

20ft Containerized ESS Factsheet and Capacity Profile

20FT CONTAINERIZED ENERGY STORAGE SYSTEM (ESS) - OFFICIAL COMMERCIAL BESS TECHNICAL OVERVIEW & DATASHEET

EXECUTIVE SUMMARY

This document presents the technical overview and detailed specifications for the 20ft Containerized Energy Storage System (ESS), a turnkey, high-capacity solution engineered for utility-scale, commercial & industrial (C&I), and micro-grid applications. This platform integrates Tier-1 LFP battery cells, a bi-directional Power Conversion System (PCS), an advanced Battery Management System (BMS), and a smart Liquid Cooling Thermal Management System (TMS) within a rugged, IP54-rated 20-foot ISO container. Designed for global deployment, this system offers a scalable, safe, and reliable solution for peak shaving, demand response, renewable energy time-shifting, and grid stabilization. The architecture emphasizes a low Levelized Cost of Storage (LCOS), high round-trip efficiency, and adherence to the most stringent international safety and performance standards.



SYSTEM ARCHITECTURE & SAFETY

The 20ft ESS platform is built upon a modular and integrated architecture, ensuring seamless on-site integration and optimal performance. The core subsystems are housed within a structurally reinforced, thermally insulated 20ft container, designed for outdoor installation.

CELL INTEGRATION: The system utilizes high-cycle-life, prismatic Tier-1 LFP (Lithium Iron Phosphate) cells, known for their exceptional thermal and chemical stability, intrinsic safety, and long calendar life. Cells are configured in a series-parallel arrangement within modular racks to achieve the nominal DC voltage and total energy capacity.

BATTERY MANAGEMENT SYSTEM (BMS): A multi-layered, redundant BMS

provides real-time monitoring and control at the cell, module, and rack levels.

Key functions include:

- State of Charge (SoC) and State of Health (SoH) estimation.
- Cell voltage and temperature balancing (passive and active balancing strategies).
- Over-voltage, under-voltage, over-current, over-temperature, and under-temperature protection.
- Insulation monitoring and ground fault detection.
- Communication with the PCS and Energy Management System (EMS) via standard protocols (Modbus, CAN).

POWER CONVERSION SYSTEM (PCS): The integrated bi-directional PCS acts as the interface between the battery DC bus and the AC grid or load. It is designed for high efficiency (>98% peak) and features:

- Four-quadrant operation for charging and discharging.
- Grid-forming and grid-following capabilities for on-grid and off-grid operation.
- Active and reactive power control (PF control).
- Low-voltage ride-through (LVRT) and high-voltage ride-through (HVRT) capabilities.
- Anti-islanding protection.

THERMAL MANAGEMENT SYSTEM (TMS): An advanced liquid cooling system is employed to maintain the battery cells within their optimal operating temperature range ($25 \pm 3^{\circ}\text{C}$). This active TMS significantly enhances cycle life, improves system efficiency, and ensures performance stability under extreme ambient conditions. The system comprises a chiller unit, coolant distribution pipelines, and cold plates integrated directly into the battery module design.

FIRE SAFETY & SUPPRESSION: The container is equipped with a multi-level safety system, including:

- Aerosol or gas-based fire suppression system (e.g., FM-200, Novec 1230).
- Early warning smoke and gas (CO, VOC) detectors.
- Explosion venting panels.
- Internal and external emergency stop (E-Stop) buttons.
- The system is designed in compliance with NFPA 855 and other local fire codes.

KEY FEATURES

- **HIGH ENERGY DENSITY:** Optimized packaging within a 20ft footprint maximizes energy capacity, reducing the physical footprint per MWh.
- **ENHANCED SAFETY:** LFP chemistry combined with a multi-tiered BMS and robust fire suppression ensures the highest level of operational safety.

- LIQUID COOLING EXCELLENCE: Superior thermal management improves cell life by up to 20% and ensures consistent performance in diverse climates (-30° C to +50°C).
- MODULAR & SCALABLE: Designed for simple paralleling, allowing for system expansion from a single unit to multi-MWh power plants.
- SEAMLESS INTEGRATION: Pre-commissioned and factory-tested for plug-and-play deployment, significantly reducing on-site construction and commissioning time.
- GRID SUPPORT FUNCTIONS: Provides essential grid services including frequency regulation, voltage support, and black-start capability.
- SMART EMS CONNECTIVITY: Equipped with a local EMS that supports remote monitoring, data logging, and OTA firmware updates via a secure cloud platform.
- ROBUST ENCLOSURE: IP54-rated container protects internal components from dust, water ingress, and physical impact, ensuring durability in harsh outdoor environments.

COMPLIANCE & STANDARDS

The 20ft Containerized ESS is designed and certified to meet the most stringent international standards, ensuring global bankability and project acceptance.

- IEC 62619: Safety requirements for secondary lithium cells and batteries for industrial applications.
- IEC 62477: Safety requirements for power electronic converter systems and equipment.
- UL 1973: Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power, and Light Electric Rail (LER) Applications.
- UL 9540: Standard for Energy Storage Systems and Equipment.
- UL 9540A: Test method for evaluating thermal runaway fire propagation in battery energy storage systems.
- IEEE 1547: Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
- CE, UKCA, EAC, etc. (depending on regional configurations).
- Compliance with local grid codes (e.g., VDE-AR-N 4110, ENTSO-E).
- RoHS and REACH compliant.

TECHNICAL SPECIFICATIONS

Parameter	Specification
Cell Chemistry	Tier-1 Lithium Iron Phosphate (LFP)
Nominal Energy Capacity	2.0 MWh - 2.5 MWh
Usable Energy (DoD 90%)	1.8 MWh - 2.25 MWh
Rated AC Power	1000 kW - 1250 kW

Peak AC Power (10s)	1200 kW - 1500 kW
Max DC Voltage	1500 Vdc
Nominal DC Voltage	1300 Vdc
Min DC Voltage	1000 Vdc
Cooling Method	Active Liquid Cooling (Chiller + Coolant)
Operating Temperature Range	-30°C to +50°C (Derating >45°C)
Relative Humidity	0% - 95% (Non-condensing)
Max Altitude	2000 m (Derating above)
AC Grid Connection	3W + N + PE, 380/400/480 Vac, 50/60 Hz
Max AC Current	~1500 A (at rated power)
Total Harmonic Distortion (THDi)	<3% (at rated power)
Power Factor Range	0.99 leading - 0.99 lagging
Round-Trip Efficiency (AC-AC)	≥ 92% (at nominal conditions)
Enclosure Protection	IP54 (Indoor and outdoor installation)
Fire Suppression	Aerosol / Gas-based system
Communication Protocols	Modbus TCP/RTU, CAN, IEC 61850
Container Dimensions (W x H x D)	~ 6058 x 2896 x 2438 mm (20ft HC)
Container Weight	~ 22,000 - 25,000 kg (depending on capacity)
Warranty	10 years / 6000 cycles (at 80% EOL)

INDUSTRIAL DEPLOYMENT

The 20ft Containerized ESS is ideally suited for a wide range of demanding applications. Its robust construction and advanced control systems make it a versatile asset for the future of energy.

- RENEWABLE INTEGRATION: Smoothing the output of solar and wind farms, reducing curtailment, and enabling time-shifting of energy to peak demand periods.
- PEAK SHAVING & DEMAND RESPONSE: For commercial and industrial facilities, reducing peak demand charges and participating in demand response programs to generate revenue.
- GRID ANCILLARY SERVICES: Providing fast-responding frequency regulation (FCR, aFRR), voltage support, and spinning reserve to enhance grid stability and reliability.
- MICRO-GRIDS: Serving as a primary energy storage component for off-grid and grid-tied micro-grids, supporting islanded operation and ensuring energy independence.
- EV CHARGING INFRASTRUCTURE: Buffering the grid connection to reduce peak loads and enable ultra-fast charging without costly grid upgrades.

