SAFETY COLLABORATIVE

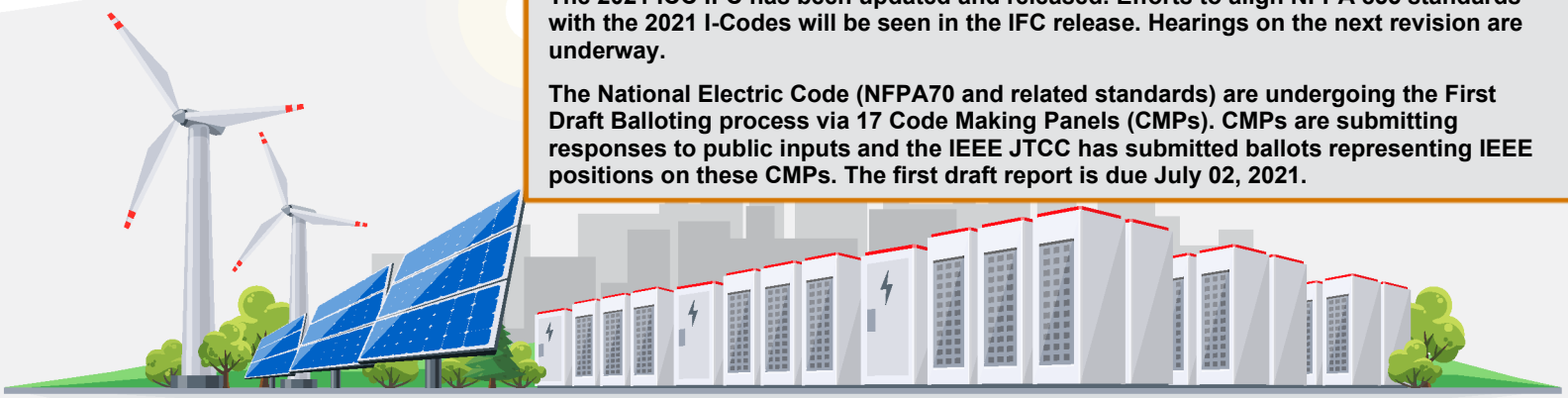
2Q2021 Highlights

The first draft of NFPA 855 (2023 edition) has been balloted and is now open for additional public comment until July 22, 2021.

NFPA 1 2021 has just been released. Due to a reorganization following this release, this standard committee will be divided into four technical committees. For details, read the update below.

The 2021 ICC IFC has been updated and released. Efforts to align NFPA 855 standards with the 2021 I-Codes will be seen in the IFC release. Hearings on the next revision are underway.

The National Electric Code (NFPA70 and related standards) are undergoing the First Draft Balloting process via 17 Code Making Panels (CMPs). CMPs are submitting responses to public inputs and the IEEE JTCC has submitted ballots representing IEEE positions on these CMPs. The first draft report is due July 02, 2021.



CODES AND STANDARDS UPDATE SPRING/SUMMER 2021

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

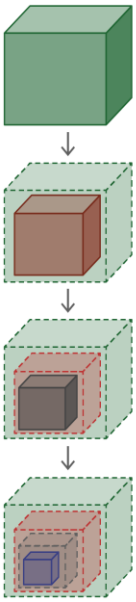
The purpose of this Codes and Standards Update is to support these objectives by providing information on efforts being conducted by U.S. standards developing organizations (SDOs) and other entities that include focus on ESS safety.

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- related communications visit https://public.govdelivery.com/accounts/USDOESNLEC/subscriber/new?topic_id=USDOESNLEC_195.

Standards and Model Codes Hierarchy



BUILT ENVIRONMENT

- iCodes – IFC, IRC, IBC
- IEEE – C2, SCC 18, SCC21
- NFPA 5000, NFPA 1, ISA

COMPLETE ESS

- UL 9540, MESA
- ASME TES-1, NECA
- NFPA 855
- NFPA 791

INSTALLATION / APPLICATION

- NFPA 70
- UL 9540A
- IEEE C2
- IEEE 1635/ASHRAE 21
- IEEE P1578
- DNVGL GRIDSTOR
- FM GLOBAL 5-33
- NECA 416 & 416

SYSTEM COMPONENTS

- UL 1973
- UL 1974
- UL 810A
- UL1741
- CSA 22.2 No. 340-201
- IEEE 1547
- IEEE 1679 Series

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	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 stationary battery applications, and how to properly manage this in installations of those cells.
Date of Current Edition	2018
Date of Next Edition	2021
Current Activity	Working in collaboration with IEEE 1635. ASHRAE will be establishing the GPC 21 Committee to work with IEEE ESSB in 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.

	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. **The next TES Standards Committee meeting is scheduled for May 26, 2021.**

	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	The TES-2 standard will provide 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. This standard will be suitable for use by manufacturers, owners, employers, users, and others concerned with, or responsible for its application by prescribing 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 TES-2 Task Group held their kick-off meeting in June 2020. The Task Group is currently working on defining a scope for the new standard and is recruiting participants with in-depth knowledge of phase-change thermal energy storage systems, specifically those that operate at high temperatures. For more information or to join the committee, contact Nicole Gomez.

	American Society of Mechanical Engineers (ASME) www.asme.org [Reference Item]
SDO/Committee/ Association Name	***American Society of Mechanical Engineers (ASME)***
ESS Relevance	ASME is a nonprofit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines while promoting the vital role of the engineer in society. ASME published a number of codes and standards to promote a safer world. The Energy and Environmental Standards Advisory Board has authorized the creation of an ASME Energy Storage Committee (ESC) to compliment the ASME Performance Test Committee (PTC). These two committees will investigate how the ESC can fill gaps with necessary ESS standards while the PTC will provide information on Mechanical and Thermal Energy ESS (see TES 1 & TES 2). The goal is to provide ESS guidance to its members as well as the industry at large. The ESC is currently developing an ESS matrix to identify various technologies that are used in the ESS space.
Date of Next Meeting	TBD
Requested Action (if any)	Currently the ESC Committee is by invitation only, but IEEE ESSB and other SDO's/groups have been invited to participate. More information to follow as this new group advances. For information on this committee, a request to participate, and future meeting agendas, contact Ryan Crane.

	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	The object of this Code is to establish safety standards for the installation and maintenance of electrical equipment. Consideration has been given to the prevention of fire and shock hazards, as well as proper maintenance and operation. In the 2021 edition, Section 64 has been revised to incorporate energy storage rules and codes. Section 64 provides requirements for the installation of renewable energy, energy production, and energy storage systems (ESS).
Date of Current Edition	**2021**
Date of Next Edition	**TBD**
Current Activity	2021 edition was published in January 2021 and is available here. ESS requirements are included under Section 64-900 Rules. 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	Applies to alternating current (AC) and direct current (DC) power conversion equipment which can be associated with an energy storage system (ESS).
Date of Current Edition	2016
Date of Next Edition	2021
Current Activity	A New Edition (Edition 5.0) is currently under development. **Public review and comments can be made until June 14, 2021**. 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	This standard applies to the design, performance, and safety of battery management systems. Battery management systems are electronic or electromechanical devices that control or regulate a battery or set of batteries which may include external communication capabilities. It will apply to battery management systems in all applications including stationary batteries (e.g. local energy storage, smart grids, auxiliary power systems), batteries used to power mobility applications (e.g. electric vehicles, rail transport, aeronautics), and appliances and machinery (e.g. tools, kitchen appliances, manufacturing lines) used in consumer/residential, commercial, and industrial settings.
Date of Current Edition	New Standard
Date of Next Edition	2021 (Anticipated)
Current Activity	A technical committee was formed in December 2019. **Public review concluded on January 2021. The standard is currently under editorial review.** For more information contact Mohsen Sepehr. **Note:** IEEE ESSB Committee is developing a guide on BMS. See IEEE ESSB Committee activity below. Both groups are aware of each other's activities and 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	Effective March 1, DNV-GL changed its name to DNV. A major reorganization is underway. However, this recommended practice currently remains valid. The standard provides a comprehensive set of recommendations for grid-connected energy storage systems, focusing on safety, operation and performance. It purpose is to be valid for all ESS applications. End users, operators, and other stakeholders can find specific guidance in the document and contains 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.

	**DNV** **www.dnv.com/rules-standards/** **[Reference Item]**
SDO/Committee/ Association Name	**DNV**
ESS Relevance	DNV has reorganized and changed its name from DNV-GL to DNV. Power and Renewables is one of 7 market segments that is being structured as part a corporate reorganization. This group of approximately 25 people is working globally to provide testing, certification, and technical advisory services to the energy value chain, with a major emphasis on renewables and energy storage.
Reason for Reference Item	DNV will continue to provide proven engineering guidelines in several specific areas and support research that enhances external standards and codes that is of value and interest to the ES community. Their North American efforts are currently working with local fire department and regulatory efforts to integrate NFPA and IBC codes efforts with local and regional entities.
SDO/Committee Comment	
Requested Action (if any)	**Learn more about DNV's efforts at** Power and renewables - DNV.

	**FM Global** **www.fmglobal.com** **[Reference Item]**
Document Name	**FM Global Property Loss Prevention Data Sheet # 5-33: Electrical Energy Storage Systems**
ESS Relevance	The data sheet 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 and 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.

	**FM Global** **www.fmglobal.com** **[Reference Item]**
SDO/Committee/ Association Name	**FM Global Group**
ESS Relevance	FM Global is a Property Insurance Company with proven engineering guidelines and is committed to reducing risk at existing facilities as well as those under construction. FM Global currently publishes 267 FM Global Property Loss Prevention Data Sheets, of which 32 have recently been updated and published in October 2020. Thirteen of these have potential relevance to ESS, REN, and fire safety related issues.
Reason for Reference Item	FM data sheets and associated research projects contain proven engineering guidelines in a multitude of specific areas and support research that enhances external standards and codes which proves of value and interest to the ES community.
SDO/Committee Comment	TBD
Requested Action (if any)	Register and subscribe to receive updated information at www.fmglobal.com.

	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	Visit ICC Advocacy to learn more about codes adoption as well as federal and state activities. Work to revise ESS requirements in the 2021 IFC (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). Latest updates for the 2021 Group A Cycle can be found here. Proposals for the IFC were heard and voted upon at the Code Action Hearings from April 11 - May 5. **The report from the Committee Action Hearings will be posted May 24 with public comments being accepted until July 2, 2021**. The Public Comment Hearings will take place Sept 22-29, 2021. Review the ICC Current Code Development Cycle for additional context.

	International Code Council (ICC) www.iccsafe.org [Built Environment]
Document Name	**International Residential Code (IRC)**
ESS Relevance	Chapter 2 - Definitions, Chapter 3 - Building Planning: Section R328 Energy Storage Systems in the 2021 IRC. The 2018 IRC section was Section R327 titled Stationary Storage Battery Systems. Provisions were expanded in 2021 to include location and spacing limits, detection requirements and vehicle impact protection. The provisions are outside the energy efficiency provisions within Chapter 11 - Energy Efficiency where all other provisions regarding energy (IRC and IECC) are addressed.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	Proposals to the 2021 IRC will be heard next April 2022 during the Group B Code Development Cycle. Proposals are due January 10, 2022. Some areas of focus will likely be upon fire detection and impact protection to be consistent with the IFC residential ESS proposals. Note that Proposal F153-21 is proposed to align the IFC residential provisions with the IRC R328 ESS provisions.

	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	IBC G– General, IBC-E Egress, IBC-FS Fire Safety provisions, IFC Chapter 10 maintained by IBC-E, IMC, IPC, IRC-M, IRC-P
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	2021 IBC now addresses “ESS in dedicated use buildings” as moderate-hazard factory industrial, Group F-1 buildings; deletes the stationary storage battery system room/area requirements from the table providing required separation and/or protection requirements (the room is addressed by Section 1207 of the IFC); new Section 3115 covering intermodal shipping containers that are repurposed for use as buildings or structures or as a part of a building or structure, includes an exemption for stationary storage battery arrays located in such containers complying with Chapter 12 of the IFC (modifications do not impact the exception). Note that the IMC continues to reference the IFC Section 1207 for ventilation of energy storage systems (Sections 502.4 and 502.5). Latest updates for the 2021 Group A Cycle can be found here. Proposals for the IBC and IRC P&M were heard and voted upon at the Code Action Hearings from April 11 - May 5. **The report from the Committee Action Hearings will be posted May 24th with public comments being accepted until July 2, 2021**. The Public Comment Hearings will take place Sept 22-29, 2021.

	International Code Council (ICC) www.iccsafe.org [Reference Item]
SDO/Committee/ Association Name	**International Codes Council (ICC) - General**
ESS Relevance	The ICC publishes the I-Codes set which include the IFC, IEBC, IECC and IRC. 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.
Reason for Reference Item	The ICC and its committees are considered and followed by AHJs and Code officials in most states within the United States and, to a certain extent, outside the United States.
SDO/Committee Comment	The ICC has published its 2021 editions. The development of the 2024 editions are currently underway – the Group A cycle in 2021 (IBC and IFC) and Group B in 2022 (IRC). The International Green Construction Code (IgCC) will follow this process and is tied to the ASHRAE 189.1 process which is an on-going effort.
Requested Action (if any)	N/A

	International Code Council (ICC) www.iccsafe.org [Reference File]
SDO/Committee/ Association Name	**International Codes Council (ICC) – Fire Code Action Committee (FCAC) Working Groups**
ESS Relevance	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.
Reason for Reference Item	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 the 2020 edition of NFPA 855 and correlating IFC residential requirements with IRC (RB 154-19). Note that the FCAC works with BCAC when there are proposals associated with the IRC.
SDO/Committee Comment	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 will testify at the Code Action Hearings underway during this cycle, then preparing comments to the proposals and testifying during the Public Comment Hearings in the fall of 2021.
Requested Action (if any)	To get involved with FCAC and the WG4 dealing with ES issues, contact Beth Tubbs.

IEEE Advancing Technology for Humanity	**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	This is the Standard for interconnection of DER with electric power systems. DER as defined in IEEE 1547 includes energy storage DER 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.
Date of Current Edition	2018
Date of Next Edition	TBD (A new revision is not expected for several years)
Current Activity	IEEE 1547 WG members have expanded to create several '1547.X' working groups that are currently updating or creating new guides within the set of IEEE 1547 Standards (e.g., 1547.1) as well as various supporting guides (e.g. P1547.9 for ES DER). For questions about IEEE 1547-2018, contact the P1547 Revision Chair, David Narang.

IEEE Advancing Technology for Humanity	**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	Technical background and application details to support understanding of IEEE Std 1547-2003. The guide facilitates the use of IEEE Std 1547-2003 by characterizing various forms of distributed resource (DR) technologies and their associated interconnection issues. It provides background and rationale of the technical requirements of IEEE Std 1547-2003. It also provides tips, techniques, and rules of thumb, and it addresses topics related to DR project implementation to enhance the user's understanding of how IEEE Std 1547-2003 may relate to those topics. This guide is intended for use by engineers, engineering consultants, and knowledgeable individuals in the field of DR. The IEEE 1547 series of standards is cited in the Federal Energy Policy Act of 2005, and this guide is one document in the IEEE 1547 series.
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	There is an active project P1547.2 to revise 1547.2-2008 to reflect 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 P1547.9: Guide for Interconnection of Energy Storage Distributed Energy Resources (DER) with Power Systems**
ESS Relevance	This Guide provides information on and examples of how to apply IEEE Standard 1547, "IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces," to the interconnection of Energy Storage Distributed Energy Resources (DER ES) including DER ES 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	2021 (anticipated)
Current Activity	An active IEEE Working Group, made up of members from both the IEEE ESSB and IEEE SCC 21, is in the process of developing the Guide. Current work is on Draft Version 4. A general working group meeting is planned for June 7-8, 2021. To join this WG, 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	This Standard covers electrical safety for utility systems and equipment.
Date of Current Edition	2017
Date of Next Edition	2023 (Anticipated publication available August 2022)
Current Activity	NESC Sub-Committees held meetings in 2019 to consider change proposals submitted by member representatives and prepared recommendations on each of them. During those meetings the NESC battery section was 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 were added to that section. Proposed revision of the NESC will be submitted for letter ballot and to ANSI for concurrent public review. Further approvals are required before submitting to ANSI for recognition as an ANSI standard. See http://standards.ieee.org/about/nesc/ and https://standards.ieee.org/products-services/nesc/process.html for more information.

	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	This document specifies the DNP3 protocol structure, functions, cyber security features and interoperable application options (subset levels). The specified subset level defines the functionality implemented in each device. The simplest level is intended for basic devices. More 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 (A new revision is not expected for several years)
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, 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 (IEEE SA allows a 10-year period before the standard must be renewed or revised) **Note:** This standard may need to be revised sooner than the 10-yr period to add spill containment recommendations for flow batteries.
Current Activity	None. The standard was approved October 23, 2018 and is available here. For more information, contact the Working Group Chair Jeff Donato.

IEEE Advancing Technology for Humanity	**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 (NiCad) stationary batteries will function in installed environments with appropriate ventilation and thermal management.
Date of Current Edition	2018
Date of Next Edition	2021 (projected)
Current Activity	This standard is a joint standard with *ASHRAE Guideline 21* (See ASHRAE 21 section). A Working Group has been formed and a new PAR issued to address lithium-ion and emerging technology requirements. For more information, contact the Working Group Chair Curtis Ashton or ASHRAE GPC 21 Chair Deep Ghosh.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers** **https://cmte.ieee.org/pes-essb/** **[ESS Installations]**
Document Name	**IEEE P2932: Recommended Practice for Installation, Operation, Maintenance, Testing, and Replacement of Lithium-ion Batteries for Stationary Applications**
ESS Relevance	There is currently no published standard on how to properly install/replace and maintain/test/operate stationary Li-ion battery installations, which are presently (and may continue to be) the bulk of BESS deployments.
Date of Current Edition	New Standard
Date of Next Edition	2024 (projected)
Current Activity	This guide is being developed using KEPIC (Korea Electric Industry Code) 1400 as a base, and IEEE 450, 484, 485, 1106, 1115, 1187, and 1188 as guidance. This a new working group but using these different base documents to work from with the goal of expediting progress. For more information (including interest in being a working group chair or other officer), contact interim Working Group Chair Curtis Ashton.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers** **https://cmte.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	As EVs proliferate, there will be cases at charging stations where demand exceeds the ability of the local distribution grid to provide the requested energy. These charging stations will have BESS, and many of them will have PV on the roof of the carports (and may or may not have a connection to the local distribution network). This is a Chinese EPRI-proposed entity-based standard. It covers how to test the performance of those charging stations that use PV as a primary power source, and BESS to store the energy and meet peak demand.
Date of Current Edition	New Standard
Date of Next Edition	2021
Current Activity	The document is in ballot now This is a “closed-process” ballot entity-based standard. For more information, contact the working group chair, Shanshan Shi.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers** **https://cmte.ieee.org/pes-essb/** **[Built Environment]**
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 (IEEE SA allows a 10-year period before the standard must be renewed or revised)
Current Activity	None. See IEEE 1679-2020 for more information.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers** **www.ieee.org** **[ESS Components]**
Document Name	**IEEE 1679.1: Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications**
ESS Relevance	The first in a series of Guides and Best Practices under the IEEE 1679 base standard that covers various emerging or alternative battery energy storage technologies used in Battery Energy Storage Systems (BESS) including safety issues. Each guide in this series will follow a similar pattern to aid the user in a synergistic manner. The guide describes the range of technologies for lithium-based batteries, including their construction, aging mechanisms, and failure modes. The guide also points to existing safety standards (e.g., UL 1973) and existing regulatory requirements. This guide focuses mainly on lithium-ion batteries.
Date of Current Edition	2017
Date of Next Edition	TBD (IEEE SA allows a 10-year period before the standard must be renewed or revised)
Current Activity	An active working group is engaged in considering updates to the standard. See IEEE 1679.1-2017 for more information.

IEEE Advancing Technology for Humanity	**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	The second in a series of guides and best practices under the IEEE 1679 base standard that covers various emerging or alternative battery energy storage technologies used in Battery Energy Storage Systems (BESS) including safety issues. Each guide in this series follows a similar pattern to aid the user in a synergistic manner. The guide describes the range of technologies for sodium-beta batteries, including their construction, aging mechanisms, and failure modes. The guide also points 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 (IEEE SA allows a 10-year period before the standard must be renewed or revised)
Current Activity	None. See IEEE 1679.2-2018 for more information.

IEEE Advancing Technology for Humanity	**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	The third in a series of guides and best practices under the IEEE 1679 base standard that covers various emerging pr alternative battery energy storage technologies used in Battery Energy Storage Systems (BESS) including safety issues. Each guide in this series follows a similar pattern to aid the user in a synergistic manner. The guide describes the range of technologies for sodium-beta batteries, including their construction, aging mechanisms, failure modes, safety and life cycle costing. The guide also points 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.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers** **https://cmte.ieee.org/pes-essb/** **[ESS Components]**
Document Name	**IEEE P1679.4: Guide for the Characterization and Evaluation of Alkaline Batteries (excluding Ni-Cd) in Stationary Applications**
ESS Relevance	The fourth in a series of guides and best practices under the IEEE 1679 base standard that covers various emerging or alternative battery energy storage technologies used in Battery Energy Storage Systems (BESS) including safety issues. Each guide in this series follows a similar pattern to aid the user in a synergistic manner. The guide describes the range of technologies for alkaline batteries, including their construction, aging mechanisms, and failure modes. The guide also points to existing safety standards and existing regulatory requirements. This guide covers a variety of alkaline battery technologies, including nickel-zinc, zinc-air, nickel-metal hydride, nickel-iron, and zinc-manganese dioxide.
Date of Current Edition	New Standard
Date of Next Edition	TBD
Current Activity	The working group is actively developing this document. For more information or to participate in this working group, contact Dan Lambert.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers – https://cmte.ieee.org/pes-essb/ ESSB Committee [ESS Components]**
Document Name	**IEEE P2688: Recommended Practice for Energy Storage Management Systems (ESMS) in Energy Storage Applications**
ESS Relevance	Provides a reference for ESMS designers and integrators regarding the challenges in ESMS development and deployment, and best practices to address these challenges. This document assists in the selection between design options by supplying the pros and cons of a range of technical solutions. The purpose of the ESMS is to dispatch single and aggregated multiple ESSs and coordinate their operation together with other distributed energy resources (DERs) in grid applications.
Date of Current Edition	New standard
Date of Next Edition	TBD
Current Activity	The working group is actively developing this document. For more information or to participate in this working group, contact David Schoenwald.

IEEE Advancing Technology for Humanity	**Institute of Electrical and Electronics Engineers www.ieee.org [Reference Item]**
SDO/Committee/ Association Name	**IEEE PES Energy Storage and Stationary Battery Committee (ESSB)**
ESS Relevance	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.
Date of Next General Meeting	**June 14, 2021**
Current Activity	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. The ESSB Codes 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. A liaison has been formed with the DOE National Laboratories engaged in ESS efforts to proactively contribute to ESS standards development with these SDOs. 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 or Curtis Ashton.

	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	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 a potentially explosive atmosphere. Explosive atmospheres are identified and categorized by the National Electric Code® ANSI/NFPA 70.
Date of Current Edition	2013
Date of Next Edition	N/A
Current Activity	TBD

	International Society of Automation www.isa.org [Built Environment]
Document Name	**ANSI/ISA-TR12.13.01-1000 (R2013): Flammability Characteristics of Combustible Gases and Vapors**
ESS Relevance	This publication 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.
Date of Current Edition	1999
Date of Next Edition	N/A
Current Activity	TBD

	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	Established goal to revisit with Alliance members in 2021.

	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	This document specifies standardized communication between components within the ESS. This technical memo identifies tools that can be used to verify compliance with MESA-Device specification by using the SunSpec Modbus communications standard.
Date of Current Edition	July 2020 (Final Draft) Document No. 12032
Date of Next Edition	TBD
Current Activity	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.

	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	This Standard 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.
Date of Current Edition	2013
Date of Next Edition	TBD based on current activity
Current Activity	This Standard helped electrical contractors understand the emerging world of new energy storage applications when it was in its developing stages. This standard will need to be updated soon to keep up with changing technologies.

	National Electrical Contractors Association (NECA) www.necanet.org [ESS Installation]
Document Name	**NECA 417: Recommended Practice for Designing, Installing, Maintaining, and Operating Micro-grids**
ESS Relevance	This document 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.
Date of Current Edition	2019
Date of Next Edition	TBD
Current Activity	For more information see the 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	This Standard identifies general information and technical specifications relevant in describing an ESS. It also defines a set of test, measurement, and evaluation criteria which expresses the performance of electrical ESSs intended for energy-intensive and/or power-intensive stationary applications. There are eight ESS applications covered in this Standard including 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	This standard 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	This is currently adopted in 19 states and is 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	The NFPA 1 Committee is being divided into four separate groups (committees or subcommittees): [1] Building Systems and Special Occupancies (FCC-OCP) which met on April 27, May 7, and May 11, 2021; [2] Special Equipment, Processes and Hazardous Materials (FCC-HAZ) which met April 28, May 6, and May 13, 2021; [3] Fundamentals (FCC-FUN) which met on April 29, May 10, and May 12, 2021; [4] The Fire Code Committee (FCC-AAC) is open to membership application, but membership in this group is somewhat restricted as it serves as an overall committee for NFPA 1. The Public Input period closed April 1, 2021, for the 2024 edition. The First Draft Report will be published by 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. For more information, see NFPA 1: Fire Code.

	National Fire Protection Association (NFPA) www.nfpa.org [Built Environment]
Document Name	**NFPA 70: National Electrical Code (NEC)**
ESS Relevance	This standard is adopted in all 50 states and 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 (CMP's). CMP 4 covers requirements for articles 690 for PV and 705 for Interconnections. CMP 13 covers requirements for articles 480 for batteries, and article 706 for ESS. This is a major standard for NFPA and is used as the North American standard for all electrical installation requirements.
Date of Current Edition	2020
Date of Next Edition	2023
Current Activity	First draft public inputs closed on September 10, 2020. **The First Draft Report is due to be posted no later than July 2, 2021, with public comments accepted until August 19, 2021**. 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. For more information, see NFPA 70: National Electrical Code.

	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	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, the 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.
Date of Current Edition	2020
Date of Next Edition	2024
Current Activity	**Public Inputs for the next edition can now be submitted online until 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.

	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	This standard is sometimes considered as 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 in essence digitally run facilities, the 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 are being 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	This code addresses those construction, protection and occupancy features necessary to minimize danger to life and property.
Date of Current Edition	2021
Date of Next Edition	2024
Current Activity	**Public inputs are being accepted for the 2024 edition until June 1, 2021**. The First Draft Report posting date is March 22, 2022. This will allow public comments to be submitted 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, 2923 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. As such if an ESS were unlabeled, NFPA 791 could be used to evaluate the acceptability of an ESS. However, it should be noted that 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	**Public inputs are being accepted for the 2024 edition until June 1, 2021**. The First Draft Report will be posted March 22, 2022. 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	This new standard covers the minimum criteria to aid in organizing and conducting electrical inspections, including administrations, 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	**Public Inputs are being accepted for the 2024 edition until June 1, 2021**. The first draft posting date is March 22, 2022. Second drafting public comments will begin after March 22, 2022 and may be submitted until May 31, 2022. The Second Draft Report will follow on February 28, 2023. NITMAMs may be submitted until March 28, 292,3 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	This standard stipulates requirements to ensure the safety of energy storage systems including new and emerging technologies. 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.
Date of Current Edition	2020
Date of Next Edition	2023
Current Activity	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 First Draft Report was posted May 12, 2021. **Public Comments will be accepted until July 27, 2021**. **A Proposed Tentative Interim Amendment (TIA) for explosion control has been issued to include cabinets. Soliciting public comments for TIA No. 1585, Reference: 4.12, A.4.12 and A.4.12.1, comment closing date: July 12, 2021.** Second Draft Report and NITMAM dates have not yet been posted. For more information see NFPA 855: Standard for the Installation of Stationary Energy Storage Systems.

	National Fire Protection Association (NFPA) www.nfpa.org [Reference Item]
SDO/Committee/ Association Name	**National Fire Protection Association (NFPA)**
ESS Relevance	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).
Date of Next Meeting	The NFPA General Conference and Expo, normally held in June of each year, has been replaced with a series of virtual educational programs that will be offered throughout the year. The Technical Meeting will be a virtual event as well. For more information and a listing of key dates, go to https://www.nfpa.org/technical-meeting.
Current Activity	Various NFPA Committees are in different stages of standards development as shown above. The 2021 General Meeting, including the Technical Meeting Session, will be conducted virtually. For more information, visit the NFPA Conference & Expo page.

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 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 an energy storage system
Date of Current Edition	February 2020
Date of Next Edition	TBD – UL standards are under continuous maintenance and are updated as warranted.
Current Activity	The 2nd Edition of ANSI/CAN/UL 9540 was published February 27, 2020 and 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. The intent is to integrate UL 1973 system level test requirements that satisfy the actual risks associated with these two battery types (See also UL 9540A).

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 (BESS)**
ESS Relevance	Named a “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 can be used to determine the fire and explosion protection required for an installation of a battery energy storage system.
Date of Current Edition	November 2019
Date of Next Edition	TBD – UL standards are under continuous maintenance and are updated as warranted
Current Activity	The 4th Edition of ANSI/CAN/UL 9540A was published November 12, 2019, and 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 in the future. Visit the UL Available Proposals page to view future proposal activity (when active) for UL 9540A. A new CRD has been 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.

Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	**UL 62133-2: 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	UL 62133-2 is a 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. **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.
Date of Current Edition	January 10, 2020 (First edition)
Date of Next Edition	TBD
Current Activity	See Standard 62133-2, Edition 1 for more information on the published standard.

Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	**ANSI/UL 810A: Electrochemical Capacitors**
ESS Relevance	Addresses the safety of electrochemical capacitors, which can be used as an energy source in energy storage systems.
Date of Current Edition	The first edition of the standard was reaffirmed via a CSDS bulletin on February 3, 2017 and approved by ANSI on March 28. 2017.
Date of Next Edition	TBD (UL standards are under continual maintenance and are updated as warranted.)
Current Activity	N/A

Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	**UL 1642: Lithium Batteries**
ESS Relevance	This standard cover lithium batteries intended for use in technician-replaceable or use-replaceable applications. Purpose is to reduce the risk of fire or explosion when Lithium batteries are used in a product. The standard imposes limits as to the amount of lithium contained in a battery that is covered by this standard without additional testing requirements.
Date of Current Edition	September 2020 (Edition 6)
Date of Next Edition	TBD (UL standards are under continual 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	This standard covers requirements for inverters, converters, charge controller and interconnection system equipment (ISE) intended for use in both off-grid and grid-connected environments. Recent (2018) revision adds information that clarifies intention to supplement IEEE 1547 and IEEE 1547.1.
Date of Current Edition	October 28, 2020 (Edition 2)
Date of Next Edition	TBD (UL standards are under continual maintenance and are updated as warranted.)
Current Activity	Revisions contained in the second edition address rapid shutdown to better align UL 1741 with the Standard for Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for Construction, UL 61730-1. A Preliminary Review Proposal was issued in November 2019 detailing new requirements for Grid Support Utility Interactive Interoperability Optional Functions: Prevent Enter Service and Limit Active Power (CA Rule 21, Phase 3, functions 2 and 3). Comments were received and are being considered.

Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	**ANSI/CAN/UL 1973: Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications**
ESS Relevance	This standard 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. Two appendixes are specific to newer emerging technologies: 1) Appendix B – sodium-beta type batteries, and 2) Appendix C to flowing electrolyte batteries. A CRD is now being balloted to create an Appendix H that accommodates lead-acid and nickel-cadmium batteries at both the component and ESS system levels.
Date of Current Edition	2018 (Edition 2)
Date of Next Edition	TBD (UL standards are under continual maintenance and are updated as warranted.)
Current Activity	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 preliminary review document that is being considered by the STP and standard subscribers. See the UL Proposals page for future preliminary review proposal activity for UL 1973.

Underwriters Laboratories Inc.®	Underwriters Laboratories (UL) https://ulstandards.ul.com/develop-standards/ [ESS Components]
Document Name	**ANSI/CAN/UL 1974: Evaluation for Repurposing Batteries**
ESS Relevance	This standard 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 are intended for a repurposed use application, such as for use in stationary energy storage systems and other applications. The requirement is essentially to determine their state of health for continued viability and the rating mechanisms the repurposing manufacturer may use for those that are determined suitable for continued use in these applications.
Date of Current Edition	2018
Date of Next Edition	TBD (UL standards are under continual maintenance and are updated as warranted.)
Current Activity	See Standard 1974, Edition 1 for more information.

Underwriters Laboratories Inc.®	**Underwriters Laboratories (UL)** **https://ulstandards.ul.com/develop-standards/** **[ESS Components]**
Document Name	**UL 2580: Batteries for Use in Electric Vehicles**
ESS Relevance	This standard covers electrical energy storage assemblies such as battery packs and combination battery pack-electrochemical capacitor assemblies and the subassembly/modules that make up these assemblies for use in electric-powered vehicles. The requirements evaluate the electrical energy storage assembly's ability to safely withstand simulated abuse conditions and prevents any exposure of persons to hazards as a result of the abuse. This standard evaluates the electric energy storage assembly and modules based upon the manufacturer's specified charge and discharge parameters at specified temperatures. UL 1974 references UL 2580 for battery construction and cell safety requirements.
Date of Current Edition	**2020 (3rd edition)**
Date of Next Edition	TBD (UL standards are under continual maintenance and are updated as warranted.)
Current Activity	This standard is a Joint Binational Standard with ULC. See Standard 2580, Edition 3 for information on the proposal out for ballot and comment.

Underwriters Laboratories Inc.®	**Underwriters Laboratories (UL)** **https://ulstandards.ul.com/develop-standards/** **[Reference Item]**
SDO/Committee/ Association Name	**United Underwriters Laboratories is a non-profit affiliate of UL, Inc.**
ESS Relevance	Responsible for 10 of the ESS related standards listed in this report. UL 9540 and UL 9540A become the bedrock testing standards for all BESS and ESS related safety assurances for batteries and emerging technologies installed in systems.
Date of Next Meeting	United Underwriter Laboratories does not conduct a general meeting, nor does it hold regular meetings with the various standards development efforts. Instead, they employ Standards Technical Panels (STPs) to act as de facto Working Groups to review inputs from comments received when standards could stand revision or updating. As pointed out in the UL standards listed above, 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.ashreae.org
ASME		2			1	3	www.asme.org
CSA			1	2		3	www.csagroup.org
DNV-GL		1			1	2	www.dnvgl.com
FM Global		1			2	3	www.fmglobal.com
ICC	3				2	5	www.iccsafe.org
IEEE	4	1	4	6	1	16	www.ieee.org
ISA	2					2	www.isa.org
MESA		2				2	www.mesastandards.org
NECA		1	1			2	https://necanet.org/
NEMA		1		1		2	www.nema.org
NFPA	2	1	2		1	6	www.nfpa.org
SANDIA					1	1	www.sandia.gov
UL		2		7	1	10	https://ulstandards.ul.com/
	11	**12**	**9**	**16**	**10**	**58**	
	19%	**21%**	**15%**	**28%**	**17%**	**100%**	

Every effort is made by the Pacific Northwest National Laboratory (PNNL) and Sandia National Laboratories (SNL) staff to ensure the accuracy of the information presented in this report. SNL 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.

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Sandia National Laboratories

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