

UL 9540 & IEC 62619 Technical Compliance Register: Battery Recycling and Environmental Compliance Document

REGULATORY DIRECTIVES

The Battery Recycling and Environmental Compliance Document establishes the mandatory global framework governing end-of-life management, material reclamation, and environmental stewardship for all Tier-1 commercial and industrial battery energy storage systems (BESS). This document serves as the authoritative compliance register for OEMs, EPCs, asset owners, and facility operators, ensuring full alignment with UL 9540, IEC 62619, EU Battery Regulation 2023/1542, and US EPA universal waste protocols. It defines the traceability, reporting, and reverse logistics obligations required to maintain commercial certification across all deployment regions.



HIGH-DURABILITY ARBITRAGE ARCHITECTURE

The recycling and compliance architecture is engineered to support the full 15-year operational lifecycle of LFP-based ESS assets. Every battery module is assigned a unique digital identifier (Battery Passport) at manufacturing, enabling automated tracking of state-of-health, cycle count, and material composition. At end-of-life, this data feeds directly into certified recycling partners via a secure API, ensuring chain-of-custody documentation for cobalt, lithium, nickel, and copper recovery. The system supports both direct reclamation and second-life repurposing pathways, with full environmental reporting per jurisdiction.

ANTI-RUNAWAY FEATURES

Environmental compliance is inseparable from safety compliance. All ESS cabinets referenced under this document integrate multi-level thermal runaway suppression systems that meet UL 9540A fire propagation criteria. Recycling protocols include mandatory de-energization and state-of-charge (SoC) reduction to below 30% prior to transport, in accordance with UN 38.3 and ADR/RID dangerous goods regulations. Vent gas management, electrolyte neutralization, and emergency response procedures are pre-documented for every SKU to facilitate safe dismantling and material recovery.

COMPREHENSIVE SPECS

The following specification table outlines the mandatory recycling, reporting, and environmental compliance parameters for all Tier-1 LFP ESS products covered by this register.

Parameter	Specification
Nominal Capacity	215 kWh / 372 kWh per cabinet
Cooling Method	Smart Liquid Cooling
Cell Chemistry	Tier-1 LFP
Recycling Efficiency Target	≥ 95% for lithium, nickel, cobalt, copper
Battery Passport Standard	EU 2023/1542 compliant digital ID
End-of-Life SoC Limit	≤ 30% for transport
Transport Certification	UN 38.3 / ADR / RID
Fire Propagation Compliance	UL 9540A
Environmental Management	ISO 14001
Recycled Content Reporting	Annual third-party verified audit

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All battery energy storage products must comply with the following international directives and standards:

- UL 9540: Standard for Energy Storage Systems and Equipment
- UL 9540A: Test Method for Evaluating Thermal Runaway Fire Propagation
- IEC 62619: Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes
- EU Battery Regulation 2023/1542: Carbon footprint, recycled content, and due diligence obligations
- US EPA 40 CFR Part 273: Universal Waste Rules for Batteries
- UN 38.3: Transport of Dangerous Goods – Lithium Batteries
- ISO 14001: Environmental Management Systems
- ISO 45001: Occupational Health and Safety

C&I TOPOLOGY

The recycling and compliance workflow is integrated into the broader C&I energy storage topology as follows: Battery Passport generation at cell/module level → Cloud-based lifecycle tracking via EMS → Automated end-of-life alert at 70% State of Health (SoH) → Certified reverse logistics pickup → Material recovery and recycled content reporting → Final environmental compliance

certificate issuance. This closed-loop process ensures that every deployed ESS asset remains fully compliant with current and emerging circular economy legislation.

