



1Q2022 Highlights

The NFPA 855 Technical Committee concluded its second draft meeting in early November for the 2023 edition. The second draft report is expected to be released in March 2022.

UL 1973 has undergone a major revision with several appendices adopted that affect several newer or emerging technologies with a new certification requirement decision in the offing. Both NFPA 855 and UL 1973 standards carry additional information below.

The 2024 ICC IFC is in final approval stages. Efforts to align NFPA 855 standards will be noted in the 2024 edition of the IFC.

The NEC Code Making Panels (CMP's) are currently meeting to address second draft recommendations. The IEEE JTCC is actively representing IEEE positions on these CMPs. The second draft report is due in March 2022. See additional information below.

CODES AND STANDARDS UPDATE WINTER REPORT 2022

The goal of the [DOE OE Energy Storage System Safety Roadmap](#) is to foster confidence in the safety and reliability of energy storage systems. There are three interrelated objectives to support the realization of that goal: 1) research, 2) codes and standards (C/S), and 3) communication/coordination. The C/S objective is "To apply research and development to support efforts focused on ensuring that codes and standards are available to enable the safe implementation of energy storage systems in a comprehensive, technology agnostic, and science-based manner."

The following activities support that objective and realization of the goal:

1. Review and assess C/S which affect the design, installation, and operation of energy storage systems (ESS)
2. Identify gaps in knowledge that require research and analysis to provide data for technical committee inputs
3. Identify areas in C/S that are potentially in need of revision or enhancement and can benefit from activities conducted under research and development
4. Develop input for new or revisions to existing C/S through individual stakeholders, facilitated task forces, or through laboratory staff supporting these efforts

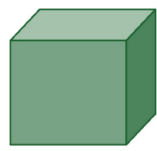
The purpose of this Codes and Standards Update is to support these objectives by providing information on efforts being conducted by U.S. standards developing organizations (SDOs) and other entities that include focus on ESS safety.

The information is organized by SDO relative to the scope of each document in relation to how it fits into the ESS paradigm. The categories are color coded as codes and standards that apply as follows: **1** Built Environment; **2** Complete ESS; **3** ESS Installation; **4** ESS Components; and **5** Reference Items.

Changes in current activity from the prior edition are shown in italics. Time-sensitive items (e.g., those having an upcoming schedule/due date) are shown as **highlighted, bold, and underlined**.

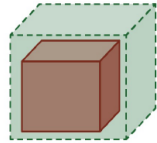
To subscribe to the ES Safety Collaborative and receive ongoing ESS safety communications visit <https://public.govdelivery.com/accounts/USDOESNLEC/signup/30707>.

Standards and Model Codes Hierarchy



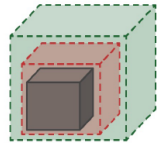
BUILT ENVIRONMENT

- iCodes – IFC, IRC, IBC
- IEEE – C2
- NFPA 1, 5000



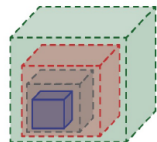
Complete ESS

- NFPA 855
- UL 9540
- ASME TES-1
- FM GLOBAL 5-33
- DNVGL GRIDSTOR
- NECA 416 & 417



INSTALLATION / APPLICATION

- NFPA 70
- UL 9540 A
- IEEE C2
- IEEE 1635/ASHRAE 21
- IEEE P1578
- IEEE 1547
- IEEE 1679





SYSTEM COMPONENTS


- UL 1973
- UL 1974
- UL 810A
- UL1741
- CSA 22.2 No. 340-201
- IEEE P2686


Graphic courtesy of Pacific Northwest National Laboratory


Note: This is a representative listing for illustrative purposes only. Actual category designations may differ slightly in the report.


	American Society of Heating, Refrigeration and Air Conditioning Engineers www.ashrae.org [ESS Installation]
Document Name	ASHRAE 21-2018: Guideline for the Ventilation and Thermal Management of Batteries for Stationary Applications
ESS Relevance	Serves as a guide to understanding the ventilation and thermal management characteristics of vented lead-acid (VLA) and valve-regulated (VRLA) lead-acid and nickel-cadmium (Ni-Cd) cells used in standby and energy storage applications, with calculations on how to properly manage this in installations of those cells. The 2022 edition will address the management of li-ion batteries as well.
Date of Current Edition	2018
Date of Next Edition	2022
Current Activity	Working in collaboration with the IEEE Energy Storage and Stationary Battery (ESSB) Committee and IEEE 1635, the ASHRAE GPC 21 Committee is formulating revisions needed, including addressing lithium batteries in the next edition. Contact ASHRAE GPC 21 Chair Deep Ghosh or IEEE Working Group Chair Curtis Ashton for additional information.


	American Society of Mechanical Engineers (ASME) www.asme.org [Complete ESS]
Document Name	TES-1: Safety Standard for Thermal Energy Storage Systems
ESS Relevance	Provides safety-related criteria for molten salt thermal energy storage systems.
Date of Current Edition	June 2020
Date of Next Edition	2023
Current Activity	The first edition of TES-1 was published in June 2020. The Committee is currently discussing revisions for the next edition. Please contact Nicole Gomez for information regarding the next meeting.


	American Society of Mechanical Engineers (ASME) www.asme.org [Complete ESS]
Document Name	TES-2: Safety Standard for Thermal Energy Storage Systems, Requirements for Phase Change, Solid and Other Thermal Energy Storage Systems
ESS Relevance	Provides guidance on the design, construction, testing, maintenance, and operation of thermal energy storage systems, including but not limited to phase change materials and solid-state energy storage media, giving manufacturers, owners, users, and others concerned with or responsible for its application by prescribing necessary safety requirements.
Date of Current Edition	New Standard
Date of Next Edition	TBD
Current Activity	A PINS has been filed with ANSI to develop a new standard. The task group was officially established as the TES-2 Committee met in July 2021 and will report to the TES Standards Committee. The Committee is recruiting participants with an in-depth knowledge of phase-change thermal energy storage systems, specifically those that operate at high temperatures. For more information on the next scheduled meeting and to join the committee, contact Nicole Gomez .


	CSA GROUP (CSA) www.csagroup.org [ESS Installations]
Document Name	C22.1-21 Canadian Electrical Code, Part I (25th edition), Safety Standard for Electrical Installations
ESS Relevance	In many respects, this is the Canadian equivalent of the US National Electrical Code (NFPA 70). Section 64-900 now incorporates energy storage requirements for the installation and maintenance of renewable energy, energy production, and energy storage systems.
Date of Current Edition	2021
Date of Next Edition	TBD
Current Activity	The 2021 edition was published in January 2021 and is available here . Plans for the next release have not been determined. For more information, contact Mohsen Sepehr .


	CSA GROUP (CSA) www.csagroup.org [ESS Components]
Document Name	CSA C22.2 No. 107.1-2016 Power Conversion Equipment
ESS Relevance	Pertains to both alternating current (AC) and direct current (DC) power conversion equipment associated with an energy storage system.
Date of Current Edition	2016
Date of Next Edition	2022 (Estimated)
Current Activity	A new edition (Edition 5.0) is currently in the final stages of development. Interested stakeholders can review and provide comments through the CSA PR portal . For more information, contact Mohsen Sepehr .


	CSA GROUP (CSA) www.csagroup.org [ESS Components]
Document Name	CSA C22.2 No. 340-20xx Battery Management Systems
ESS Relevance	A new standard that will apply to the design, performance, and safety of battery management systems. It includes use in several application areas, including stationary batteries installed in local energy storage, smart grids and auxiliary power systems, as well as mobile batteries used in electric vehicles (EV), rail transport, and aeronautics.
Date of Current Edition	New Standard
Date of Next Edition	TBD
Current Activity	A public review has been completed and the standard is nearing release for publication. For more information contact Mohsen Sepehr . Note: IEEE ESSB Committee is also developing a guide on BMS. See IEEE ESSB Committee activity below. Both groups have established a liaison with each other.


	DNV www.dnv.com/rules-standards/ Complete ESS]
Document Name	DNVGL-RP-0043: Safety, Operation, and Performance of Grid-Connected Energy Storage Systems (GRIDSTOR)
ESS Relevance	Provides a comprehensive set of recommendations for grid-connected energy storage systems, focusing on safety, operation and performance, valid for all ESS applications. End users, operators, and other stakeholders can find specific guidance with references to other relevant standards, codes, and guidelines.
Date of Current Edition	October 2017
Date of Next Edition	TBD
Current Activity	See GRIDSTOR Recommended Practice for Grid-Connected Energy Storage for more information.


	FM Global www.fmglobal.com [Built Environment]
Document Name	FM Global Property Loss Prevention Data Sheet # 5-33: Electrical Energy Storage Systems
ESS Relevance	Describes loss prevention recommendations for the design, operation, protection, inspection, maintenance, and testing of electrical energy storage systems, which can include batteries, battery chargers, battery management systems, thermal management issues, associated enclosures and auxiliary systems. The focus of this data sheet is primarily on lithium-ion battery technology.
Date of Current Edition	July 2020
Date of Next Edition	TBD
Current Activity	Typically, data sheets are developed internally at FM Global with support from FM Global field operations. See FM Global Property Loss Prevention Data Sheets for more information.


	International Code Council (ICC) www.iccsafe.org [Built Environment]
Document Name	International Fire Code (IFC)
ESS Relevance	Chapter 12 of the IFC covers energy systems. Section 1207 within that chapter covers electrical energy storage systems. The ICC code development process (CDP) associated with the 2021 IFC has been completed and the new edition has been available since December 2021. During the process the provisions of the 2018 IFC related to ESS were enhanced to be consistent with the needs of industry and with NFPA 855.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	<p>Work to revise ESS requirements for the 2024 IFC update (Group A) began in early 2020 through a Work Group within ESS WG 4.1 which falls under the ICC Fire Code Action Committee (FCAC). Visit ICC Advocacy to learn more about codes adoption as well as federal and state activities.</p> <p>Proposals for the IFC were heard and voted upon at the Code Action Hearings during April and early May of 2021. The public comment hearings took place in September, and governmental online voting was completed November 1, 2021. Review the ICC Current Code Development Cycle for additional information and next steps in the revision cycle process. Latest updates for the 2021 Group A Cycle can be found here.</p>


	International Code Council (ICC) www.iccsafe.org [Built Environment]
Document Name	International Residential Code (IRC)
ESS Relevance	Chapter 3 R328 lays out requirements for the installation, spacing, locations, energy ratings limitations, and ventilation, as well as EV issues for energy storage systems to be located in one- and two-family dwellings. Some of these provisions were added during the 2018 revision. Section 1207 of the IFC deals with ESS installations exceeding the limits published in R328.5. These provisions are outside the energy efficiency provisions within Chapter 11 - Energy Efficiency where all other provisions regarding energy are addressed.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	The deadline for submitting proposals for the 2024 IRC revision closed on January 10, 2022. These proposals will be considered at the Group B Code Development Cycle in April 2022. To ensure consistency within the Group B Codes including the IRC, continued areas of focus will likely be upon fire detection and impact protection. Note that Proposal F153-21 better aligns the IFC residential provisions with the IRC R328 ESS provisions. For more information regarding governing procedures for participating in this standard, contact Beth Tubbs .


	International Code Council (ICC) www.iccsafe.org [Built Environment]
Document Name	International Building Code (IBC) and International Residential Code (IRC) Plumbing and Mechanical Chapters 2018 and 2021 editions
ESS Relevance	2021 IBC now addresses “ESS in dedicated use buildings” as moderate-hazard factory industrial, Group F-1 buildings; separation and protection requirements have been removed since they are covered by Section 1207 of the IFC; Section 3115 (new) covers intermodal shipping containers that are repurposed for use as buildings or structures but includes an exemption for stationary storage battery that comply with Chapter 12 of the IFC. Reference is also made for ventilation of energy storage systems. (Sections 502.4 and 502.5).
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	Proposals for the IBC and IRC P&M were heard and voted upon at the Code Action Hearings were held in April to early May of 2021. Public Comment Hearings took place Sept 21-26, 2021, and governmental online voting was completed Nov 1. Please review the ICC Current Code Development Cycle for additional information and next steps in the revision cycle process. Latest updates for the 2021 Group A Cycle can be found here .


	International Code Council (ICC) www.iccsafe.org [Reference Item]
SDO/Committee/ Association Name	International Codes Council (ICC) - General
ESS Relevance	<p>The ICC publishes the set of I-Codes which include the IFC, IEBC, IECC and IRC.</p> <p>The ICC has a code development process with a variety of committees responsible for decisions on the I-Codes. Four main Code Action Committees: 1) Building Code Action Committee (BCAC), 2) Fire Code Action Committee [FCAC], 3) Sustainability, Energy & High-Performance Building Code Action Committee [SEHPCAC], and 4) Plumbing Mechanical Fuel Gas [PMGCAC] draft proposals that result in the publication of the International Fire Code (IFC), the International Residential Code (IRC) and the International Building Code (IBC), highlighted in this report.</p>
Reason for Reference Item	<p>The ICC and its committees are considered and followed by AHJs and Code officials in a majority of states within the USA and, to a certain extent, outside the United States.</p>
SDO/Committee Comment	<p>The ICC has published all scheduled 2021 editions. Initial development of the 2024 IBC and IFC (Group A) and 2025 IRC (Group B) editions are currently underway. The International Green Construction Code (IgCC) will follow this process and is tied to the ASHRAE 189.1 process which is an ongoing effort.</p>
Requested Action	N/A

	International Code Council (ICC) www.iccsafe.org [Reference Item]
SDO/Committee/ Association Name	International Codes Council (ICC) – Fire Code Action Committee (FCAC) Working Groups
ESS Relevance	<p>There are 6 main FCAC Work Groups (WGs) that deal with various sections of the IFC, IBC and WUIC based on the areas being modified. Each WG provides recommendations to FCAC for proposals to the appropriate code action committee.</p>
Reason for Reference Item	<p>The current ESS FCAC WG reviewed recommendations from the International Association of Fire Chiefs (IAFC) Fire and Life Safety Section (FLSS) which includes keeping the IFC consistent with NFPA 855 and correlating IFC residential requirements with IRC. Note that the FCAC works with BCAC when there are proposals associated with the IRC.</p>
SDO/Committee Comment	<p>The FCAC WGs are open to the public and have submitted their recommendations for the 2024 cycle. Positions of FCAC are a consensus of the FCAC members. FCAC testified at the Code Action Hearings, followed by comments and testimony during the recent public comment hearings held in Pittsburgh PA.</p>
Requested Action	To get involved with FCAC and the WG4 dealing with ES issues, contact Beth Tubbs .


	Institute of Electrical and Electronics Engineers https://standards.ieee.org [Built Environment]
Document Name	IEEE 1547: Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
ESS Relevance	Standard for interconnection of distributed energy resources (DER) with electric power systems. DER as defined in IEEE 1547 includes energy storage systems capable of exchanging real power (kW, MW) with the local distribution utility grid. IEEE 1547 also defines the performance requirements that are the basis for UL 1741 listing. Amendment 1547a was passed in 2020, revising the ranges of allowable trip clearing time settings for DERs in abnormal operating performance situations.
Date of Current Edition	2018
Date of Next Edition	TBD
Current Activity	IEEE 1547 WG members have engaged in creating several additional standards that address issues that affect DER interconnection with the grid. For questions about IEEE 1547-2018, contact the P1547 Revision Chair, David Narang .


	Institute of Electrical and Electronics Engineers https://standards.ieee.org [Built Environment]
Document Name	IEEE P1547.2-2008: Application Guide for IEEE Standard 1547-IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems
ESS Relevance	Provides technical background and application details to support applying the basic requirements of IEEE 1547-2003. This is done by characterizing various forms of distributed resource (DR) technologies and their associated interconnection issues. The IEEE 1547 series of standards is cited in the Federal Energy Policy Act of 2005.
Date of Current Edition	IEEE Approved Date: 2008-12-10 Published Date: 2009-04-15 Withdrawn Date: 2021-03-25
Date of Next Edition	2022 (anticipated)
Current Activity	An SCC21 working group has begun work on P1547.2 to revise 1547.2-2008 to address the revised content in IEEE 1547-2018. For questions, contact the P1547.2 Chair, Wayne Stec .


	Institute of Electrical and Electronics Engineers https://standards.ieee.org [Built Environment]
Document Name	IEEE P1547.3: Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems
ESS Relevance	Facilitates the interoperability of distributed resources (DR) and help DR project stakeholders implement monitoring, information exchange, and control (MIC) to support the technical and business operations of DR and transactions among the stakeholders. This document is being updated to provide guidelines for Cybersecurity of Distributed Energy Resources (DER) interconnection with Electric Power Systems (EPS).
Date of Current Edition	2007
Date of Next Edition	2022 (in ballot process now)
Current Activity	With current update out for ballot and the revised standard planned for early to mid-2022 release, the working group may enter a hiatus for the foreseeable future. For more information, contact the IEEE Std 1547.3-2007 (Revision in Progress) - IEEE Standards Coordinating Committee 21 (SCC21) .


	Institute of Electrical and Electronics Engineers https://standards.ieee.org [Built Environment]
Document Name	IEEE P1547.9: Guide for Interconnection of Energy Storage Distributed Energy Resources (DER) with Power Systems
ESS Relevance	Guide provides information on and examples of how to apply IEEE Standard 1547 with associated electric power systems (EPS) interfaces that result in interconnection of energy storage distributed energy resources (DER ES), including those connected to electric power systems (EPS) capable of bidirectional real power exchange with the EPS.
Date of Current Edition	New Standard
Date of Next Edition	2022 (anticipated)
Current Activity	This has been an active IEEE Working Group, made up of members from both the IEEE ESSB and IEEE SCC 21 committees. The guide is out for ballot and should be approved and published after the next IEEE REVCOM meeting in early 2022. To learn more about this standard contact Charlie Vartanian or Jim McDowall .


	Institute of Electrical and Electronics Engineers www.ieee.org [Built Environment]
Document Name	IEEE C2-17, National Electric Safety Code (NESC)
ESS Relevance	Governing electric utility standard that covers electrical safety for utility systems and equipment. The 2023 edition will add provisions for energy storage systems installed within an electric utility.
Date of Current Edition	2017
Date of Next Edition	2023 (Publication release anticipated August 2022)
Current Activity	<p>NESC Sub-Committees have been engaged in proposals submitted by member representatives over the past two years and prepared recommendations on each section. The NESC battery section is being reorganized into three sections (general, protection and control, and grid storage). The grid storage section is new and provisions for fire protection and spill control are being added to that section. The proposed revision must be submitted to ANSI for concurrent public review before becoming an approved ANSI standard.</p> <p>See The National Electrical Safety Code (NESC) and Process, Procedures & Schedule – The National Electrical Safety Code (NESC) for more information.</p>


	Institute of Electrical and Electronics Engineers www.ieee.org [Complete ESS]
Document Name	IEEE 1815: Standard for Electric Power Systems Communications-Distributed Network Protocol (DNP3)
ESS Relevance	Specifies the DNP3 protocol structure, functions, cyber security features and interoperable application options at subset levels, which defines the functionality implemented in each device. The simplest level is intended for basic devices while advanced levels support increasing functionality. The protocol is suitable for operation on a variety of communication media consistent with the makeup of most electric power communication systems.
Date of Current Edition	2012
Date of Next Edition	TBD
Current Activity	DNP3 Application Note AN2018-001 — DNP3 Profile for Communications with Distributed Energy Resources has been developed in partnership with the DNP Users Group, within the MESA Standards Alliance, SunSpec Alliance, EnerNex, and Xanthus Consulting. This is a useful reference for ES systems that will communicate with utility SCADA using DNP3.0 protocol. See also IEEE 1815.1.


	Institute of Electrical and Electronics Engineers www.ieee.org [ESS Installation]
Document Name	IEEE 1578: Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management
ESS Relevance	Provides descriptions of products, methods, and procedures relating to stationary batteries, battery electrolyte spill mechanisms, electrolyte containment and control methodologies, and firefighting considerations.
Date of Current Edition	2018
Date of Next Edition	TBD
Current Activity	None at the present time. The standard is available here . Consideration is being given to revise this standard to address spill containment recommendations for flow batteries. For more information, contact Working Group Chair Jeff Donato .


	Institute of Electrical and Electronics Engineers https://cmte.ieee.org/pes-essb/ [ESS Installations]
Document Name	IEEE 1635/ASHRAE 21-2018: Guideline for Ventilation and Thermal Management of Batteries for Stationary Applications
ESS Relevance	This guide details how vented lead-acid (VLA), valve-regulated lead-acid (VRLA), and nickel-cadmium (Ni-Cd) stationary batteries will function in installed stationary battery environments including energy storage with appropriate ventilation and thermal management.
Date of Current Edition	2018
Date of Next Edition	2022
Current Activity	This standard is a joint standard with ASHRAE 21 (See ASHRAE 21 section). A working group has been formed and a new Project Authorization Request (PAR) issued to address lithium-ion and emerging technology requirements. Meanwhile, a ballot group has been formed to ballot the draft of the 3 rd edition. For more information, contact the IEEE 1635 Working Group Chair Curtis Ashton or ASHRAE GPC 21 Chair Deep Ghosh .


	Institute of Electrical and Electronics Engineers https://cmt.e.ieee.org/pes-essb/ [ESS Installations]
Document Name	IEEE P2836: Recommended Practice for Performance Testing of Electrical Energy Storage (EES) System in Electric Charging Stations in Combination with Photovoltaic (PV)
ESS Relevance	This recommended practice focuses on the performance test of energy storage systems in the application scenario of PV-Storage-Charging stations with voltage levels of 10kV and below.
Date of Current Edition	New Standard
Date of Next Edition	2021
Current Activity	This document has been issued. As an entity-based standard, IEEE employs a “closed-process” balloting procedure. For more information, contact the working group chair, Shanshan Shi .


	Institute of Electrical and Electronics Engineers https://cmt.e.ieee.org/pes-essb/ [ESS Installations]
Document Name	IEEE P2962: Recommended Practice for Installation, Operation, Maintenance, Testing, and Replacement of Lithium-ion Batteries for Stationary Applications
ESS Relevance	This standard seeks to provide guidance on installation, testing, and O&M for stationary lithium-ion ESS.
Date of Current Edition	New Standard
Date of Next Edition	2024 (projected)
Current Activity	The Korea Electric Power Industry Code (KEPIC) 1400 serves as the anchor for the standard, while utilizing several other IEEE standards for development guidance. Contact the interim Working Group Chair Curtis Ashton for more information, including interest in being a working group chair or other officer.


	<p>Institute of Electrical and Electronics Engineers https://cmte.ieee.org/pes-essb/ [Built Environment]</p>
Document Name	IEEE 1679-2020: IEEE Recommended Practice for the Characterization and Evaluation of Energy Storage Technologies in Stationary Applications
ESS Relevance	Provides a framework for manufacturers to characterize their emerging or alternative energy storage technology, and for prospective users to make an informed evaluation on the suitability of that technology to meet their needs.
Date of Current Edition	2020
Date of Next Edition	TBD
Current Activity	None. See IEEE 1679-2020 for more information.


	<p>Institute of Electrical and Electronics Engineers www.ieee.org [ESS Components]</p>
Document Name	IEEE 1679.1: Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications
ESS Relevance	Defines a range of technologies for lithium-based batteries, including their construction, aging mechanisms, and failure modes as well as pointing to existing safety standards and regulatory requirements.
Date of Current Edition	2017
Date of Next Edition	TBD
Current Activity	An active working group is engaged in considering updates to the standard. Regular virtual meetings will occur during 2022. See IEEE 1679.1-2017 for basic information or contact Jim McDowall at jim.mcdowall@saftamerica.com for more information.


	Institute of Electrical and Electronics Engineers www.ieee.org [ESS Components]
Document Name	IEEE 1679.2: Guide for the Characterization and Evaluation of Sodium-Beta Batteries in Stationary Applications
ESS Relevance	Defines the range of technologies for sodium-beta batteries, including their construction, aging mechanisms, and failure modes, as well as pointing to existing safety standards and existing regulatory requirements. This guide focuses on sodium-nickel chloride and sodium-sulfur batteries.
Date of Current Edition	2018
Date of Next Edition	TBD
Current Activity	None. See IEEE 1679.2-2018 for more information.


	Institute of Electrical and Electronics Engineers www.ieee.org [ESS Components]
Document Name	IEEE P1679.3: Guide for the Characterization and Evaluation of Flow Batteries in Stationary Applications
ESS Relevance	Defines the range of technologies for flow batteries, including their construction, aging mechanisms, failure modes, safety and life cycle costing as well as pointing to existing safety standards and existing regulatory requirements. This guide focuses on zinc bromide and vanadium redox flow batteries.
Date of Current Edition	New Standard
Date of Next Edition	2022 (estimated)
Current Activity	Several task forces are working on different sections of the proposed standard in virtual meetings. For more information or to participate in this working group, contact Vilayanur ("Vish") Viswanathan .


 <p>Advancing Technology for Humanity</p>	<p>Institute of Electrical and Electronics Engineers https://cmte.ieee.org/pes-essb/ [ESS Components]</p>
<p>Document Name</p>	<p>IEEE P1679.4: Guide for the Characterization and Evaluation of Alkaline Batteries (excluding Ni-Cd) in Stationary Applications</p>
<p>ESS Relevance</p>	<p>Defines the range of technologies for alkaline batteries, including their construction, aging mechanisms, and failure modes while also pointing to existing safety standards and existing regulatory requirements. A variety of alkaline battery technologies including nickel-zinc, zinc-air, nickel-metal hydride, nickel-iron, and zinc-manganese dioxide are covered.</p>
<p>Date of Current Edition</p>	<p>New Standard</p>
<p>Date of Next Edition</p>	<p>TBD</p>
<p>Current Activity</p>	<p>The working group is actively developing this document. Regular virtual meetings will occur during 2022. For more information or to participate in this working group, contact Dan Lambert.</p>


 <p>Advancing Technology for Humanity</p>	<p>Institute of Electrical and Electronics Engineers https://cmte.ieee.org/pes-essb/ [ESS Components]</p>
<p>Document Name</p>	<p>IEEE P2686: Battery Management Systems in Energy Storage Applications</p>
<p>ESS Relevance</p>	<p>A recommended practice that provides information on the design, installation, and configuration of battery management systems in stationary energy storage applications, including both grid-interactive, standalone cycling and standby modes.</p>
<p>Date of Current Edition</p>	<p>New standard</p>
<p>Date of Next Edition</p>	<p>TBD</p>
<p>Current Activity</p>	<p>The working group is actively developing this document. Regular virtual meetings will occur during 2022. For more information or to participate in this working group, contact David Rosewater.</p>


 <p>Advancing Technology for Humanity</p>	<p>Institute of Electrical and Electronics Engineers https://cmte.ieee.org/pes-essb/ [ESS Components]</p>
<p>Document Name</p>	<p>IEEE P2688: Recommended Practice for Energy Storage Management Systems (ESMS) in Energy Storage Applications</p>
<p>ESS Relevance</p>	<p>Recommended practice providing a source for ESMS designers and integrators to understand the challenges in ESMS development and deployment, and the best practices to address them. This document investigates design options by supplying the pros and cons to a range of technical solutions, permitting the ESMS to dispatch single and aggregated multiple ESSs while coordinating their operation together with other distributed energy resources (DERs) in grid applications.</p>
<p>Date of Current Edition</p>	<p>New standard</p>
<p>Date of Next Edition</p>	<p>TBD</p>
<p>Current Activity</p>	<p>The working group is actively developing this document. Regular virtual meetings will occur during 2022. For more information or to participate in this working group, contact David Schoenwald.</p>


 <p>Advancing Technology for Humanity</p>	<p>Institute of Electrical and Electronics Engineers www.ieee.org [Reference Item]</p>
<p>SDO/Committee/ Association Name</p>	<p>IEEE PES Energy Storage and Stationary Battery Committee (ESSB)</p>
<p>ESS Relevance</p>	<p>The IEEE ESSB Committee is the major committee within the IEEE PES that develops multiple standards covering significant aspects of energy storage. It also has the largest and most active working group devoted to ESS Codes and Standards within IEEE.</p>
<p>Date of Next General Meeting</p>	<p>June 2022</p>
<p>Current Activity</p>	<p>The IEEE ESSB Committee has formed a third subcommittee named the Energy Storage (ES) Subcommittee. Nine working groups are working on various energy storage standards with new ones expected. Click here to join the committee. An officer will respond with information and add you to the ESSB meeting notice email list.</p> <p>The ESSB Safety Codes and Standards Working Group has been actively engaged with several committees within NFPA and ICC to ensure that IEEE ESSB concerns are understood by those committees creating standards related to ESS. The working group completed an onsite meeting January 26, 2022 during the Winter IEEE ESSB Committee general meeting. A liaison has been formed with the DOE National Laboratories engaged in ESS efforts to proactively contribute to ESS standards development with these SDOs. Contact Chris Searles for more information or to become involved with this working group.</p> <p>A collaborative effort of the ESSB Committee (ESSB ESCT) and IEEE SCC 21 currently cosponsor IEEE P1547.9 and IEEE 2688, conduct ESS tutorials, and will jointly sponsor future standards that involve mutual committee interests. For more information in any of these activities or to get involved, contact Babu Chalamala, Curtis Ashton, or visit the IEEE PES Energy Storage and Stationary Battery Committee (ESSB) for more information.</p>


	International Society of Automation www.isa.org [Built Environment]
Document Name	ANSI/ISA-60079-0 (12.00.01-2013 Explosive Atmospheres – Part 0): Equipment - General Requirements
ESS Relevance	<p>This is part of a group of ANSI/ISA standards modified from IEC standards. This standard specifies the general requirements for construction, testing and marking of electrical equipment and Ex Components intended for use in explosive atmosphere. Explosive atmospheres are identified and categorized by the National Electric Code® ANSI/NFPA 70.</p>
Date of Current Edition	2013
Date of Next Edition	N/A
Current Activity	<p>The work of the ISA12 Standards Committee and Subcommittees has been transferred to Underwriters Laboratories Inc. (UL) under UL STP 60079. For more information, contact Eliana Brazda.</p>


	International Society of Automation www.isa.org [Built Environment]
Document Name	ANSI/ISA-TR12.13.01-1999 (R2013): Flammability Characteristics of Combustible Gases and Vapors
ESS Relevance	<p>This standard documents the available limit of flammability, autoignition and burning-rate data for more than 200 combustible gases and vapors in air and other oxidants, as well as empirical rules and graphs that can be used predict similar data for thousands of other combustibles under a variety of environmental conditions.</p>
Date of Current Edition	2013
Date of Next Edition	N/A
Current Activity	<p>The work of the ISA12 Standards Committee and Subcommittees has been transferred to Underwriters Laboratories Inc. (UL) under UL STP 60079. For more information, contact Eliana Brazda.</p>


	Modular Energy Storage Architecture Standards Alliance www.mesastandards.org [Complete ESS]
Document Name	MESA ESS Specification
ESS Relevance	This standard addresses the communication architecture between a utility’s control system and the energy storage system (ESS).
Date of Current Edition	December 2018
Date of Next Edition	TBD
Current Activity	TBD

	Modular Energy Storage Architecture Standards Alliance www.mesastandards.org [ESS Components]
Document Name	MESA – Verifying ESS Device Compliance with the SunSpec Modbus Communication Standard Using the MESA Profile
ESS Relevance	<p>Specifies standardized communication between components within the ESS. And identifies tools that can be used to verify compliance with MESA-Device specification by using the SunSpec Modbus communications standard.</p> <p>The MESA Testing & Certification Work Group (T&C WG) is a MESA-member volunteer team that is facilitating development of processes and tools to support certification of MESA standards.</p>
Date of Current Edition	July 2020 (Final Draft) Document No. 12032
Date of Next Edition	TBD
Current Activity	TBD

	National Electrical Contractors Association (NECA) www.necanet.org [Codes and Complete ESS]
Document Name	NECA 701: Standard for Energy Management, Demand Response and Energy Solutions
ESS Relevance	<p>Describes methods and procedures used for performing energy conservation surveys, controlling and maintaining energy consumption, implementing smart grid and demand response for residential, commercial and industrial ESS applications.</p> <p>This standard helps electrical contractors understand the world of new energy storage applications when it is in its developing stages.</p>
Date of Current Edition	2013
Date of Next Edition	TBD
Current Activity	TBD

	National Electrical Contractors Association (NECA) www.necanet.org [ESS Installation]
Document Name	NECA 417: Recommended Practice for Designing, Installing, Maintaining, and Operating Microgrids
ESS Relevance	<p>Improves communication among integrators, purchasers, and suppliers of electrical construction services and should be referenced in contract documents for electrical construction projects. NECA 417 will cover the design, installation, maintenance, and operation of microgrids.</p>
Date of Current Edition	2019
Date of Next Edition	TBD
Current Activity	For more information see NECA Codes & Standards .

	National Electrical Manufacturers Association www.nema.org [Complete ESS]
Document Name	NEMA ESS 1: Standard for Uniformly Measuring and Expressing the Performance of Electrical Energy Storage Systems
ESS Relevance	Provides technical specifications relevant to an ESS. It also defines a set of test, measurement, and evaluation criteria to determine the performance of electrical ESSs intended for energy-intensive and/or power-intensive stationary applications. Eight ESS applications covered in this Standard include peak shaving, frequency regulation, islanded microgrids, PV smoothing, volt/VAR, renewables firming, power quality and frequency control.
Date of Current Edition	2019
Date of Next Edition	TBD
Current Activity	TBD


	National Electrical Manufacturers Association www.nema.org [ESS Components]
Document Name	NEMA 250: Enclosure for Electrical Equipment (1000V Maximum)
ESS Relevance	Covers enclosures used to house electrical equipment not to exceed 1000V. It includes enclosures used in both indoor, outdoor, and hazardous locations. It references adoption to requirements detailed in section 110.3(B) of NFPA 70.
Date of Current Edition	2018
Date of Next Edition	TBD
Current Activity	TBD





National Fire Protection Association (NFPA)


www.nfpa.org
[Built Environment]


Document Name	NFPA 1: Fire Code
ESS Relevance	Adopted in 19 states as one of the key NFPA safety codes working at an overarching level for fire prevention and remedial action. Chapter 52 now includes extracts from the recently published NFPA 855 specifying requirements related to the installation of energy storage systems. These requirements recognize both established battery technologies and newer emerging energy storage technologies. Provisions apply to all energy storage system applications.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	<p>The NFPA 1 Committee has been divided into four separate groups (committees or subcommittees): [1] Building Systems and Special Occupancies (FCC-OCP); [2] Special Equipment, Processes and Hazardous Materials (FCC-HAZ); [3] Fundamentals (FCC-FUN); and [4] The Fire Code Committee (FCC-AAC) are all open to membership application.</p> <p>The Public Input period closed April 1, 2021, for the 2024 edition. The First Draft Report was published December 16, 2021. Public comments on the report will be accepted until the closing date of February 24, 2023. The Second Draft Report will be posted by November 17, 2022. The NITMAM closing date will be January 5, 2023.</p> <p>For more information, see NFPA 1: Fire Code.</p>


	National Fire Protection Association (NFPA) www.nfpa.org [Built Environment]
Document Name	NFPA 70: National Electrical Code (NEC)
ESS Relevance	<p>Adopted in all 50 states, NFPA 70 is considered the benchmark for safe electrical design, installation and inspection to protect both people and property from electrical hazards. Article 706 (new in the 2017 edition) applies to energy storage systems and Article 480 remains applicable to batteries as used in standard stationary backup power applications, in addition to other criteria in the NEC relevant to electrical equipment and installations. The NEC is made up of 18 Code Making Panels (CMPs). CMP 4 covers requirements for articles 690 for PV and 705 for Interconnections. CMP 13 covers requirements for batteries in article 480, and for ESS in article 706. This is used as the North American standard for all electrical installation requirements.</p>
Date of Current Edition	2020
Date of Next Edition	2023
Current Activity	<p>First draft public inputs closed September 10, 2020. The Second Draft Report will be published by March 21, 2022. NITMAMs must be submitted by April 11, 2022, with a pre-conference posting date of May 2, 2022.</p> <p>For more information, see NFPA 70: National Electrical Code.</p>


	National Fire Protection Association (NFPA) www.nfpa.org [Built Environment]
Document Name	NFPA 75: Standard for the Fire Protection of Information Technology Equipment
ESS Relevance	<p>This standard has evolved since its adoption in 1962 as the Standard for the Protection of Electronic Computer Systems to its current form that encompasses all information technology equipment. However, it encompasses more than equipment, dealing with fire protection requirements for buildings, construction, UL listing requirements including UL 9540, air sampling requirements, as well as aisle placement systems. As such, it is considered for report purposes as a Built Environment standard.</p>
Date of Current Edition	2020
Date of Next Edition	2024
Current Activity	<p>Public Inputs for the next edition closed January 5, 2022. The first draft report will be posted October 26, 2022. Second draft public input will close January 4, 2023. NITMAMs can be submitted until November 1, 2023, before final NITMAM posting December 13, 2023.</p>


	National Fire Protection Association (NFPA) www.nfpa.org [Built Environment]
Document Name	NFPA 76: Standard for the Fire Protection of Information Technology Equipment
ESS Relevance	Sometimes considered a companion to NFPA 75, where NFPA 76 addresses the elements like those in NFPA 75, but specifically addressing telecommunications facilities. Because most telecommunications facilities are now digitally run there is significant overlap between telecommunications and IT. This standard address telephone exchanges but excludes remote outdoor wireless facilities. NFPA 855 contains certain paragraphs that are excluded under NFPA 76.
Date of Current Edition	2020
Date of Next Edition	2024
Current Activity	As with NFPA 75, Public Inputs for the 2024 edition were accepted until January 5, 2022. The dates for first draft report will be posted October 26, 2022 ; second draft public input will close January 4, 2023; NITMAMs submittals until November 1, 2023; and final NITMAM posting December 13, 2023 – parallel the dates of NFPA 75.


	National Fire Protection Association (NFPA) www.nfpa.org [Built Environment]
Document Name	NFPA 5000: Building Safety and Construction Code
ESS Relevance	Provides requirements necessary in construction, protection, and occupancy that minimize danger to life and property.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	Public inputs have been accepted for the 2024 edition. The First Draft Report posting date is March 22, 2022. At that time Public Comments will be accepted for the second draft until May 31, 2022 , with that drafting report due to be posted February 28, 2023. The NITMAM closing date is March 28, 2023 with a final posting scheduled for May 9, 2023. For more information, see NFPA 5000: Building Safety and Construction Code .


	National Fire Protection Association (NFPA) www.nfpa.org [Complete ESS]
Document Name	NFPA 791: Recommended Practice and Procedures for Unlabeled Electrical Equipment
ESS Relevance	Provides recommended procedures for evaluating unlabeled electrical equipment for compliance with nationally recognized standards. If an ESS were unlabeled, NFPA 791 could be used to evaluate the acceptability of that ESS. However, NFPA 791 does not cover procedures or evaluations relating to product certification systems that result in listed and/or labeled products.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	The First Draft Report will be posted March 22, 2022. At that time, Public Comments for the Second Draft will be accepted until May 31, 2022, with the Second Draft Report posted February 28, 2023. NITMAMs can be submitted through March 28, 2023, with the posting completed May 9, 2023, in advance of the 2023 General Meeting. For more information, see NFPA 791: Recommended Practice and Procedures for Unlabeled Electrical Equipment .


	National Fire Protection Association (NFPA) www.nfpa.org [ESS Installation]
Document Name	NFPA 78: Guide on Electrical Inspections
ESS Relevance	New standard covering the minimum criteria for organizing and conducting electrical inspections, including administration, plan review and field inspections. This applies to new as well as modifications to existing electrical installations, including energy storage systems.
Date of Current Edition	2020
Date of Next Edition	2024
Current Activity	The first draft posting date is March 22, 2022. At that time, Public Comments may be submitted until May 31, 2022. The Second Draft Report will follow on February 28, 2023. NITMAMs may be submitted until March 28, 2023 before final posting on May 9, 2023. For more information, see NFPA 78: Guide on Electrical Inspections . Note: Both NFPA 78 and NFPA 1078 (Standard for Electrical Inspector Professional Qualifications) Committees and Staff Liaisons are identical.


	National Fire Protection Association (NFPA) www.nfpa.org [ESS Installation]
Document Name	NFPA 855: Standard for the Installation of Stationary Energy Storage Systems
ESS Relevance	<p>Stipulates requirements to ensure the safety of stationary, energy storage systems. Chapters place emphasis on electrochemical devices for energy storage systems (BESS) although the next revision will expand its scope to include additional ESS technologies (e.g., flywheels). The standard provides limitations on maximum threshold quantities, capacities for a given system, footprint and separation, with breakdowns for specific energy storage system technologies. Requirements for commissioning, operations and maintenance, as well as decommissioning of systems with information for AHJ's and first responders is also detailed. NFPA 855 is the key ESS NFPA standard, and an effort is underway to synchronize all ESS related inputs in other NFPA standards with NFPA 855.</p>
Date of Current Edition	2020
Date of Next Edition	2023
Current Activity	<p>NFPA 855 is in the process of being updated for the 2023 edition. First Draft balloting has been completed after review of over 500 public inputs resulting in 150 First Revision changes. The Second Draft Report posting date is scheduled for March 21, 2022. The NITMAM closing date is February 22, 2022. NITMAMs will be posted by April 5, 2022.</p> <p>For more information see NFPA 855: Standard for the Installation of Stationary Energy Storage Systems.</p>


	National Fire Protection Association (NFPA) www.nfpa.org [Reference Item]
SDO/Committee/ Association Name	National Fire Protection Association (NFPA)
ESS Relevance	<p>NFPA is one of the main safety codes organizations focused on all aspects of safety, especially fire safety. NFPA is owner of a variety of codes and standards applicable to energy storage and energy storage systems. Major codes/standards of current interest include NFPA 855, NFPA 1, NFPA 75 and NFPA 76 as well as certain sections of the National Electric Code (NFPA 70).</p>
Date of Next Meeting	<p>For more information on NFPA Technical Meetings and a listing of key dates, visit the NFPA Technical Meetings page.</p>
Current Activity	<p>Various NFPA Committees are in different stages of standards development as shown above. The 2022 NFPA Conference and Expo will be held in Boston, June 6-9, 2022. Visit the NFPA Conference & Expo page for more information and to register for the conference.</p>


 Sandia National Laboratories	Sandia National Laboratories Grid Energy Storage Department US Department of Energy Office of Electricity Energy Storage Program https://energy.sandia.gov/programs/energy-storage [Reference Item]
Name	BatteryArchive.org
ESS Relevance	BatteryArchive.org is a recently launched public repository for visualization, analysis, and comparison of battery data across institutions. The database includes standardized metadata and file formats, and basic plots of all uploaded time series and cycle data. The site currently focuses on cycle aging for commercial Li-ion cells but will expand to other kinds of battery data in the future.
Reason for Reference Item	Sandia's National Laboratories is one of a group of DOE national laboratories engaged in various aspects of energy storage. Sandia's vision for enabling electric grid modernization includes diverse energy storage research programs and engineering efforts that range from basic research and development (R&D) to large scale demonstrations and deployments. They also collect key information on current and future storage technologies and act as a clearinghouse for energy storage information. To support these efforts, Sandia manages the DOE Energy Storage Systems website and the Global Energy Storage Database .
SDO/Committee Comment	This work is supported by the U.S. Department of Energy Office of Electricity Energy Storage Program through the Sandia National Laboratories Grid Energy Storage Department . The report is part of that effort and is created in collaboration with Pacific Northwest National Laboratory (PNNL).
Requested Action (if any)	To offer site feedback, contribute datasets, or obtain API credentials to download large amounts of data, email info@batteryarchive.org .


 Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [Complete ESS]
Document Name	ANSI/CAN/UL 9540: Energy Storage Systems and Equipment
ESS Relevance	Product safety standard for a UL listing of an energy storage system.
Date of Current Edition	February 27, 2020 (Edition 2)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	The 2 nd Edition of ANSI/CAN/UL 9540 can be viewed or purchased here . A new Certified Requirement Decision (CRD) has been issued to address specific testing requirements for lead-acid and nickel-cadmium batteries. A revision is underway with comment period closed and voting by STP members expected to take place by Feb 2022.


 Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [Complete ESS]
Document Name	UL 9540A: Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
ESS Relevance	This is the standardized test method also known as “Large-Scale Fire Test”. This multi-level test method evaluates the fire characteristics of a battery energy storage system that undergoes thermal runaway. The data generated is used to determine the fire and explosion protection required for an installation of that battery energy storage system.
Date of Current Edition	November 12, 2019 (Edition 4)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	<p>ANSI/CAN/UL 9540A can be viewed or purchased here. CRDs (Certification Requirement Decisions) have been issued covering corrections to gas measurement methods and residential tests to simplify indoor or outdoor performance requirements. These changes have also been submitted as proposals to the next edition of UL 9540A and will be sent out for review and comment. Visit the UL Available Proposals page to view future proposal activity (when active) for UL 9540A.</p> <p>A new CRD is being created to address a coordination between UL 1973 system level requirements for lead-acid/nickel-cadmium batteries and requirements specified within UL 9540A for thermal runaway requirements to accommodate NFPA 855 stipulations (See UL 1973 and UL 9540). Other future considerations include an installation test method for container systems and an explosion test method for residential systems.</p>


 Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	UL 60079-0: Explosive Atmospheres - Part 0: Equipment - General Requirements
ESS Relevance	Documents the available limit of flammability, autoignition and burning-rate data for more than 200 combustible gases and vapors in air and other oxidants, as well as empirical rules and graphs that can be used predict similar data for thousands of other combustibles under a variety of environmental conditions. Note: This is an IEC-based UL standard with USA differences.
Date of Current Edition	April 15, 2020 (Edition 7)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	See UL Standard UL 60079-0 for more information on the published standard.


	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	UL 62133-2: Safety for Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications - Part 2: Lithium Systems
ESS Relevance	<p>Binational, IEC based standard that specifies requirements and tests for the safe operation of portable sealed secondary lithium cells and batteries containing non-acid electrolyte for lithium systems for Canada and the US. This standard is not, by itself, generally suitable for the evaluation of the safety of end-products, as it lacks specific requirements regarding charging, the effect of normal loads, abnormal conditions that should be considered, and the physical and electromagnetic stresses encountered in the anticipated environment of the end-product.</p> <p>Note: Battery packs with additional features or circuitry, including integral circuitry that facilitates charging, are considered to be end-products. This standard deals with the covered components used in accordance with CAN/CSA-C22.2 No. 0.</p>
Date of Current Edition	January 10, 2020 (Edition 1)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	See Standard 62133-2, Edition 1 for more information on the published standard.


	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	ANSI/UL 810A: Electrochemical Capacitors
ESS Relevance	<p>Addresses the safety of electrochemical capacitors (sometimes called electric double-layer capacitors, ultracapacitors or supercapacitors), which can be used as an energy source in energy storage systems.</p>
Date of Current Edition	October 2008 with approved revision March 2017 (Edition 1)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	See UL Standard UL 810A for further details.


 Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	UL 1642: Lithium Batteries
ESS Relevance	Covers the use of lithium batteries (both primary and rechargeable) used in technician-replaceable or user-replaceable applications with the purpose of reducing the risk of fire or explosion. The standard limits the amount of lithium contained in a battery that is covered without additional testing requirements. Edition 6 clarifies the projectile test as well as revising the coin cell warning marking.
Date of Current Edition	September 29, 2020 (Edition 6)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	See Standard 1642, Edition 6 for more information.

 Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
ESS Relevance	Covers requirements for inverters, converters, charge controllers and interconnection system equipment (ISE) intended for use in both off-grid and grid-connected environments. Information that clarifies intention to supplement IEEE 1547 and IEEE 1547.1 has been included.
Date of Current Edition	September 28, 2021 (Edition 3)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	This Standard contains revisions to Supplement SB-Grid Support utility-interactive inverters and converters along with other miscellaneous editorial updates. See UL Standard UL 1741 for more information.

	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	ANSI/CAN/UL 1973: Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
ESS Relevance	<p>Covers requirements for battery systems for use in energy storage systems for stationary applications such as PV, wind turbine storage or UPS. It also covers battery systems for use in light rail and stationary rail applications such as rail substations as well as vehicle auxiliary power such as that used in RV applications. There are appendices specific to newer or emerging technologies: 1) Appendix B – sodium-beta type batteries, 2) Appendix C to flowing electrolyte batteries, 3) Appendix E – Lithium ion, lithium metal and sodium ion cells, and 4) Appendix I – mechanically recharged metal air batteries. A certification requirements decision (CRD) is now published to create an Appendix H that accommodates lead-acid and nickel-cadmium batteries at both the component and ESS system levels and can be used now for certification. This is expected to be released in early 2022.</p>
Date of Current Edition	February 7, 2018 (Edition 2)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	<p>A Call for Proposals to update UL 1973 was sent to Standard Technical Panel (STP) members and standard subscribers. Numerous proposals were received and are being included in a new release scheduled for early 2022. The Appendices mentioned above are now published for certification, and the CRD covering lead-acid and nickel-cadmium will be included in the next published revision of UL 1973. A CRD addressing sodium nickel chloride revisions to Annex B has been submitted and will be included in a published edition at a later date. See UL Standard UL 1973 (shopulstandards.com) for more information.</p>

	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	ANSI/CAN/UL 1974: Evaluation for Repurposing Batteries
ESS Relevance	<p>Covers the sorting and grading process of battery packs, modules and cells, as well as electrochemical capacitors that were originally configured and used for other purposes, such as electric vehicle (EV) propulsion, and now intended for a repurposed use application, such as for use in stationary energy storage systems and other applications. This standard excludes the process for remanufactured batteries.</p>
Date of Current Edition	October 25, 2018 (Edition 1)
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	<p>See Standard 1974, Edition 1 for more information.</p>

	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	ANSI-CAN-UL 2580-2021: Batteries for Use in Electric Vehicles
ESS Relevance	Covers electrical energy storage assemblies such as battery packs, combination battery pack-electrochemical capacitor assemblies and the subassembly/modules that make up these assemblies for use in electric-powered vehicles. The ability of the electrical energy storage assembly's to safely withstand simulated abuse conditions while preventing personal exposure to the resulting hazards is evaluated. The manufacturer's specified charge and discharge parameters at specified temperatures is also evaluated. See also UL 1974.
Date of Current Edition	April 2020 (Edition 3) <i>Note: a French translation of this Edition was released March 2021.</i>
Date of Next Edition	UL standards are under continuous maintenance and are updated as warranted.
Current Activity	This standard is a Joint Binational Standard with ULC. See Standard 2580, Edition 3 for more information on the recent proposal out for ballot and comment.

	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [Reference Item]
SDO/Committee/ Association Name	Underwriters Laboratories is a non-profit affiliate of UL, Inc.
ESS Relevance	Responsible for ten (10) of the ESS related standards listed in this report. UL 9540 and UL 9540A are the bedrock testing standards for all BESS and ESS related safety assurances for batteries and emerging technologies installed in energy storage systems. Underwriter Laboratories (UL) does not conduct a general meeting, nor hold regular working group meetings. Instead, they employ Standards Technical Panels (STPs) to act as de facto working groups to review inputs/comments received when standards need revision or updating. UL standards are under continuous maintenance and are updated as warranted.
Current Activity	See standards activities above.

ENERGY STORAGE C/S SAFETY COLLABORATIVE							
STANDARDS DEVELOPMENT ORGANIZATIONS (SDOs)							
ORGANIZATION	Built Environment	Complete ESS	ESS Installations	ESS Components	Reference Items	TOTAL	SDO Website
ASHRAE			1			1	www.ashrae.org
ASME		2				2	www.asme.org
CSA			1	2		3	www.csagroup.org
DNV-GL		1			1	2	www.dnvgl.com
FM Global	1					1	www.fmglobal.com
ICC	3				2	5	www.iccsafe.org
IEEE	5	1	4	7	1	18	www.ieee.org
ISA	2					2	www.isa.org
MESA		1		1		2	www.mesastandards.org
NECA		1	1			2	https://necanet.org/
NEMA		1		1		2	www.nema.org
NFPA	5	1	2		1	9	www.nfpa.org
SANDIA					1	1	www.sandia.gov
UL		2		8	1	11	https://ulstandards.ul.com/
	16	10	9	19	7	61	
	26%	16%	15%	31%	12%	100%	

Every effort is made by the Pacific Northwest National Laboratory (PNNL) and Sandia National Laboratories staff to ensure the accuracy of the information presented in this report. Sandia and PNNL very much appreciate the input from the standards developing organizations (SDOs) covered in the report as well as contributing volunteers who may be involved in one or more of the SDO initiatives covered in this document. We acknowledge that there may be standards/codes that exist but are not included in this report. Suggestions for revision, additions, and enhancements to this document are welcome and encouraged.

On behalf of the U.S. Department of Energy, Office of Energy and Energy Storage System Program, whose support has made this report possible, we hope this document serves as a solid source of information about codes and standards related to ESS safety. This report allows us to achieve the objectives outlined in the ESS Safety Roadmap as well as fostering confidence in the safety and reliability of Energy Storage Systems. For more information about the ESS Safety Roadmap efforts visit sandia.gov/energystoragesafety. For questions related to or to provide input on this document, please contact [Chris Searles](#) or [Matt Paiss](#).

Sandia National Laboratories is a multi-mission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

At PNNL, our mission is to transform the world through courageous discovery and innovation. It is our vision that PNNL science and technology inspires and enables the world to live prosperously, safely, and securely.



**PNNL-32596
SAND2022-1307 O**



Contact Information

For more information about this document and/or ES Safety Collaborative activities, contact:

Chris Searles

Consulting Liaison for Sandia National Laboratories
P.O. Box 5800 MS 0613
Albuquerque, NM87185-0613

Phone: 214-850-1183

Email: chris.searles@ieee.org



Contact Information

For more information about this document and/or ES Safety Collaborative activities, contact:

Matthew Paiss

Pacific Northwest National Laboratory
P.O. Box 999, MSIN K2-44
Richland, WA 99352

Phone: 831-566-3057

Email: matthew.paiss@pnnl.gov