



Highlights

The second draft report on NFPA 855 has been posted and has an April 29, 2019 closing date to submit a NITMAM.

The first draft report on NFPA 791 has been posted and has a May 8, 2019 public comment closing date.

The first draft report on NFPA 1 has been posted and has a June 5, 2019 public comment closing date

Ballots and comments on UL 2580, Batteries for Use in Electric Vehicles, are due April 9, 2019.

Proposed changes to the ICC Group B Codes were published on March 4, 2019 and will be the subject of open public hearings on April 28 to May 8, 2019 in Albuquerque, NM

The proposed 2nd edition of UL 9540 was released for preliminary review starting March 29, 2019 with comments due April 22, 2019.

The proposed ANSI/CAN/UL 9540A was released for STP ballot and comment and public review starting March 29, 2019 with STP ballots and comments due May 28, 2019

CODES AND STANDARDS UPDATE MARCH 2019

The goal of the DOE OE Energy Storage System Safety Roadmap¹ 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: research, codes and standards (C/S) and communication/coordination. The objective focused on C/S is *“To apply research and development to support efforts that refocused on ensuring that codes and standards are available to enable the safe implementation of energy storage systems in a comprehensive, non-discriminatory and science-based manner.”*

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

- Review and assess C/S which affect the design, installation, and operation of energy storage systems (ESS).
- Identify gaps in knowledge that require research and analysis that can serve as a basis for criteria in those C/S.
- Identify areas in C/S that are potentially in need of revision or enhancement and can benefit from activities conducted under research and development.
- 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 the above activities by providing information on efforts being conducted by U.S. standards developing organizations (SDOs) and other entities that are focused on ESS safety.

The information is organized relative to the scope of each document in relation to ESS from the “macro to the micro” (e.g., from overarching covering considerable scope, to installation specific, to ESS and then ESS components). Note that more macro documents are also likely to adopt by reference more micro documents.

Changes in current activity from the prior edition are shown in bold italics. Time-sensitive items (e.g., those having a schedule/due date) are highlighted in yellow.

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

¹ DOE OE Energy Storage Systems Safety Roadmap, PNNL-SA-126115 | SAND2017-5140 R https://www.sandia.gov/ess-ssl/publications/EnergyStorage_safetyroadmap_2017.pdf

OVERARCHING CODES AND STANDARDS

	DNV GL – www.dnvgl.com/rules-standards/
Document:	DNVGL-RP-0043, Safety, Operation, and Performance of Grid-Connected Energy Storage Systems (GRIDSTOR)
ESS relevance:	The objective of GRIDSTOR is to provide a comprehensive set of recommendations for grid-connected energy storage systems. It aims to be valid in all major markets and geographic regions, for all applications, on all levels from component to system, covering the entire life cycle. End users, operators, and other stakeholders can find specific guidance in the document and references to other relevant standards, codes, and guidelines.
Current activity:	Supporting the second edition of GRIDSTOR released in September 2017. See https://www.dnvgl.com/services/gridstor-recommended-practice-for-grid-connected-energy-storage-52177 for more information.
Date of next edition:	TBD

	International Code Council (ICC) – www.iccsafe.org https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/
Document:	2018 International Fire Code (IFC)
ESS relevance:	Chapter 12 of the IFC covers energy systems and Section 1206 in that chapter covers electrical energy storage systems.
Current activity:	<i>The final action on all code change proposals has been posted (See https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/ for more information).</i> The final actions did NOT change the outcome of any of the proposed changes to the IFC as reported in the November 2018 Special Brief covering the results of the public comment hearings on proposed code changes to the IFC related to ESS safety. See https://www.sandia.gov/energystoragesafety-ssl/wp-content/uploads/2018/11/ICC-2018-ESS-code-changes-11-2018-002.pdf
Date of next edition:	2021
Document:	2018 International Residential Code (IRC)
ESS relevance:	<i>A section of the IRC covers energy storage systems.</i>
Current activity:	<i>See current activity below under IRC covering the energy and building related portions of the IRC.</i>
Date of next edition:	2021
Document:	2018 International Building Code (IBC) (except structural)
ESS relevance:	Provides a basis for adoption and application of other standards and ICC model codes.
Current activity:	<i>See current activity above under the IFC. The final actions DID change the outcome of one of the proposed changes to the IBC (G91-18 was disapproved)</i> reported in the November 2018 Special Brief covering the results of the public comment hearings on proposed code changes to the IBC related to ESS safety. See https://www.sandia.gov/energystoragesafety-ssl/wp-content/uploads/2018/11/ICC-2018-ESS-code-changes-11-2018-002.pdf
Date of next edition:	2021

	International Code Council (ICC) – www.iccsafe.org https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/
Document:	2018 International Mechanical Code (IMC)
ESS relevance:	Includes basic requirements for stationary fuel cell power systems and criteria for ventilation and exhaust of spaces.
Current activity:	See current activity above under the IFC.
Date of next edition:	2021
Documents:	2018 International Building Code (structural provisions), International Existing Buildings Code, International Energy Conservation Code, International Residential Code (energy and building related provisions) and International Green Construction Code
ESS relevance:	<i>Some of the provisions in these codes are relevant to ESS. Those in the IECC and IgCC address the ‘value’ of ESS. Those in the IRC also address the installation of ESS.</i>
Current activity:	<i>Proposed changes to these codes were published March 4, 2019 and are available at https://www.iccsafe.org/codes-tech-support/codes/code-development-process/2019-group-b/. A review of the code change monograph finds that changes ADM (administrative) 21, 22, 32 and 39 have potential relevance to ESS and ADM 47 includes updated references to UL 1973 and 9540 (2018 and 2016 editions respectively). Some code changes to the IECC are related to ESS as are six changes to the IRC (RE 153 to 158). A special briefing report covering ESS related changes to these codes is available at https://www.sandia.gov/energystoragesafety-ssl/publications/. The Committee Action Hearings for these codes will occur April 28 to May 8, 2019 in Albuquerque, NM. See http://media.iccsafe.org/2019_CAH/index.html for more information.</i>
Date of next edition:	2021

	IEEE – www.ieee.org http://standards.ieee.org/about/nesc/
Document:	IEEE C2-17, National Electric Safety Code (NESC)
ESS relevance:	Covers electrical safety for utility systems and equipment.
Current activity:	NESC Sub-Committees held meetings to consider all change proposals submitted by the July 16, 2018 deadline 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. <i>A preprint of change proposals, which is based on recommendations of the relevant sub-committee, is scheduled for release July 1, 2019. All proposals are available for public comment with comments due March 1, 2020.</i> See http://standards.ieee.org/about/nesc/ and https://standards.ieee.org/products-services/nesc/process.html for more information.
Date of next edition:	2022

 <p>Advancing Technology for Humanity</p>	<p>IEEE – www.ieee.org http://standards.ieee.org/about/nesc/</p>
Activity:	IEEE PES Energy Storage and Stationary Battery Committee (ESSB)
ESS relevance:	This is a growing subcommittee of the power and energy society (PES) that manages many of the standards related to energy storage and battery technologies. http://sites.ieee.org/pes-essb/
Current activity:	<p>An ESSB task force on codes and standards is organizing their future efforts associated with development of IEEE standards related to energy storage systems and batteries as well as laying out their involvement in the development of codes and standards by other organizations that are related to energy storage systems and batteries. The next ESSB meeting will be in Santa Fe NM June 24 to 28, 2019.</p> <p>As of March 2019, the Energy Storage Task Force has been renamed the Energy Storage Collaboration Team (ESCT), and will continue working under the oversight of the ESSB. The ESCT will continue to coordinate standards development for energy storage systems that encompass DC through AC scope.</p> <p>IEEE P1547.9 Guide for ES Interconnection had its kick-off working group (WG) meeting on February 28, 2019 at NERC in Atlanta. The next P1547.9 WG meeting will be held June 5-6, at Xcel Energy in Minneapolis.</p>

 <p>NFPA®</p>	<p>National Fire Protection Association (NFPA) – www.nfpa.org</p>
Document:	NFPA 1-18, Fire Code
ESS relevance:	Chapter 52 (new in the 2018 edition) includes requirements related to the installation of energy storage systems. Requirements recognize both established battery technologies and new energy storage technologies. Provisions apply to new and existing energy storage system applications.
Current activity:	The first draft meeting to act on public inputs was held September 18 and 19, 2018 and an extract review meeting was held November 15, 2018 at which time a task force was formed to review NFPA 855 for inclusion by reference in NFPA 1. The first draft report has been posted and has a June 5, 2019 public comment closing date. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1&tab=nextedition for more information.
Date of next edition:	2021
Document:	NFPA 70-17, National Electrical Code (NEC)
ESS relevance:	Article 706 (new in the 2017 edition) applies to energy storage systems and Article 480 remains applicable to batteries, in addition to other criteria in the NEC relevant to electrical equipment and installations.
Current activity:	The Second Draft Report is scheduled to be posted April 5, 2019 and the closing date for NITMAMs (notice of intent to make an amendment) is April 26, 2019. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70&tab=nextedition https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70&tab=nextedition for more information.
Date of next edition:	2020
Document:	NFPA 5000-18, Building Code
ESS relevance:	Provides a basis for adoption and application of other standards.
Current activity:	The first draft report has been posted and has a public comment closing date of May 8, 2019. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=5000&tab=nextedition for more information.
Date of next edition:	2021

CODES AND STANDARDS FOR ESS INSTALLATIONS

	FM Global – http://www.fmglobal.com (https://www.fmglobal.com/research-and-resources/fm-global-data-sheets)
Document:	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.
Current activity:	Work to update the data sheet via an interim revision will begin in 2019. Typically data sheets are developed internally at FM Global with support from FM Global field operations. See https://www.fmglobal.com/research-and-resources/fm-global-data-sheets for more information.
Date of next edition:	2019 (est.).

	IEEE – www.ieee.org
Document:	IEEE 1635-18/ASHRAE Guideline 21-18, Guide for Ventilation and Thermal Management of Batteries for Stationary Applications
ESS relevance:	Covers how stationary battery systems utilizing vented lead-acid (VLA), valve-regulated lead-acid (VRLA) and nickel-cadmium (NiCad) stationary battery applications can be provided with appropriate ventilation and thermal management.
Current activity:	The revisions to the 2012 edition have been completed and the 2018 edition of the document was published on July 31, 2018.
Date of next edition:	TBD
Document:	IEEE 1578-18, 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.
Current activity:	None. The standard was approved October 23, 2018 and is available at https://standards.ieee.org/standard/1578-2018.html
Date of next edition:	TBD

	National Electrical Contractors Association (NECA)—www.necanet.org
Document:	NECA 416-16, Recommended Practice for Installing Stored Energy Systems
ESS relevance:	National Electrical Installation Standards (NEISs) are designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services and are intended to be referenced in contract documents for electrical construction projects. NECA 416-16 describes installation practices for energy storage systems such as battery systems, flywheels, ultra-capacitors, and smart chargers used for electric vehicle (EV) vehicle-to-grid (V2G) applications.
Current activity:	Suggestions for revisions and improvements to this document are welcome and can be directed to NECA at www.neca-neis.org

	National Electrical Contractors Association (NECA)—www.necanet.org
Date of next edition:	TBD based on current activity.
Document:	NECA 417 (new standard), Recommended Practice for Designing, Installing, Maintaining, and Operating Micro-grids
ESS relevance:	The document is designed to improve communication among specifiers, purchasers, and suppliers of electrical construction services and is intended to be referenced in contract documents for electrical construction projects. NECA 417 will cover the design, installation, maintenance, and operation of microgrids.
Current activity:	The fourth ballot for NECA 417, which closed on January 28, 2019, did not receive the required minimum number of returned votes. A new ballot opened on February 15, 2019 and closed on March 17, 2019. This is expected to be the last ballot for this standard. See http://www.necanet.org/ballot/fifth-ballot-for-creation-of-neca-417-201x-recommended-practice-for-designing-installing-operating-and-maintaining-microgrids for more information.
Date of first edition:	<i>Anticipated on X date.</i>

	National Fire Protection Association (NFPA) – www.nfpa.org
Document:	NFPA 855, Standard for the Installation of Stationary Energy Storage Systems
ESS relevance:	The standard covers the safety of all energy storage systems and their installation in the built environment. Chapters of the standard cover equipment, protection and installation, limitations on energy storage system capacity as a function of technology and location and then provide additional criteria focused on specific energy storage system technologies.
Current activity:	The ballot on the second revisions closed February 8, 2019 and the second draft was posted on February 18, 2019. The standard is now in the second stage of the development process (Comment stage). The closing date to submit a NITMAM is April 29, 2019. A NITMAM is an amending motion to change the resulting final standard from what the NFPA 855 committee submitted for consideration as the second draft. NITMAMs will be heard by the NFPA Membership at the NFPA Technical Meeting See https://submittals.nfpa.org/TerraViewWeb/ViewerPage.jsp?id=855-proposed.ditamap&pubStatus=SDR for more information.
Date of first edition:	2020
Document:	NFPA 1078 (new standard), Standard for Electrical Inspector Professional Qualifications
ESS relevance:	Addressed qualifications of those who would review and approve electrical plans and conduct electrical inspections. Such plan reviews and electrical inspections would include, but not be limited to, energy storage systems.
Current activity:	The first draft report was open for submission of public comments with a closing date of October 31, 2018. Five second revisions were approved. Three of the revisions to the draft address adding ‘equipment’ to clarify equipment is within the scope of a field inspection. One added a sample job description for an electrical inspector as a new Annex to the standard. One added a reference to NFPA 73, which covers electrical inspections for existing dwellings. A second draft meeting occurred March 15, 2019 via web/teleconference. The second draft report will be posted April 5, 2019 and the closing date to submit a NITMAM is April 26, 2019. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1078&tab=nextedition for more information.
Date of first edition:	2021



National Fire Protection Association (NFPA) – www.nfpa.org

Document:	NFPA 78 (new standard), Guide on Electrical Inspections (proposed edition).
ESS relevance:	This document covers the minimum criteria to aid in organizing and conducting electrical inspections, including plan review and field inspection. Such plan reviews and electrical inspections would include, but not be limited to, energy storage systems.
Current activity:	The first draft report was open for submission of public comments with a closing date of October 31, 2018. The second draft meeting occurred February 26-27, 2019 in Tampa, FL. The second draft report will be posted April 5, 2019 and the closing date to submit a NITMAM is April 26, 2019. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=78&tab=nextedition for more information.
Date of first edition:	2021

CODES AND STANDARDS FOR A COMPLETE ESS

 American Society of Mechanical Engineers (ASME) – www.asme.org	
Document:	TES-1 (new standard) Safety Standard for Thermal Energy Storage Systems
ESS relevance:	Provides safety-related criteria for molten salt thermal energy storage systems.
Current activity:	A revised TES-1 draft was submitted to the committee for a Review & Comment Ballot that closed on February 22, 2019. <i>A revised TES-1 draft was sent to the Committee for Review & Comment Ballot, which closed on February 22, 2019. Four committee members submitted comments, which were discussed during the TES Standards Committee teleconference meeting on March 21, 2019. As a result, the draft was further revised and has been issued for First Consideration Ballot to the committee members with a due date of April 22, 2019..</i>
Date of first edition:	TBD
Document:	TES-2 (new standard) 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.
Current activity:	A PINS has been filed with ANSI to develop a new standard. The TES Standards Committee is currently seeking participants with in-depth knowledge of phase change thermal energy storage systems who are interested in joining the committee. For more information or to join the Committee, contact Nicole Gomez at gomezn@asme.org .
Date of first edition:	TBD
Document:	PTC 53 (new standard) Performance Test Code for Mechanical and Thermal Energy Storage Systems
ESS relevance:	Provides test methods for conducting performance tests on mechanical and thermal energy storage systems intended for various energy storage applications.
Current activity:	Sections 1 to 3 of the standard have been published as a draft standard for trial use. See https://www.asme.org/products/codes-standards/ptc-53-2018-thermal-energy-storage-systems-draft for more information. The PTC 53 Committee is currently pursuing the approval process for the Sections 4 to 7 of the standard, which contains the instrumentation and uncertainty requirements for the performance test. The Committee welcomes participation by any interested in aiding in the development of the standard. Contact Donnie Alonzo (alonzod@asme.org) at ASME for more information.
Date of first edition:	It is anticipated that the publication of PTC 53 will be complete before the end of 2019.

 National Electrical Manufacturers Association – www.nema.org	
Document:	ESS-1-2019 Standard for Uniformly Measuring and Expressing the Performance of Electrical Energy Storage Systems
ESS relevance:	Provides safety-related criteria for electrical ESSs.
Current activity:	The standard was published in February 2019. See https://www.nema.org/Standards/Pages/Standard-for-Uniformly-Measuring-and-Expressing-the-Performance-of-Electrical-Energy-Storage-Systems.aspx for more information.
Date of next edition:	TBD

	National Fire Protection Association (NFPA) – www.nfpa.org
Document:	NFPA 791-2018, Recommended Practice and Procedures for Unlabeled Electrical Equipment
ESS relevance:	Could form a basis for assessing an energy storage system that is not labeled. Note that recommended practices are guides and are not documents that can be enforced by jurisdictions.
Current activity:	A number of changes were submitted during the prior public comment period to help ensure the standard could better address ESS. Many of those changes were approved and appear as one of 19 proposed changes to the standard shown in the first draft report, which was posted February 12, 2019. Public comments are being accepted with a closing date of May 8, 2019.
Date of next edition:	2021

	Underwriters Laboratories (UL) – https://ulstandards.ul.com/develop-standards/
Document:	ANSI/CAN/UL 9540, Energy Storage Systems and Equipment
ESS relevance:	Product safety standard for an energy storage system.
Current activity:	The first edition of the standard was issued November 21, 2016. The proposed 2nd edition of UL 9540 was released for preliminary review starting March 29, 2019 with comments due April 22, 2019. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information on the preliminary review proposal for UL 9540.
Date of next edition:	TBD – UL standards are under continuous maintenance and are updated as warranted
Document:	UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (BESSs)
ESS relevance:	This 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.
Current activity:	<p>A third edition of the standard was issued June 15, 2018. A Certification Requirement Decision (CRD) was published October 25, 2018 for UL 9540A to clarify current practice for the cell portion of the test method. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=34477 to purchase the standard and access the information with regards to the CRD.</p> <p>UL is proposing UL 9540A as a Joint National Standard for Canada and the United States, ANSI/CAN/UL 9540A. The proposed standard was released for STP ballot and comment and public review starting March 29, 2019 with STP ballots and all comments due May 28, 2019. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information on the proposal for UL 9540A.</p>
Date of next edition:	TBD – UL standards are under continuous maintenance and are updated as warranted

CODES AND STANDARDS FOR ESS COMPONENTS

	CSA GROUP (CSA) – www.csagroup.org
Document:	CSA C22.2 No. 107.1-2016, Power Conversion Equipment
ESS relevance:	Applies to alternating current (AC) and direct current (DC) type power conversion equipment, which can be associated with an energy storage system.
Current activity:	The standard is under continuous maintenance and updated as warranted. See https://webstore.ansi.org/Standards/CSA/CSAC221072016 for more information on the standard.
Date of next edition:	TBD
Document:	CSA C22.2 No. 340-20XX (new standard), Battery Management Systems
ESS relevance:	The standard covers the design, performance, and safety of battery management systems (electronic or electromechanical systems that control or regulate a battery or batteries, which may include external communication capabilities).
Current activity:	<p>A standard seed document is under development by a task force and is expected to be finalized by the end of April 2019 and will then be used as a starting point by the development committee to develop the first standard draft, which will be initiated in May/early June. CSA is still accepting members to join the working group. For more information and to join contact Mohsen Sepehr at mohsen.sepehr@csagroup.org.</p> <p>Note that IEEE is developing a guide on battery management systems (BMS), P2686-“Battery Management Systems in Energy Storage Applications”. The CSA standard will be a consensus safety standard and the IEEE document (a publically available specification or PAS) will be a non-normative guide that details more procedural aspects of implementing a BMS and the techniques to achieve best functionality of a BMS. The CSA Group and IEEE are aware of each other’s activities and have established liaisons to one another.</p>
Date of first edition:	TBD

	IEEE – www.ieee.org
Document:	IEEE 1679.1-17, Guide for the Characterization and Evaluation of Lithium-Based Batteries in Stationary Applications
ESS relevance:	Provides appropriate information about the safety attributes and operating conditions related to stationary applications of lithium-based batteries including recommendations for how to characterize lithium-ion battery performance and safety in stationary applications. Very general and nonprescriptive content with the caveat to “consult the manufactures recommendations” for specific devices or technologies. The guide points to existing standards (e.g., UL 1642) and existing regulatory requirements (e.g., adoption of NFPA 70) wherever possible. The 2017 edition was approved on December 6, 2017 and published on January 31, 2018.
Current activity:	An active working group is engaged in considering updates to the standard. See https://standards.ieee.org/standard/1679_1-2017.html for more information.
Date of next edition:	TBD

Document:	IEEE P1679.2-18, Guide for the Characterization and Evaluation of Sodium-Beta Batteries in Stationary Applications
ESS relevance:	Provides the same information and content as described above for lithium-based batteries but for sodium-beta batteries instead.
Current activity:	<i>None. See https://standards.ieee.org/standard/1679_2-2018.html for more information concerning the 2018 edition that was published on December 21, 2018.</i>
Date of first edition:	2018
Document:	IEEE P1679.3 (new standard), Guide for the Characterization and Evaluation of Flow Batteries in Stationary Applications
ESS relevance:	Provides the same information and content as described above for Lithium-based batteries but for flow batteries instead.
Current activity:	<i>The working group had a meeting during the IEEE ESSB 2019 Winter General Meeting in Phoenix AZ, February 4-8. Contact the working group chair to get involved: Vilayanur (“Vish”) Viswanathan, vilayanur.viswanathan@pnnl.gov</i>
Date of first edition:	TBD
Document:	IEEE P2686 (new standard) Recommended Practice for Battery Management Systems in Energy Storage Applications
ESS relevance:	<p>This recommended practice includes information on the design, installation, and configuration of battery management systems in stationary applications, including both grid-interactive, standalone cycling and standby modes. This document covers battery management hardware, software, and configuration. Hardware capabilities in large systems include: grounding and isolation; passive and active balancing; and wired or wireless sensors. Software capabilities include: algorithms for optimal operation with reduced risk; best practices for verification and validation; alarms; and communication with external systems. Common settings are discussed along with setting selection methods. Battery types that this document covers include lithium-ion, sodium-beta, advanced lead-acid, and flow batteries. General factors for other types are provided.</p> <p>Note that the CSA is developing a document on battery management systems (CSA C22.2 No. 340). The IEEE recommended practice will focus on non-normative design options and best-practices rather than safety requirements. The CSA Group and IEEE are aware of each other’s activities and have established liaisons to one another.</p>
Current activity:	The kickoff meeting for the newly approved working group was held at the IEEE ESSB 2019 Winter General Meeting in Phoenix AZ, February 4-8, 2019. The working group formed four study groups to collect information and references that will be used in the initial draft: BMS requirements, failure mode analysis, modelling, and architecture. Each study group will present their findings at the IEEE ESSB summer meeting, June 24 th -28 th in Santa Fe, NM (http://sites.ieee.org/pes-essb/event/essb-2019-meeting-sante-fe-nm/). Contact the working group chair David Rosewater, dmrose@sandia.gov to get involved.
Date of first edition:	TBD
Document:	IEEE P1547.9 (new standard) Guide to Using IEEE Standard 1547 for Interconnection of Energy Storage Distributed Energy Resources with Electric Power Systems
ESS relevance:	Addresses how to interconnect ESS (and other distributed energy resources) to power systems. It will also consider ESS-related topics not addressed or fully covered in IEEE 1547 such as guidance on when ESS are or are not within the scope of IEEE 1547.
Current activity:	The first meeting of the working group developing this standard occurred February 28, 2019 in Atlanta in conjunction with the IEEE 1547 meetings. See http://www.cvent.com/events/ieee-p1547-1-p1547-2-p1547-9-meetings-february-2019/event-summary-d925c96b49a741e59786afa4db221d76.aspx for more information.
Date of first edition:	TBD



Underwriters Laboratories (UL) – <https://ulstandards.ul.com/develop-standards/>

Document:	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.
Current activity:	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 continuous maintenance and are updated as warranted.
Document:	UL 1642, Lithium Batteries
ESS relevance:	Lithium cell/battery requirements for battery systems that would be employed in energy storage systems.
Current activity:	The fifth edition of the standard was published March 13, 2012 and revised in 2013 and 2015. SEE New test requirements for soft-case pouch cells for a Narrow Bar Crush Test or Dent Test instead of the Impact Test were sent out August 24, 2018 for preliminary review with comments due September 28, 2018. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=34818 for more information on the proposal dated August 24, 2018. Comments were received during preliminary review and are being considered before proceeding to ballot.
Date of next edition:	TBD - UL standards are under continuous maintenance and are updated as warranted.
Document:	UL 1741, Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
ESS relevance:	Applies to the subject technology when used in conjunction with an energy storage system.
Current activity:	<p><i>The Second Edition of UL 1741 has been published with an edition date of March 8, 2018. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=20941 for more information.</i></p> <p><i>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.</i></p> <p><i>A Bulletin was issued March 14, 2019 announcing a preliminary review of the addition of requirements covering power control systems to the standard. The review closed March 28, 2019. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information.</i></p>
Date of next edition:	TBD - UL standards are under continuous maintenance and are updated as warranted.
Document:	ANSI/CAN/UL 1973, Standard for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications
ESS relevance:	Battery systems that would be employed in energy storage systems
Current activity:	The second edition of the standard was issued February 7, 2018. A Call for Proposals for UL 1973 was sent out to STP members and standard subscribers with any new proposals due by October 15, 2018. Numerous proposals were received. These proposals are being included in a preliminary review document that will be sent out for comment only to the STP and standard subscribers in the future.
Date of next edition:	TBD – UL standards are under continuous maintenance and are updated as warranted.

	Underwriters Laboratories (UL) – https://ulstandards.ul.com/develop-standards/
Document:	ANSI/CAN/UL 1974-18, Evaluation for Repurposing Batteries
ESS relevance:	<p>This standard covers the sorting and grading process of battery packs, modules and cells, and electrochemical capacitors that were originally configured and used for other purposes, such as electric vehicle (EV) propulsion, and that are intended for a repurposed use application, such as for use in stationary energy storage systems and other applications. The process of sorting and grading these devices is essentially determining their state of health and other parameters to identify continued viability and the rating mechanisms the repurposing manufacturer may use for those that are determined suitable for continued use. This standard also covers application specific requirements for battery packs utilizing repurposed batteries and components.</p>
Current activity:	<p>The first edition of the Joint National Standard for Canada and the United States, ANSI/CAN/UL 1974 was published October 25, 2018. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=35079 for more information on the published standard.</p>
Date of next edition:	<p>TBD – UL standards are under continuous maintenance and are updated as warranted.</p>
Document:	UL 2580, Batteries for Use in Electric Vehicles
ESS relevance:	<p>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.</p>
Current activity:	<p><i>This standard is a Joint Binational Standard with ULC. Proposed revisions were released for ballot and comment on February 8, 2019, with ballots and comments due April 9, 2019. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=35420 for more information on the proposal out for ballot and comment.</i></p>
Date of next edition:	<p>TBD – UL standards are under continuous maintenance and are updated as warranted.</p>
Document:	UL CSDS Proposal 62133-1, 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 1: Nickel Systems
ESS relevance:	<p>Subject 62133-1 is an IEC based standard that specifies requirements and tests for the safe operation of portable sealed secondary nickel cells and batteries containing alkaline electrolyte for Canada and the US.</p>
Current activity:	<p>The proposed first edition of UL 62133-1 was sent out for preliminary review on January 11, 2019 with comments due February 26, 2019. This proposed standard is binational standard with CSA Group and harmonized with the first edition of IEC 62133-1. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=35323 for more information.</p>
Date of publication:	<p>TBD</p>

	Underwriters Laboratories (UL) – https://ulstandards.ul.com/develop-standards/
Document:	UL CSDS Proposal 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:	Subject 62133-2 is an 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 Canada and the U.S..
Current activity:	The proposed first edition of UL 62133-2 was sent out for preliminary review on January 11, 2019 with comments due February 26, 2019. This proposed standard is binational standard with CSA Group and harmonized with the first edition of IEC 62133-2. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=35324 for more information.
Date of publication:	TBD

Every effort is made by the Pacific Northwest National Laboratory (PNNL) and Sandia¹ staff to ensure the accuracy of the information presented in this report. PNNL and Sandia very much appreciate the input from staff of the standards developing organizations (SDOs) covered in the report as well as volunteers who are involved in one or more of the SDO initiatives covered in this document. Suggestions for revision, additions, and enhancements to this document are welcome and encouraged.

We at PNNL and Sandia, on behalf of the U.S. Department of Energy, Office of Energy, Energy Storage System Program whose support has made this report possible, want this document to be “the” source of information about codes and standards related to ESS safety. With your help we can make that happen and as outlined on page one achieve the codes and standards related objective in the ESS Safety Roadmap and the goal of fostering confidence in the safety and reliability of ESSs. For more information about the ESS Safety Roadmap efforts visit <http://www.sandia.gov/ess/>. For questions related to or to provide input on this document, please contact david.conover@pnnl.gov.

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