STANDARDS UPDATE NOTICE (SUN)
ISSUED: November 14, 2024

STANDARD INFORMATION

Standard: ANSI/CAN/UL 9540
Standard ID: Energy Storage Systems and Equipment [ANSI/CAN/UL 9540:2023 Ed.3]
Previous Standard ID: Energy Storage Systems and Equipment [ANSI/CAN/UL 9540:2020 Ed.2+R:09Apr2021]

EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

Effective Date: **August 29, 2025**

IMPACT, OVERVIEW, AND ACTION REQUIRED

Impact Statement: Per our accreditation, Intertek is required to review reports against the standard revisions to confirm compliance. Once compliance is confirmed, the standard reference in the report is updated to show continued compliance to the technical requirements of the standard. Reports not updated to this version by the effective date above will be withdrawn.

This standard contains Functional Safety requirements.

Overview of Changes:

- Requirement to evaluate Energy Storage System (ESS) as AC ESS and DC ESS
- Update marking requirements that affect Multi part ESS
- Update Impulse test criteria
- Added new criteria for Noise level measurement
- Update explosion protection requirement for ESS use certain chemistry that release flammable gas during abnormal conditions
- Lithium based ESS revisions
- Update requirement for Mechanical and thermal ESS evaluation
- New annex G for ESS using halocarbon Direct Injection Clean Agent Cooling System
- Revision to Remote software update requirement
- Update requirement to perform applicable test representative subassembly instead of complete ESS
- Update non-metallic and metallic enclosure requirement
- Additional test to evaluate ESS enclosure

Specific details of new/revised requirements are found in table below

Current Listings Not Active? – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records. We will do this at no charge as long as Intertek is notified in writing prior to the review of your reports.

STANDARD INFORMATION

CLAUSE	VERDICT	COMMENT
		Additions to existing requirements are underlined and deletions are shown ~~lined out~~ below.
1	Info	**Scope**
1.6		The maximum energy capacity of individual electrochemical ESS shall be determined by the following in (a) – (d). Where the results of testing are used, the results shall be determined in accordance with the Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems, UL 9540A: a) The maximum energy capacity of residential use electrochemical ESS shall not exceed 20 kWh (72 MJ). This value shall be permitted to be increased to the value of the unit which meets the performance criteria of the UL 9540A Unit Level test; b) The maximum energy capacity of non-residential use electrochemical ESS shall not exceed 50 kWh (180 MJ). This value shall be permitted to be increased to the value of the unit which meets the performance criteria of the UL 9540A Installation Level test, provided the ESS is marked in accordance with 45.20; c) There is no maximum energy capacity limit for non-residential use electrochemical ESS that are tested in accordance with UL 9540A in which the performance level criteria of the cell level test have been met; and d) There is no maximum energy capacity limit for non-residential use electrochemical ESS intended for use in remote outdoor locations as defined in the applicable installation code, provided they are marked in accordance with 45.21.
7	Info	**Non-Metallic Materials**
7.1		Polymeric materials employed for enclosures, or parts of enclosures for ESS shall comply with (a) and (b) below: a) The enclosure requirements outlined in UL 746C, Path III of the Enclosure Requirements, or CSA C22.2 No. 0.17; and b) For BESS, the enclosure shall be evaluated to UL 9540A Unit Level testing and meet the unit level performance criteria.

CLAUSE	VERDICT	COMMENT
7.4		***New clause added;*** The requirements in 7.3 do not apply to a nonmetallic part that forms part of the enclosure under any one of the following conditions in accordance with UL 94 or CSA C22.2 No. 0.17: a) The part covers an opening that has no dimension greater than 25.4 mm (1 in) and the part is made of a material Classed as V-0, V-1, V-2, or HB; b) The part is made of a material Classed V-0, V-1, V-2, or HB and covers an opening which does not give access to the user, when the part is removed, to live parts involving a risk of fire, electric shock, or electric energy-high current levels or moving parts; c) The part covers an opening that has no dimension greater than 101.6 mm (4 in) and the part is made of a material Classed as V-0, V-1, V-2, or HB, and there is no source of a risk of fire closer than 101.6 mm (4 in) from the surface of the enclosure; or d) The part is made of a material Classed V-0, V-1, V-2, or HB and there is a barrier or a device that forms a barrier made of a material Classed V-0 between the part and a source of a risk of fire. Exception: A part of a component is not required to be Classed V-0, V-1, V-2, or HB when it complies with the flammability requirements applicable to the component.
7.7		***New clause added;*** Compliance with 7.6 for gaskets and seals relied upon to prevent ingress of moisture into the enclosure, can either comply with the Gaskets Tests Clause of UL 50E/CSA C22.2 No. 94.2 or comply with UL 157 or ASTM D412 for the anticipated exposures.
8	Info	**Metallic Enclosures and Parts Resistance to Corrosion**
8.1		***New clause added;*** Metallic enclosure parts for BESS shall be of non-combustible materials as defined in this Standard. Exception: Metallic enclosures of BESS that do not meet the definition of non-combustible, shall be evaluated to UL 9540A Unit Level testing and meet the performance level criteria for the unit level test.

CLAUSE	VERDICT	COMMENT
9	Info	**Enclosures and Guarding of Hazardous Parts**
9.1		The enclosure(s) of an ESS shall have the strength and rigidity required to resist the possible physical abuses that it will be exposed to during its transportation, installation and intended use. The enclosure strength shall be determined and specified to demonstrate compliance. The enclosure strength requirements outlined in UL 50, UL 1741, IEC 62477-1, UL 2755, ISO 1496-1 or equivalent standard shall be applied to demonstrate compliance. Exception: For smaller systems that are less than or equal to 50 kWh, the enclosure strength may be evaluated to the enclosure requirements of this Standard and tested in accordance with the applicable tests of Section 40.
9.5		Enclosures of systems and components of systems located where they will be subject to exposure to water and other elements shall be rated for the level of intended exposure as outlined in Table 110.28 of Article 110 of NFPA 70, or Section 2 of CSA C22.1 or for the ingress protection rating of IPX3 or higher as outlined in IEC 60529 or CSA C22.2 No. 60529 if using as IP rating. Installation instructions shall indicate restrictions with regard to limiting ingress from the environment based upon the enclosure rating.
14	Info	**Insulation Levels and Protective Grounding**
14.4		The methods of protective bonding and grounding of an ESS shall be in accordance with Article 250 of NFPA 70 or Section 9 of IEEE C2 as applicable to where the system is located. When sizing the protective bonding and grounding wire, the rating and fault current path of all sources of supply connected to the equipment or system shall be considered. If used, grounding (bonding) braids used in the ESS or from the ESS to the grounding electrode shall comply with UL 467/CSA C22.2 No. 41, and sized according to the Grounding – Size of Terminal or Bonding Conductor requirements of UL 508A or CSA C22.1. In Canada, the methods of bonding and grounding an ESS shall be in accordance with Section 10 and 36 of CSA C22.1.
15	Info	**Safety Analysis and Control Systems**
15.4		***New clause added;*** Analysis of thermal ESS shall ensure that there is sufficient monitoring and control of pressure, thermal and fluid flow to ensure that the various parts of the system are maintained within their specifications for pressure temperature and fluid levels.

CLAUSE	VERDICT	COMMENT
16		***New section added;*** **Remote Software Update Enabled ESS** The requirements in 16.1.2 – 16.1.7 apply when the manufacturer declares the ESS has critical and supervisory and related critical supervisory sections of software per UL 1998, and has the functionality to remotely update this software. The requirements in 16.2.2 – 16.2.8 apply when the manufacturer declares the ESS has Class B software in accordance with UL 60730-1 or CSA E60730-1 and has the functionality to remotely update this software. See standard for details.
18	Info	**Communication Systems**
18.2		***New section added;*** **External warning communication system (EWCS)** Electrochemical ESS using lithium-ion batteries as the storage mechanism that have an energy capacity of 500 kWh or greater shall be provided with an external warning communication system, as outlined in 18.2.2 – 18.2.6, that gives an advance notification to operators of a potential safety issue with the ESS. See standard for details.
20	Info	**Piping Systems, Pressure Vessels, Fuel and Other Fluid Supply Connections and Controls**
20.8		***New clause added;*** ESS containing liquids, including ESS with coolant systems containing liquid coolant, shall be provided with some means of leak detection to monitor for loss of coolant that could lead to a potential hazardous condition. Coolant leaks that are detected shall result in a warning signal to the ESS monitoring and control system and shall initiate an alarm if provided.
21	Info	**Containment of Moving Parts in Mechanical ESS**
21.2		***New clause added;*** The alternator/generator elements associated with mechanical ESS shall comply with UL 1004-1 and other parts (UL 1004-2, UL 1004-3, UL 1004-5, UL 1004-6, UL 1004-7, UL 1007-8, UL 1004-9) as applicable or CSA 22.2 No. 100.

CLAUSE	VERDICT	COMMENT
22	Info	**Noise Levels**
22.1		***New clause added;*** The noise level from an ESS during operation, including noise levels in walk-in ESS that can be entered during operation, shall be limited to an 8-hr time-weighted average of 85 dBA when tested in accordance with 29 CFR 1910.95 (C)(1)(2). Measurements of the sound are determined in accordance with 29 CFR 1910.95 or equivalent method. Systems that have noise levels in excess of this limit shall be provided with warning labels and instructions that address hearing protection and other protective measures to be taken for those who may be exposed to the noise in accordance with 29 CFR 1910.95. NOTE: 29 CFR 1910.95 (C) (1)(2) indicates an 8-hr limit of 90 dBA, unless exposures can exceed 85 dBA greater than 50 % of the time. The lower 85 dBA is chosen as this is a limit in accordance with NIOSH limits and other standards. This still exceeds the limits of the EU machinery directive, which is 80 dBA.
24	Info	**Combustible Vapor Concentrations**
24.5		***New clause added;*** Electrochemical ESS with integral enclosures where there is the potential for a flammable gas concentration within the enclosure from an abnormal condition such as thermal runaway and propagation, shall be provided with deflagration or explosion protection in accordance with NFPA 68 or NFPA 69. This protection shall be installed on the ESS or its enclosure depending upon the type of protection and installed in a location where its operation shall not result in the introduction of a hazard after installation. See the figure for BESS Deflagration Protection Analysis, in the Annex for Test Concepts and Application of Test Results to Installations in UL 9540A for reference and guidance. Exception No. 1: The protection is not required if the testing in accordance with UL 9540A with a deflagration hazard analysis demonstrates that the concentration of flammable gas measured during testing remains under 25 % LFL within the room, building, ESS cabinet, or walk-in ESS and there is no potential for partial volume deflagration. Exception No. 2: For ESS cabinets/enclosures, protection other than as noted can be used if it has been determined that the ESS cabinet/enclosure has been designed to effectively protect against hazards due to combustible concentrations when the ESS has been tested in accordance with the Unit Level or Installation Level test of UL 9540A.

CLAUSE	VERDICT	COMMENT
25	Info	**Flammable Solids**
25.1		***New clause added;*** ESS containing hazardous solids (i.e. pyrophoric or water reactive metals) shall be designed and installed in accordance with NFPA 484.
26	Info	**Fire Detection, Suppression and Propagation**
26.2	Info	**Large scale fire testing**
26.2.1		Electrochemical type ESS, including but not limited to capacitor and battery ESS, shall be subjected to the large scale fire testing in accordance with UL 9540A as follows in (a) – (d). a) Systems with increased energy capacities as required in codes and standards; b) Systems with decreased separation distances to adjacent ESS units, doors and windows, or exposures. See 46.2 and/or 46.4; c) Indoor systems; or d) Systems for installation in dwelling units (where permitted). NOTE: See Annex E for guidance on code limits related to separation distances and energy capacity.
26.2.3		***New clause added;*** Electrochemical ESS intended for use in dwelling units where UL 9540A testing is indicated per the codes and standards, shall minimally meet the Unit Level Performance Criteria for residential installations identified in UL 9540A with a test that aligns with the manufacturer's installation instructions. These ESS shall be marked in accordance with 45.3(e)(3).
26.2.4		***New clause added;*** Electrochemical ESS intended for non-residential use shall be subjected to specific large scale fire testing in accordance with UL 9540A for installations described in the manufacturer's instructions.
28	Info	**Energy Storage System Technologies**
28.3	Info	**Mechanical ESS**
28.3.3		Flywheel energy storage devices with a maximum surface speed of 200 m/s or less fall within standard electric generator design practice and shall be evaluated in accordance with the Standard for Electric Generators, UL 1004-4 or the Standard for Motors and Generators, CSA 22.2, No. 100. Exception: In some cases, flywheel energy storage systems with maximum surface speeds of 200 m/s or less may have features such as magnetic bearings that are not commonly found on ordinary electric machines as covered in UL 1004-4 or CSA 22.2, No. 100. The safety of these features shall be evaluated and tested to all applicable requirements in this Standard.

CLAUSE	VERDICT	COMMENT
28.4	Info	**Thermal ESS**
28.4.1		***New clause added;*** A thermal ESS consists of gases, fluids, and/or solids storing heat energy that can be turned into electrical energy when needed through the use of energy conversion equipment (e.g. engines, generators). NOTE: The three types of thermal ESS are sensible heat, latent heat and thermochemical thermal ESS.
28.4.3		***New clause added;*** Stationary engine generators that are part of a thermal ESS shall comply with UL 2200 or CSA C22.2 No. 100, and CSA C22.2 No. 286. Generators that are part of a thermal ESS shall comply with UL 1004-4 or CSA C22.2 No. 100.
28.4.4		***New clause added;*** Hazardous fluid containing parts of a thermal ESS shall be constructed of materials suitable for use with that fluid at the pressures and temperatures of use. Pressure vessels used for storage and piping employed as part of a thermal ESS shall comply with Section 20. Stresses on containment parts associated with swings of high and low temperature extremes shall be considered when evaluating the suitability.
28.4.5		***New clause added;*** Containment systems for combustible materials (solids or fluids) shall be designed to prevent the potential for explosion hazards as a result of contact with moisture, contaminants, etc.
28.4.6		***New clause added;*** A thermal ESS shall have sufficient pressure controls, fluid level controls and temperature controls to prevent the potential for a hazardous condition from occurring through an out of specification operation. Compliance is determined through the safety analysis of the system and the functional safety investigation of the controls per Section 15 and the abnormal operations tests for thermal ESS in accordance with Section 31.
31		***New section added;*** **Abnormal Operation Tests for Thermal Energy Storage Systems** See standard for details.

CLAUSE	VERDICT	COMMENT
36	Info	**Electromagnetic Immunity Tests**
36.9	Info	**Operational verification of remote software update capability**
36.9.1		***New clause added;*** The test of 36.8 shall be conducted on safety controls intended for remote software updates in accordance with Section 16 to ensure that they are operational after the update. See 16.1.7 and 16.2.8.
37	Info	**Containment of Moving Parts**
37.4	Info	**Mechanical integrity test**
37.4.1		~~An ESS with any moving part having the capacity to store kinetic energy shall have the mechanical (i.e. rotating) energy storage elements subjected to a mechanical failure test. The mechanical failure test shall be conducted to assure that at maximum operating speed, the mechanical energy storage element or flywheel will have a margin of safety factor of at least 2.0 between the stress that exists in the mechanical energy storage element at maximum normal operating speed and the ultimate tensile strength of the mechanical energy storage element material at room ambient temperature of 25 ±5°C (77 ±9°F).~~ An ESS with any moving part having the capacity to store kinetic energy shall have the mechanical (i.e. rotating) energy storage elements designed to have a minimum margin factor of safety. The factor of safety requirements vary depending on the material of construction. The factor of safety based on material type shall be as follows: a) For assemblies composed of laminated composite materials, the minimum factor of safety shall be at least 2.0 between the maximum principal stress that exists at the point of highest stress in each layer of the mechanical energy storage element and the ultimate strength of that layer at that point. The factor of safety shall be evaluated at maximum normal operating speed and at a room ambient temperature of 25 °C ±5 °C (77 °F ±9 °F). b) For assemblies composed of ductile metallic materials exhibiting a traditional nonlinear stress-strain curve, the minimum factor of safety shall be at least 1.3 between the maximum von Mises stress that exists anywhere in the mechanical energy storage element at maximum normal operating speed and the tensile yield strength of the material where the stress exists at room ambient temperature of 25 °C ±5 °C (77 °F ±9 °F). c) For other material types and combinations of materials including metals and laminated composites, the minimum factor of safety shall be at least 2.0 between the maximum combined stress that exists anywhere in the mechanical energy storage element at maximum normal operating speed and the ultimate tensile strength of the material where the highest stress exists at room ambient temperature of 25 °C ±5 °C (77 °F ±9 °F).

CLAUSE	VERDICT	COMMENT
		The mechanical energy storage element shall be subjected to ~~a mechanical failure test in a test facility capable of safely containing a mechanically failed component. The DUT shall be subjected to a stress that is at least 2x greater than the calculated stress at maximum operating speed. For the purpose here, rotor working stress is presumed to scale exactly as the square of the rotation speed.~~ an overspeed type test demonstrating the required factor of safety. The DUT shall be representative of the latest design revision and subjected to an overspeed and corresponding stress as follows in (a) or (b). For the purpose here, rotor working stress is presumed to scale exactly as the square of the rotation speed.
37.4.2		a) Where the minimum required factor of safety is 2.0, the overspeed shall be at least 139 %. The DUT shall sustain the overspeed for a time period of 1 min without ruptures in of any part of the assembly. b) Where the minimum required factor of safety is 1.3, the overspeed shall be 120 % minimum. The DUT shall sustain the overspeed for a time period of 1 min. Yielding of the material during the test is permitted as long as the test requirement is met, and the DUT can be shut down afterward in a normal manner (i.e. through braking or discharge of the stored energy). This condition implies that margin between the maximum Von Mises stress in the part at normal operating speed and the ultimate tensile strength of the material must be greater than 1.45 to successfully pass the overspeed test.
37.5	Info	**Bearing failure test**
37.5.4		***New clause added;*** This test is intended to verify that the backup bearing or support system for the energy storage element is effective. This test may also suffice as the faulted securement test described in 37.2 if the safety analysis indicates a bearing failure as the worst case condition.
40	Info	**Enclosure and Mounting Tests**
40.2		***New section added;*** **Enclosure impact** The purpose of this test is to evaluate the mechanical integrity of the enclosure and its ability to provide mechanical protection to the ESS enclosure contents. See standard for details.
40.3		***New section added;*** **Enclosure steady force** The purpose of this test is to determine if the enclosure has sufficient strength to safely withstand a static force that may be applied to it. See standard for details.

CLAUSE	VERDICT	COMMENT
40.4		***New section added;*** **Mold stress** The purpose of this test is to determine if an enclosure made from molded polymeric material can withstand an accelerated aging test without compromising the safety of the enclosure. See standard for details.
41	Info	**Special Environment Installations**
41.4	Info	**Installation in seismic environments**
41.4.1		Equipment of an ESS that contains the energy storage mechanism and is intended for installation where they will be subject to seismic activity shall be evaluated and, if necessary, tested in accordance with their seismic ratings and installations instructions per 45.3 and 46.13. The installation instructions shall indicate the limitations of the particular seismic rating of the equipment. Standards that provide guidance on seismic evaluation such as IEEE 693, IEC 60980, ICC IBC, the seismic testing in GR-63-CORE, or similar, shall be used for this evaluation. Compliance is determined through review of documentation of the seismic evaluation for the appropriate seismic level (i.e. level marked on the equipment) or through testing for the specific seismic level in accordance with a testing standard for this purpose. Exception No. 1: There is equipment that cannot be practically evaluated by testing alone because of the size of the equipment. For those situations, it may be necessary to do a combination of analysis with testing of parts of the system. This approach is outlined in IEEE 344. Exception No. 2: Some standards allow for calculations and modelling as an approach for determining compliance for seismic ratings in lieu of testing.
43	Info	**Mechanical Production Tests**
43.3	Info	**Leak check of hazardous fluid systems**
43.3.1		***New clause added;*** ESS that contain hazardous fluids including ESS with liquid coolant systems shall be subjected to a leak check in accordance with Section 38 of the assembled fluid containment system.

CLAUSE	VERDICT	COMMENT
	Info	**MARKINGS**
45	Info	**General**
45.3		***New clause added;*** An ESS shall be provided with a nameplate marking (main label) that includes the following: a) The ESS model, catalog number or similar identifier and technology of the ESS; NOTE: Examples of technology markings would be lithium ion, nickel cadmium, latent heat thermal, flywheel. b) Identifies that the system is a DC ESS or AC ESS as applicable; c) Identifies the manufacturer responsible for the evaluated ESS; d) Provides the contact information per 45.10; e) Residential ESS on or in a dwelling unit shall be marked as follows: 1) If meeting the requirements of 26.2.2: "Suitable for Use in Residential Habitable Spaces"; or 2) For systems intended for installation in Canada, systems meeting the cell level performance criteria of UL 9540A shall be marked with "This equipment meets the cell level performance criteria of UL 9540A"; 3) If meeting the requirements of 26.2.3 "Suitable for Use in Residential Non-Habitable Spaces"; f) Includes the following information and ratings: 1) Output and input current (maximum continuous) for each power port in Amps; 2) Output and input voltage (minimum and maximum) for each power port in Volts; 3) Power input and output (maximum continuous) for each power port in W / kW or VA / kVA; 4) Energy storage capacity in Wh / kWh (maximum); 5) DC or Frequency in Hz and number of phases for each power port; 6) Auxiliary output and input voltage (V), current (A) and frequency (Hz) if applicable; 7) Input short-circuit current rating (SCCR) in A / kA; 8) Maximum overcurrent protective device rating in Amps; 9) Output available fault current (as defined in Article 100 of NFPA 70) and time duration that the equipment can provide; 10) Special environmental ratings and limitations as applicable (e.g. seismic, indoor/outdoor only, etc.); and 11) Suppression system to be installed if applicable.
45.4		***New clause added;*** With reference to 45.3, if the system is intended to be operated in a duty cycle, the intended duty cycle shall be included on the nameplate.

CLAUSE	VERDICT	COMMENT
45.5		***New clause added;*** With reference to 45.3, the suppression system to be installed, if applicable, shall be marked on the system.
45.6		***New clause added;*** With reference to 45.3, the operating ambient conditions in °C or °F, the weight of the system in kilograms or pounds, and the overall dimensions of the system can either be marked on the system or provided in the installation instructions.
45.7		***New clause added;*** For multi-part ESS, a nameplate marking (main label) noted in 45.3 shall be provided on at least one of the parts and shall identify that the system has been evaluated as a multi-part ESS.
45.8		***New clause added;*** The items in 45.4 – 45.6 shall be included as applicable to the system. With reference to 45.7, each separate part of the multi-part ESS shall have a nameplate marking as required by the equipment safety standard to which it was evaluated.
45.9		***New clause added;*** With reference to 45.7, where not included in the end-product standard or label, the following information shall be included in the ESS installation instructions as applicable to the ESS: a) Single-line electrical diagram of the ESS identifying all interconnections and ports; b) Input short circuit current rating (SCCR) in A / kA that each component can withstand from other parts of the ESS if the connection point is a power input or bi-direction power connection; and c) Available fault current (as defined in Article 100 of NFPA 70) and time duration that the ESS part can provide to other parts of the ESS if the connection point is a power output or bi-directional power connection.
45.14		***New clause added;*** ESS other than electrochemical ESS that contain hazardous materials such as flammable solids or fluids or toxic or other hazardous materials shall be marked in accordance with NFPA 704.

CLAUSE	VERDICT	COMMENT
	Info	**INSTRUCTIONS**
46	Info	**General**
46.3		Installation instructions for exterior wall-mounted ESS shall identify the minimum separation distances from other ESS or from openings (e.g. windows, doors, HVAC inlets or other operable openings) in accordance with the code limitations or in accordance with the large scale fire testing of 26.2. Outdoor rated ESS marked "Suitable for Use in Residential Non-Habitable Spaces" are suitable for installation on exterior walls of residential dwelling units as indicated in the manufacturer's instructions. NOTE: The separation from openings into the dwelling space in ICC IRC does not apply to exterior openings into residential attached and detached garages.
46.14		***New clause added;*** The installation instructions for a DC ESS shall include specifications for the equipment performing electric power conditioning or conversion function that is intended to be connected for supplying the DC ESS as shown in Figure 6.1, including if it is part of the DC load that the DC ESS is supplying. The instructions can include the specific equipment or systems to be used or can provide sufficient parameters required to safely connect to the DC ESS such as, but not limited to electrical ratings, communication requirements, environmental requirements, short circuit tolerance as applicable to the DC ESS.
Annex D	Info	**APPROACH FOR EVALUATING VALVE REGULATED OF VENTED LEAD ACID OR NICKEL CADMIUM BATTERY ENERGY STORAGE SYSTEMS**
D2	Info	**Construction**
D2.3		***New clause added;*** Cells and monobloc batteries shall be installed in an ESS in accordance with the battery manufacturer's instructions for spacings between batteries and other required spacings, cell/battery installation orientation, wiring and connection requirements, environmental and other protections to be provided in the installation.
D2.4		***New clause added;*** Support structures for vented and valve regulated lead acid and nickel cadmium batteries shall be suitable for handling the maximum anticipated weight of the installed cells and batteries. The rack system shall comply with the criteria outlined in the Annex for Alternative Approach for Evaluating Valve Regulated or Vented Lead Acid or Nickel Cadmium Batteries of UL 1973.

CLAUSE	VERDICT	COMMENT
D2.5		***New clause added;*** ESS employing lead acid or nickel cadmium batteries shall comply with the applicable criteria outlined in this Standard with regard to materials, enclosures, electrical safety, insulation levels and protective earthing, combustible concentrations, fire detection and suppression, and power conversion equipment as applicable to the ESS. Short circuit protection used in the system to protect the batteries and limit their short circuit current output shall be rated for dc applications.
D2.11		***New clause added;*** ESS systems with lead acid or nickel cadmium cells or batteries shall be marked in accordance to Section 45 as applicable to the system.
D2.12		***New clause added;*** Installation instructions for an ESS with lead acid or nickel cadmium batteries shall provide sufficient details of installation including any separation distances, limits to the installations such as indoors only installation in accordance with Section 46. Installation instructions for ESS employing open racks of lead acid or nickel cadmium batteries shall indicate that they are for installation in restricted access locations.
D2.13		***New clause added;*** Maintenance and operating instructions for ESS employing lead acid or nickel cadmium cells and batteries, shall indicate the need for any ongoing maintenance of the batteries such as ensuring sufficient electrolyte for vented types or checking the state of terminals of the cells or batteries in accordance with the battery manufacturer's instructions. The instructions shall indicate the frequency for monitoring and maintenance of the cells and batteries in the instructions and shall align with the instructions provided by the cell or battery manufacturer.

CLAUSE	VERDICT	COMMENT
		New annex added; **CLEAN AGENT DIRECT INJECTION BATTERY RACK COOLANT SYSTEM UNITS** These requirements cover the construction and operation of halocarbon clean agent direct injection battery rack coolant system units intended to be installed, inspected, tested, and maintained in accordance with NFPA 2001, NFPA 855, and NRC NFC.
Annex G		These clean agent direct injection battery rack coolant system units are intended to distribute clean agent directly onto lithium ion or similar battery modules following detection by the system that the cells are overheating and/or venting. The clean agent serves as a coolant to stop fire development from the effected module rather than serve as a total flooding fire suppression system that is typical of clean agent fire extinguishing systems. The design of the integral battery rack clean agent coolant system is dependent upon the battery module and rack assembly and is ultimately evaluated for effectiveness through large scale fire testing in accordance with UL 9540A. See standard for details.