>130k=>200 kWh
  - Inverter to be in accordance to the ratings of the batteries of the expected power in future. More power available for power quality purposes.
- Retrofitting of the protection needed.
ABB Compact Energy Storage Module – CESM Controls

- **Level 1.** System is working based on given set-points, including the time. Reading the signals from the measurement transformers for power quality improvement and harmonics filtration.

- **Level 2.** Level 2 includes all functions from Level 1 together with readiness for remote commands to charge and discharge.

- **Level 3.** Level 3 would include the algorithms that will let the system to work based on several signals that system owner wants to be followed. Depending on the algorithm the system will choose which application to run, eg renewables smoothing, daily load shifting. **NOT included within budget offers.**
ABB Compact Energy Storage Module – CESM Control – LEVEL 1

- LOADS
  - Highly varying
  - Inductive
  - Capacitive
  - Peak demanding
  - Non-linear

- GENERATION
  - Highly varying

- Energy storage device

- LEVEL 1 Control
  - Load leveling
  - Power quality

- AC bus

- GRID

- Power quality
  - Illustrated waveforms

- Load leveling
  - Illustrated waveforms

- HMI

- DC/AC conversion
ABB Compact Energy Storage Module – CESM
Control – LEVEL 2

- Communication with SCADA:
  - System Status
  - Remote Start/Stop programming:
    - Set points:
      - Power
      - Duration

- Highly varying
- Inductive
- Capacitive
- Peak demanding
- Non-linear

LOADS

Highly varying

GENERATION

Highly varying

Energy storage device

DC

AC

LEVEL 2 Control

Load leveling

Power quality

SCADA

HMI

GRID

AC bus
ABB Compact Energy Storage Module – CESM
Control – LEVEL 3 – NOT included within budget offers

- LOADS
  - Highly varying
  - Inductive
  - Capacitive
  - Peak demanding
  - Non-linear

- GENERATION
  - Highly varying

- Energy storage device

- LEVEL 3 Control
  - Peak shaving
  - Capacity firming
  - Load leveling
  - Power quality

- AC bus

- GRID

- Peak shaving
  - Scheduled power consumption
  - Load
  - Absorb power
  - Supply power

- Capacity firming
  - Renewable generated power
  - Supply power
  - Absorb power

- Load leveling
  - Supply power
  - Load
  - Absorb power

- SCADA

- HMI
ABB Compact Energy Storage Module – CESM
Installation room conditions

- Product designed for indoor installation.
- Normal working conditions: 23±5°C

Cooling and ventilation:

- ABB will support on the cooling system calculations once the size of the installation room and amount of units installed is clear. Other heat emitting equipment and cooling equipment in the same room to be considered.

- Also we can give the suggestions on the locations of the ventilation channels and sizes of the fans when needed. The need of the HVAC is dependent of how much/powerful ventilation will be available and the total heat emission of the installed CESM’s. (Other equipment in the same room has to be considered.)

- Ventilation system will need the flaps which will close based on the command from the fire suppression system.

- Installation by third party and NOT in the scope of delivery from ABB.

- In case CESM is installed into outdoor enclosure, all recommendations comply to this as well.
ABB Compact Energy Storage Module – CESM
Installation room conditions

- Product designed for indoor installation.
- Installation room has to answer to the local safety regulations.

Fire suppression system:

- Has to be added to the installation room due to the battery safety regulations.

- Fire suppression system will be scaled based on the size of the room and extinguishing gas used in the system. The gas is defined based on what is allowed by local regulations. Safety to the people has to be considered.

- System has to read the signals determined by ABB’s CESM and customer, if any. Has to work together with closing flaps in ventilation.

- Installation by third party and NOT in the scope of delivery from ABB.

- In case CESM is installed into outdoor enclosure, all recommendations comply to this as well.
ABB Compact Energy Storage Module – CESM

Needed site works and commissioning

- Site works to be done before commissioning. (Works NOT included in scope off the offer and to be done by customer.)
  - Power cabling:
    - Instructions to be provided by ABB
  - Reliable earthing connection
  - Fire suppression system
  - HVAC
- Commissioning
  - Rack installation and fixation to the ground
  - Mounting the battery module into the battery trays
  - Internal DC cabling for the battery string
  - Inverter setup
  - Control system setup and system test
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