



Highlights

SAND2018-11255R

Public comment hearings will occur October 24 to 29, 2018 in Richmond, VA on proposed changes to the IFC and IRC. See <https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/> for more information.

The first draft reports for NFPA 1078 and NFPA have been posted and are open for submission of public comments with a closing date of October 31, 2018.

A draft of CSA C22.2 No. 340-201, Battery Management Systems, is being developed. Contact Ryan Franks (see CSA update below) about participation.

The second draft meeting of NFPA 70 will occur on October 22 to November 3, 2018. See <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=70&tab=nextedition> for more information.

A Call for Proposals for UL 1973 has been sent out to STP members and standard subscribers with any new proposals due by October 15, 2018. Also the UL 1974 recirculation work area opened August 17, 2018, proposing additional revisions, with comments and STP ballots due October 8, 2018

CODES AND STANDARDS UPDATE SEPTEMBER 2018

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:

- a. Review and assess C/S which affect the design, installation, and operation of energy storage systems (ESS).
- b. Identify gaps in knowledge that require research and analysis that can serve as a basis for criteria in those C/S.
- c. Identify areas in C/S that are potentially in need of revision or enhancement and can benefit from activities conducted under research and development.
- d. 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 document 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 and energy storage systems from the “macro to the micro” (e.g., from overarching covering considerable scope, to installation specific, to ES systems and then ES system components). Note also that more macro documents are 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 ES Safety Collaborative 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
Document:	HEATSTOR Joint Industry Project (JIP)
ESS relevance:	The focus of HEATSTOR is on safety, operation, and performance aspects of heat storage systems. The objective of this document is to accelerate implementation of heat storage systems through creation of a globally recognized recommended practice for system safety, operation and performance.
Current activity:	An invitation is out to join the consortium that will develop HEATSTOR. For more information see https://www.dnvgl.com/article/heatstor-joint-industry-project-86759 .
Date of publication:	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:	The public comment agenda was posted August 31, 2018 at https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/ . The public comment hearings following that public comment agenda will occur October 24 to 29, 2018 in Richmond, Virginia. See https://www.sandia.gov/energystoragesafety-ssl/publications/ for a brief covering the public comments related to ESS.
Date of next edition:	2021
Document:	2018 International Residential Code (IRC)
ESS relevance:	A section of the IRC covers energy storage systems.
Current activity:	See current activity under the IFC above relative to the posting of the public comment agenda and public comment hearings.
Date of next edition:	2021
Document:	2018 International Building Code (IBC)
ESS relevance:	Provides a basis for adoption and application of other standards and ICC model codes.
Current activity:	See current activity under the IFC above relative to the posting of the public comment agenda and public comment hearings.
Date of next edition:	2021

	<p>International Code Council (ICC) – www.iccsafe.org https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/</p>
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 under the IFC above relative to the posting of the public comment agenda and public comment hearings.
Date of next edition:	2021

	<p>IEEE – www.ieee.org http://standards.ieee.org/about/nesc/</p>
Document:	IEEE C2-17, National Electric Safety Code (NESC)
ESS relevance:	Covers electrical safety for utility systems and equipment.
Current activity:	The final date to receive change proposals from the public for revision of the 2017 edition leading to the 2022 edition was July 16, 2018. See http://standards.ieee.org/about/nesc/ and http://standards.ieee.org/about/nesc/nesc_2022_schedule.pdf for more information. NESC Sub-Committees will meet in September and October of 2018 to consider all change proposals and prepare recommendations.
Date of next edition:	2022.
Activity:	IEEE Energy Storage and Stationary Battery Committee (ESSB)
ESS relevance:	This is a growing subcommittee of the power and energy society that manages many of the standards related to energy storage and battery technologies. http://sites.ieee.org/pes-essb/
Current activity:	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.


	<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 public input closing date was June 27, 2018. Six public comments were submitted to Chapter 52 on energy storage systems, some of which are intended to align Chapter 52 with NFPA 855. The first draft meeting to act on public inputs was held September 18 and 19, 2018. The first draft report is scheduled to be posted on March 27, 2019 and will have 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 and to view the public comments and first draft committee information.
Date of next edition:	2021





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

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 first draft report has been posted and had a second draft public comment closing date of August 30, 2018. A compilation of the public comments is being prepared in advance of a second draft meeting on October 22 to November 3, 2018. See 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:	Public comment was due June 27, 2018. The first draft meeting is scheduled for December 5, 2018, and the first draft report is scheduled to be posted on February 27, 2019.
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 is planned for Fall 2018.
Date of next edition:	Publication of an interim revision is expected in 2019.

	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 (flooded) lead-acid, valve-regulated lead-acid (VRLA) and nickel-cadmium (NiCd) batteries can be provided with appropriate ventilation and thermal management.
Current activity:	<i>The revisions to the 2012 edition have been completed and the 2018 edition of the document has been published.</i>
Date of next edition:	TBD
Document:	IEEE P1578 (new standard), Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management
ESS relevance:	Covers how electrolyte spills can be contained and managed. Covered are vented lead-acid, valve regulated lead-acid, vented nickel-cadmium and partially recombinant Ni-Cd batteries.
Current activity:	<i>The draft standard is available at https://standards.ieee.org/develop/project/1578.html.</i>
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 416-17 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
Date of next edition:	TBD based on current activity.



National Electrical Contractors Association (NECA)—www.necanet.org


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 are 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:	NECA staff compiled the comments received during the first public comment period for consideration by the drafting committee and have released a second circulation of the first ANSI canvass ballot for the standard that closed July 30, 2018. See http://www.necanet.org/ballot/neca-417-201x-recommended-practice-for-designing-installing-operating-and-maintaining-microgrids for more information.
Date of next edition:	<i>The goal is to complete NECA-417 in 2018.</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 first draft report was posted for public review and comment with a closing date of July 12, 2018 and NFPA received over 800 public comments. See http://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855&tab=nextedition for more information. Second draft meetings were held July 24 to 26, August 21 to 23, and September 10, 2018. The second draft report is scheduled to be posted November 1, 2018.
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 has been posted and is open for submission of public comments with a closing date of October 31, 2018. 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 next edition:	2021
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 is posted and is open for submission of public comments with a closing date of October 31, 2018. 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 next edition:	2021

CODES AND STANDARDS FOR A COMPLETE ESS

 <small>SETTING THE STANDARD</small>	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:	<i>The TES committee ballot closed on August 20, 2018 with the latest draft of TES-1 being approved. However, some comments were received which required further consideration. The committee met on September 13, 2018 and approved the changes to the draft. A revised draft has been recirculated for committee ballot which closes on October 1, 2018. If approved, the draft will then be made available for public comment.</i>
Date of next edition:	TBD


	National Electrical Manufacturers Association – www.nema.org
Document:	ESS-1-2018 Standard for Uniformly Measuring and Expressing the Performance of Electrical Energy Storage Systems
ESS relevance:	Provides safety-related criteria for electrical ESSs.
Current activity:	<i>The standard is going through the BSR-9 process for ANSI approval.</i>
Date of next edition:	<i>The standard should be published in early October 2018.</i>

	National Fire Protection Association (NFPA) – www.nfpa.org
Document:	<u>NFPA 791-2018, Recommended Practice and Procedures for Unlabeled Electrical Equipment</u>
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:	The deadline for public comment was June 27, 2018 and 34 public comments were received. The first draft report is scheduled to be posted on February 27, 2019. See https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=791&tab=nextedition for more information.
Date of next edition:	2021

Document:	<u>ANSI/CAN/UL 9540, Energy Storage Systems and Equipment</u>
ESS relevance:	Product safety standard for an energy storage system.
Current activity:	<i>UL is preparing a proposed 2nd edition of UL 9540 based on the proposal requests submitted. Once final input is received from the proposal submitters, the proposed second edition should be ready to be sent for preliminary review in October 2018. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information on the upcoming preliminary review proposal for UL 9540 once it is available in CSDS.</i>
Date of next edition:	TBD – UL standards are under continuous maintenance and are updated as warranted
Document:	<u>UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (BESSs)</u>
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. <i>There is a Certification Requirement Decision (CRD) that will be published in the near future for UL 9540A to clarify current practice for the cell portion of the test method. See https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=34477 for more information with regards to the CRD once available.</i></p> <p><i>UL will be proposing UL 9540A as a Joint National Standard for Canada and the United States, ANSI/CAN/UL 9540A. The draft standard should be ready to be sent for preliminary review in October 2018. See https://csds.ul.com/Home/ProposalsDefault.aspx for the upcoming preliminary review proposal for UL 9540A once it is available in CSDS.</i></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.
Date of next edition:	TBD
Document:	CSA C22.2 No. 340-201 (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:	A draft standard is being developed by a working group. To join the committee contact Ryan Franks at ryan.franks@csagroup.org .
Date of next 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. It provides recommendations for how to characterize lithium-ion battery performance and safety in stationary applications. The guide is very general and nonprescriptive, offering common challenges and solutions 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.
Current activity:	An active working group is engaged in considering updates to the standard.
Date of publication:	2017
Document:	IEEE P1679.2 (new standard), Guide for the Characterization and Evaluation of Sodium-Beta Batteries in Stationary Applications
ESS relevance:	Provides appropriate information about the safety attributes and operating conditions related to stationary applications of sodium-beta batteries. It provides recommendations for how to characterize sodium-beta battery performance and safety in stationary applications. The guide is very general and nonprescriptive, offering common challenges and solutions with the caveat to “consult the manufactures recommendations” for specific devices or technologies.
Current activity:	<i>A revised version of the standard was sent out for recirculation and closed August 8, 2018.</i>
Date of publication:	The unapproved draft is available from IEEE.



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

Document:	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.
Date of next edition:	TBD - UL standards are under continuous maintenance and are updated as warranted.
Document:	UL 1642, Lithium Batteries
ESS relevance:	<i>Lithium cell/battery requirements for battery systems that would be employed in energy storage systems.</i>
Current activity:	<i>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://csds.ul.com/Home/ProposalsDefault.aspx for more information on the proposal dated August 24, 2018.</i>
Date of next edition:	<i>TBD - UL standards are under continuous maintenance and are updated as warranted.</i>
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:	<i>Consensus was achieved in the UL 1741 proposal review work area dated June 18, 2018. This proposal is expanding requirements for AC modules and includes requirements for photovoltaic (PV) modules with integrated electronics. The Proposal Owner is working on responses to comments received and a recirculation work area will be opened in the future.</i> <i>A second UL 1741 proposal review work area was opened September 17, 2018, which is proposing changes to Section 13.1 of the standard related to disconnect device actuator options. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information on the proposal dated September 17, 2018.</i>
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. <i>A Call for Proposals for UL 1973 has been sent out to STP members and standard subscribers with any new proposals due by October 15, 2018. Fully developed proposals and rationales can be submitted to UL 1973 Ed. 2 via a Proposal Request through CSDS at https://csds.ul.com/Home/Default.aspx?UserGroup=1&Action=CreatePR&RefId=9 by Monday, October 15, 2018.</i>
Date of next edition:	TBD – UL standards are under continuous maintenance and are updated as warranted.



**Underwriters
Laboratories Inc.®**

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

Document:	UL 1974, Evaluation for Repurposing Batteries
ESS relevance:	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.
Current activity:	<i>This 1st edition is being proposed as a Joint National Standard for Canada and the United States, ANSI/CAN/UL 1974. Initial consensus was achieved for ANSI and additional affirmative ballots are still needed for consensus for the Canadian standard. Responses to comments have been posted in the UL 1974 proposal review work area dated March 30, 2018. The UL 1974 recirculation work area opened August 17, 2018, proposing additional revisions, with comments and STP ballots due October 10, 2018. See https://csds.ul.com/Home/ProposalsDefault.aspx for more information on the proposal dated August 17, 2018.</i>
Date of first edition:	TBD based on work to be done after the above mentioned review.

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. Note that a Sandia R&A number will be added to this document (PNNL-27997) when it is posted at the ES Safety Collaborative website <https://www.sandia.gov/energystoragesafety-ssl/>.

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

PNNL-27997



**Sandia
National
Laboratories**

Contact Information

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

David M. Rosewater
Energy Storage Systems Analyst & Researcher
Sandia National Laboratories
P.O. Box 5800 MS 1108
Albuquerque, NM 87185-1108
Phone: 505-844-3722
Email: dmrose@sandia.gov



**Pacific Northwest
NATIONAL LABORATORY**

Contact Information

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

David R. Conover
Energy Tech & Market Adoption
Pacific Northwest National Laboratory
P.O. Box 999, MSIN K6-05
Richland, WA 99352
Phone: 703-444-2175
Email: david.conover@pnnl.gov