

Class-100,000 Cleanroom Operational Profile - Official Commercial BESS

Technical Overview & Datasheet

EXECUTIVE SUMMARY

This document establishes the definitive operational and technical framework for deploying advanced Battery Energy Storage Systems (BESS) within a Class-100,000 cleanroom environment. As the global demand for high-purity manufacturing processes accelerates, the integration of reliable, high-density energy storage becomes mission-critical. The Class-100,000 operational profile represents a paradigm shift in C&I energy management, specifically engineered to meet the stringent particulate and thermal constraints of ISO Class 8 environments. This whitepaper details the architecture, safety protocols, and performance metrics of a turnkey solution designed to deliver uninterrupted power, peak shaving capabilities, and grid resilience without compromising the integrity of sensitive cleanroom operations. The system leverages Tier-1 LFP chemistry and advanced liquid cooling to ensure operational excellence in controlled contamination zones.



SYSTEM ARCHITECTURE & SAFETY

The core architecture of the Class-100,000 compliant BESS is built upon a modular, outdoor-rated enclosure that has been specifically adapted for indoor deployment within high-purity manufacturing zones. The system integrates a high-voltage DC busbar, bi-directional PCS, and an intelligent EMS, all housed within a sealed, positive-pressure cabinet to prevent particulate ingress. Safety is paramount; the design incorporates multi-level fire suppression systems, including aerosol and perfluorohexanone agents, alongside real-time thermal runaway monitoring. The architecture ensures that any potential off-gassing or thermal event is contained and mitigated without disrupting the cleanroom environment. The system's structural integrity is verified to withstand seismic events while maintaining an airtight seal, ensuring zero contamination risk to the surrounding fabrication or pharmaceutical processes.

KEY FEATURES

- Zero Particulate Emission Design: Sealed chassis with HEPA-filtered ventilation maintains internal cleanliness and prevents external contamination.
- Smart Liquid Cooling: Precision thermal management maintains optimal cell temperature, reducing degradation and ensuring uniform performance across all modules.
- High-Density LFP Chemistry: Utilizes Tier-1 Lithium Iron Phosphate cells for superior cycle life and intrinsic safety characteristics.
- Seamless PCS Integration: Bi-directional inverters provide four-quadrant operation for reactive power support and grid-forming capabilities.
- Intelligent EMS: Cloud-connected Energy Management System enables remote diagnostics, demand response logic, and peak shaving optimization.
- Modular Scalability: Rack-based design allows for parallel expansion from 215 kWh to MWh-scale capacity without facility redesign.

COMPLIANCE & STANDARDS

The Class-100,000 operational profile is engineered to meet the most rigorous international standards. The system holds certifications for UL 9540 (Energy Storage Systems and Equipment), IEC 62619 (Safety Requirements for Industrial Batteries), and UL 1973. The enclosure is rated for indoor use and complies with

NFPA 855 installation requirements for stationary energy storage. Additionally, the materials and construction methods have been validated to meet ISO 14644-1 Class 8 particulate cleanliness standards, ensuring that the BESS does not introduce contamination into the controlled environment. The system also adheres to CE, IEC 62477, and IEEE 1547 grid interconnection standards.

TECHNICAL SPECIFICATIONS

The following parameters define the standard configuration for the Class-100,000 compliant BESS cabinet. These specifications are subject to customization based on specific facility load profiles and cleanroom classification requirements.

Parameter	Specification
Nominal Capacity	215 kWh / 372 kWh per cabinet
Cooling Method	Smart Liquid Cooling (Integrated Chiller)
Cell Chemistry	Tier-1 LFP (Lithium Iron Phosphate)
Operating Temperature	-20°C to +55°C (Ambient)
Ingress Protection	IP54 (Internal Components IP66)
Cleanroom Compatibility	ISO Class 8 (Class-100,000) Compliant
Cycle Life	> 8,000 Cycles @ 80% DoD

Communication Protocols	Modbus TCP/IP, IEC 61850, CAN
Dimensions (W x H x D)	1200 x 2200 x 1100 mm
Weight	Approx. 2,800 kg
Safety Certifications	UL 9540, IEC 62619, UL 1973, NFPA 855
Grid Support	Peak Shaving, Load Shifting, Reactive Power

INDUSTRIAL DEPLOYMENT

Deployment within a Class-100,000 cleanroom requires meticulous planning. The BESS is typically installed in a dedicated mechanical utility room or an interstitial space adjacent to the main production floor. The installation process involves pre-fabricated pad staging, vibration isolation mounts, and dedicated HVAC integration to manage the minimal heat load. The system's compact footprint and front-access maintenance design minimize disruption to cleanroom operations. The EMS integrates seamlessly with the facility's SCADA and Building Management System (BMS), allowing for automated load shifting and participation in demand response programs. This deployment strategy ensures that the facility achieves maximum energy independence while maintaining the highest standards of cleanliness and operational safety.

