

NFPA®

855

Standard for
the Installation of Stationary
Energy Storage Systems

2020



IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

NFPA® codes, standards, recommended practices, and guides (“NFPA Standards”), of which the document contained herein is one, are developed through a consensus standards development process approved by the American National Standards Institute. This process brings together volunteers representing varied viewpoints and interests to achieve consensus on fire and other safety issues. While the NFPA administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in NFPA Standards.

The NFPA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on NFPA Standards. The NFPA also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making NFPA Standards available, the NFPA is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is the NFPA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

The NFPA has no power, nor does it undertake, to police or enforce compliance with the contents of NFPA Standards. Nor does the NFPA list, certify, test, or inspect products, designs, or installations for compliance with this document. Any certification or other statement of compliance with the requirements of this document shall not be attributable to the NFPA and is solely the responsibility of the certifier or maker of the statement.



ALERT: THIS STANDARD HAS BEEN MODIFIED BY A TIA OR ERRATA

Users of NFPA codes, standards, recommended practices, and guides (“NFPA Standards”) should be aware that NFPA Standards may be amended from time to time through the issuance of a Tentative Interim Amendment (TIA) or corrected by Errata. An official NFPA Standard at any point in time consists of the current edition of the document together with any TIAs and Errata then in effect.

To determine whether an NFPA Standard has been amended through the issuance of TIAs or corrected by Errata, go to www.nfpa.org/docinfo to choose from the list of NFPA Standards or use the search feature to select the NFPA Standard number (e.g., NFPA 13). The document information page provides up-to-date document-specific information as well as postings of all existing TIAs and Errata. It also includes the option to register for an “Alert” feature to receive an automatic email notification when new updates and other information are posted regarding the document.

ADDITIONAL IMPORTANT NOTICES AND DISCLAIMERS CONCERNING NFPA® STANDARDS

Updating of NFPA Standards

Users of NFPA codes, standards, recommended practices, and guides (“NFPA Standards”) should be aware that these documents may be superseded at any time by the issuance of a new edition, may be amended with the issuance of Tentative Interim Amendments (TIAs), or be corrected by Errata. It is intended that through regular revisions and amendments, participants in the NFPA standards development process consider the then-current and available information on incidents, materials, technologies, innovations, and methods as these develop over time and that NFPA Standards reflect this consideration. Therefore, any previous edition of this document no longer represents the current NFPA Standard on the subject matter addressed. NFPA encourages the use of the most current edition of any NFPA Standard [as it may be amended by TIA(s) or Errata] to take advantage of current experience and understanding. An official NFPA Standard at any point in time consists of the current edition of the document, including any issued TIAs and Errata then in effect.

To determine whether an NFPA Standard has been amended through the issuance of TIAs or corrected by Errata, visit the “Codes & Standards” section at www.nfpa.org.

Interpretations of NFPA Standards

A statement, written or oral, that is not processed in accordance with Section 6 of the Regulations Governing the Development of NFPA Standards shall not be considered the official position of NFPA or any of its Committees and shall not be considered to be, nor be relied upon as, a Formal Interpretation.

Patents

The NFPA does not take any position with respect to the validity of any patent rights referenced in, related to, or asserted in connection with an NFPA Standard. The users of NFPA Standards bear the sole responsibility for determining the validity of any such patent rights, as well as the risk of infringement of such rights, and the NFPA disclaims liability for the infringement of any patent resulting from the use of or reliance on NFPA Standards.

NFPA adheres to the policy of the American National Standards Institute (ANSI) regarding the inclusion of patents in American National Standards (“the ANSI Patent Policy”), and hereby gives the following notice pursuant to that policy:

NOTICE: The user’s attention is called to the possibility that compliance with an NFPA Standard may require use of an invention covered by patent rights. NFPA takes no position as to the validity of any such patent rights or as to whether such patent rights constitute or include essential patent claims under the ANSI Patent Policy. If, in connection with the ANSI Patent Policy, a patent holder has filed a statement of willingness to grant licenses under these rights on reasonable and nondiscriminatory terms and conditions to applicants desiring to obtain such a license, copies of such filed statements can be obtained, on request, from NFPA. For further information, contact the NFPA at the address listed below.

Law and Regulations

Users of NFPA Standards should consult applicable federal, state, and local laws and regulations. NFPA does not, by the publication of its codes, standards, recommended practices, and guides, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

NFPA Standards are copyrighted. They are made available for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of safe practices and methods. By making these documents available for use and adoption by public authorities and private users, the NFPA does not waive any rights in copyright to these documents.

Use of NFPA Standards for regulatory purposes should be accomplished through adoption by reference. The term “adoption by reference” means the citing of title, edition, and publishing information only. Any deletions, additions, and changes desired by the adopting authority should be noted separately in the adopting instrument. In order to assist NFPA in following the uses made of its documents, adopting authorities are requested to notify the NFPA (Attention: Secretary, Standards Council) in writing of such use. For technical assistance and questions concerning adoption of NFPA Standards, contact NFPA at the address below.

For Further Information

All questions or other communications relating to NFPA Standards and all requests for information on NFPA procedures governing its codes and standards development process, including information on the procedures for requesting Formal Interpretations, for proposing Tentative Interim Amendments, and for proposing revisions to NFPA standards during regular revision cycles, should be sent to NFPA headquarters, addressed to the attention of the Secretary, Standards Council, NFPA, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101; email: stds_admin@nfpa.org.

For more information about NFPA, visit the NFPA website at www.nfpa.org. All NFPA codes and standards can be viewed at no cost at www.nfpa.org/docinfo.

Copyright © 2019 National Fire Protection Association®. All Rights Reserved.

NFPA® 855

Standard for the

Installation of Stationary Energy Storage Systems

2020 Edition

This edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, was prepared by the Technical Committee on Energy Storage Systems and acted on by NFPA at its Association Technical Meeting held June 17–20, 2019, in San Antonio, TX. It was issued by the Standards Council on August 5, 2019, with an effective date of August 25, 2019.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 855 was approved as an American National Standard on August 25, 2019.

Origin and Development of NFPA 855

The energy storage system project that led to this first edition of NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, was approved by the NFPA Standards Council in April of 2016, after which a call for members was posted. The original request was submitted by an individual on behalf of the California Energy Storage Alliance in order to address gaps in regulation identified in workshops held by the U.S. Department of Energy and the Fire Protection Research Foundation. In August of that same year, the Standards Council appointed the first NFPA Technical Committee on Energy Storage Systems. The initial draft was developed over the course of three meetings by the technical committee and was released to the public in 2017. Over the past 2 years, the technical committee has met several times to review feedback from the public and to make improvements to the standard.



Technical Committee on Energy Storage Systems

James B. Biggins, *Chair*

TUV SUD America Inc./Global Risk Consultants Corporation, IL [SE]

Jim P. Barrett, Demand Energy Networks, WA [IM]

Zekarias Bekele, CSA Group, OH [RT]

Andrew Blum, Fisher Engineering, Inc., GA [SE]

William P. Cantor, TPI Corporation, PA [U]

Rep. Institute of Electrical & Electronics Engineers, Inc.

Troy Chatwin, GE Energy Storage, NY [M]

Daniel Clark, Burns & McDonnell Engineering, AZ [SE]

David Richard Conover, Pacific Northwest National Laboratory (PNNL), VA [SE]

Timothy Crnko, Eaton's Bussmann Business, MO [M]

Robert J. Davidson, Davidson Code Concepts, LLC, SC [SE]

James T. Dollard, Jr., IBEW Local Union 98, PA [L]

Stephen W. Douglas, QPS Evaluation Services Inc., Canada [RT]

Laurie B. Florence, UL LLC, IL [RT]

Kevin Fok, LG Chem Power, Inc., MI [M]

Kara Gerczynski, Elizabeth Fire Protection District, CO [E]

Rep. International Association of Fire Chiefs

David B. Ginder, Saft America, FL [M]

Walter Groden, AIG Global Technical Office, NY [I]

Jan Gromadzki, Tesla, CA [M]

Nicholas Guzman, EGPNA, NV [U]

John A. Hillaert, MPR Associates Inc., VA [SE]

James Houston, Southern Company Services, AL [U]

Jonathan G. Ingram, UTC/Kidde-Fenwal, Inc., MA [M]

Brad Kell, Unienergy Technologies, WA [M]

Chad Kennedy, Schneider Electric, SC [M]

Rep. National Electrical Manufacturers Association

Paul Kozak, Consultant, Canada [SE]

Angela Krcmar, Firetrace International, AZ [M]

Roger Lin, NEC Energy Solutions, MA [M]

Clinton Marshall, FM Global, MA [I]

Terrance L. McKinch, Mortenson Construction, MI [IM]

Celina Mikolajczak, Uber Technologies Inc., CA [U]

Mark Christopher Mirek, Beecher Carlson LLC, TX [I]

Cliff Orvedal, Fluence Energy, VA [M]

Matthew Paiss, San Jose Fire Department, CA [L]

Rep. International Association of Fire Fighters

Justin A. Perry, Dominion Energy, VA [U]

Scot Pruett, Black & Veatch Corporation, KS [SE]

Paul E. Rivers, 3M Scott Safety, MN [M]

George Andrew Ruetenik, Hartford Steam Boiler, MI [I]

Richard Karl Schlueck, Fire Department City Of New York, NY [E]

Randy H. Schubert, Ericsson, NJ [U]

Rep. Alliance for Telecommunications Industry Solutions

Andrzej Skoskiewicz, Stem, Inc., CA [M]

Alex Spataru, The Adept Group, Inc., CA [SE]

Chris Towski, Cambridge Fire Department, MA [E]

Nick Warner, DNV GL, OH [SE]

Ronald W. Woodfin, TetraTek, Inc./AES Corporation, CO [U]

Rep. Edison Electric Institute

Alternates

James (Jim) Allen, Panasonic Industrial Sales Devices Company of America (PIDSA), TX [M]

(Alt. to Chad Kennedy)

Thomas Bensen, Bensen Fire & Safety Consulting, Ltd., OH [SE]

(Alt. to Nick Warner)

Thomas M. De Lucia, Nec Energy Solutions, MA [M]

(Alt. to Roger Lin)

Eric Dein, Black & Veatch, KS [SE]

(Alt. to Scot Pruett)

Benjamin Ditch, FM Global, MA [I]

(Alt. to Clinton Marshall)

Jason M. Fisher, Tesla, Inc., VA [M]

(Alt. to Jan Gromadzki)

Becca Gillespie, Unienergy Technology, WA [M]

(Alt. to Brad Kell)

Jason Haer, Tesla Motors, CA [M]

(Voting Alt.)

Brian J. O'Connor, NFPA Staff Liaison

Howard Hopper, UL LLC, CA [RT]

(Alt. to Laurie B. Florence)

Nick Johnson, 3M Company, MN [M]

(Alt. to Paul E. Rivers)

Richard G. Kluge, Ericsson, NJ [U]

(Alt. to Randy H. Schubert)

Jason Knedlhans, Mortenson Construction, MN [IM]

(Alt. to Terrance L. McKinch)

Jody Leber, CSA Group, GA [RT]

(Alt. to Zekarias Bekele)

Anthony Natale, Consolidated Edison of New York, NY [U]

(Alt. to Ronald W. Woodfin)

Paul G. Rogers, International Association of Fire Fighters (IAFF), NY [L]

(Alt. to Matthew Paiss)

Leo Subbarao, Fire Department City of New York, NY [E]

(Alt. to Richard Karl Schlueck)

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This committee shall have primary responsibility for documents on the fire prevention, fire protection, design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary, mobile, and temporary energy storage systems.

Contents

Chapter 1 Administration	855– 4	9.3 Thermal Runaway Protection.	855– 23
1.1 Scope. (Reserved)	855– 4	9.4 Safety Caps.	855– 23
1.2 Purpose.	855– 4	Chapter 10 Capacitor Energy Storage Systems	855– 24
1.3 Application.	855– 4	10.1 Application.	855– 24
1.4 Retroactivity.	855– 4	10.2 Protection Features.	855– 24
1.5 Equivalency.	855– 4	10.3 Thermal Runaway Protection.	855– 24
1.6 Units and Formulas.	855– 4	10.4 Safety Caps.	855– 24
Chapter 2 Referenced Publications	855– 5	Chapter 11 Fuel Cell Energy Storage Systems	855– 24
2.1 General.	855– 5	11.1 Installation and Maintenance.	855– 24
2.2 NFPA Publications.	855– 5	11.2 Fuel-Cell-Powered Vehicle Use.	855– 24
2.3 Other Publications.	855– 5	Chapter 12 Superconducting Magnet Energy Storage (Reserved)	855– 24
2.4 References for Extracts in Mandatory Sections.	855– 6	Chapter 13 Flywheel (Reserved)	855– 24
Chapter 3 Definitions	855– 6	Chapter 14 Storage of Used or Off-Specification Batteries	855– 24
3.1 General.	855– 6	14.1 Used Batteries or Cells.	855– 24
3.2 NFPA Official Definitions.	855– 6	14.2 Collection Locations.	855– 24
3.3 General Definitions.	855– 6	14.3 Mercantile, Vehicle Repair, Aircraft Repair, and Laboratory Occupancy Battery Collection and Storage Locations.	855– 25
Chapter 4 General	855– 7	14.4 Indoor Storage.	855– 25
4.1 General.	855– 7	14.5 Outdoor Storage Location.	855– 25
4.2 Equipment.	855– 9	Chapter 15 One- and Two-Family Dwellings and Townhouse Units	855– 26
4.3 Installation.	855– 10	15.1 General.	855– 26
4.4 Location.	855– 12	15.2 Equipment Listings.	855– 26
4.5 Mobile ESS Equipment and Operations.	855– 15	15.3 Installation.	855– 26
4.6 Size and Separation.	855– 16	15.4 Commissioning.	855– 26
4.7 Occupied Work Centers.	855– 17	15.5 ESS Spacing.	855– 26
4.8 Maximum Stored Energy.	855– 17	15.6 Location.	855– 26
4.9 Exhaust Ventilation.	855– 17	15.7 Energy Ratings.	855– 26
4.10 Smoke and Fire Detection.	855– 18	15.8 Electrical Installation.	855– 26
4.11 Fire Control and Suppression.	855– 18	15.9 Fire Detection.	855– 26
4.12 Explosion Control.	855– 19	15.10 Protection from Impact.	855– 26
4.13 Water Supply.	855– 19	15.11 Exhaust Ventilation.	855– 26
4.14 Spill Control.	855– 19	15.12 Toxic and Highly Toxic Gas.	855– 26
4.15 Neutralization.	855– 19	15.13 Electric Vehicle Use.	855– 26
4.16 Remediation Measures.	855– 19	Annex A Explanatory Material	855– 27
Chapter 5 System Interconnections	855– 20	Annex B Battery Energy Storage System Hazards ...	855– 33
5.1 General.	855– 20	Annex C Fire-Fighting Considerations (Operations)	855– 40
5.2 Disconnecting Means.	855– 20	Annex D Overview of Energy Storage Systems Technologies	855– 43
5.3 Nonelectrical Systems.	855– 20	Annex E Permits, Inspections, Approvals, and Connections	855– 47
5.4 Communication Systems.	855– 20	Annex F Fire and Building Codes — A Short History on Stationary Storage Battery Systems	855– 48
5.5 Support Systems.	855– 20	Annex G Informational References	855– 54
Chapter 6 Commissioning	855– 20	Index	855– 56
6.1 System Commissioning.	855– 20		
6.2 Issues and Resolutions Documentation. (Reserved)	855– 21		
6.3 Operations and Maintenance Documentation. .	855– 21		
6.4 Recommissioning of Existing Systems.	855– 21		
Chapter 7 Operation and Maintenance	855– 21		
7.1 System Operation.	855– 21		
7.2 System Maintenance.	855– 22		
7.3 System Testing.	855– 22		
Chapter 8 Decommissioning	855– 22		
8.1 Decommissioning Plan.	855– 22		
8.2 Decommissioning Process.	855– 23		
8.3 Decommissioning Report.	855– 23		
Chapter 9 Electrochemical Energy Storage Systems ..	855– 23		
9.1 Application.	855– 23		
9.2 General.	855– 23		

NFPA 855

Standard for the

Installation of Stationary Energy Storage Systems

2020 Edition

IMPORTANT NOTE: This NFPA document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notices and Disclaimers Concerning NFPA Standards.” They can also be viewed at www.nfpa.org/disclaimers or obtained on request from NFPA.

UPDATES, ALERTS, AND FUTURE EDITIONS: New editions of NFPA codes, standards, recommended practices, and guides (i.e., NFPA Standards) are released on scheduled revision cycles. This edition may be superseded by a later one, or it may be amended outside of its scheduled revision cycle through the issuance of Tentative Interim Amendments (TIAs). An official NFPA Standard at any point in time consists of the current edition of the document, together with all TIAs and Errata in effect. To verify that this document is the current edition or to determine if it has been amended by TIAs or Errata, please consult the National Fire Codes® Subscription Service or the “List of NFPA Codes & Standards” at www.nfpa.org/docinfo. In addition to TIAs and Errata, the document information pages also include the option to sign up for alerts for individual documents and to be involved in the development of the next edition.

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced and extracted publications can be found in Chapter 2 and Annex G.

Chapter 1 Administration

1.1 Scope. (Reserved)

1.2 Purpose. This standard provides the minimum requirements for mitigating the hazards associated with ESS.

1.3* Application. This standard applies to ESS exceeding the values shown in Table 1.3.

1.3.1 ESS shall comply with the requirements of this standard as applicable.

1.3.2 ESS installed in one- and two-family dwellings and townhouse units shall only comply with Chapter 15.

1.3.3 Mobile ESS deployed at an electric utility substation or generation facility for 90 days or less shall not add to the threshold values in Table 1.3 for the stationary ESS installation if both of the following conditions apply:

- (1) The mobile ESS complies with Section 4.5.

Table 1.3 Threshold Quantities

ESS Technology	Aggregate Capacity ^a	
	kWh	MJ
Battery ESS		
Lead-acid, all types	70	252
Nickel including Ni-Cad, Ni-MH, and Ni-Zn ^b	70	252
Lithium-ion, all types	20	72
Sodium nickel chloride	20	72
Flow batteries ^c	20	72
Other battery technologies	10	36
Batteries in one- and two-family dwellings and townhouse units	1	3.6
Capacitor ESS		
Electrochemical double layer capacitors ^d	3	10.8
Other ESS		
All other ESS	70	252

^aFor ESS units rated in amp-hrs, kWh equals maximum rated voltage multiplied by amp-hr rating divided by 1000.

^bNickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

^cIncludes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

^dCapacitors used for power factor correction, filtering, and reactive power flow are exempt.

- (2) The mobile ESS is only being used during periods in which facility's stationary ESS is being tested, repaired, retrofitted, or replaced.

1.4 Retroactivity.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to ESS installations that existed or were approved for construction or installation prior to the effective date of this standard.

1.4.2* In those cases where the authority having jurisdiction (AHJ) determines that an existing situation presents an unacceptable degree of risk, the AHJ shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.5* Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, reliability, and safety over those prescribed in this standard.

1.6 Units and Formulas. Metric units in this standard shall be in accordance with the International System of Units, which is officially abbreviated SI in all languages.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2018 edition.

NFPA 2, *Hydrogen Technologies Code*, 2016 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2018 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2019 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2017 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2019 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2019 edition.

NFPA 54, *National Fuel Gas Code*, 2018 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2017 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2018 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2019 edition.

NFPA 70®, *National Electrical Code®*, 2017 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2019 edition.

NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, 2016 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2019 edition.

NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems*, 2015 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Fire Fighting*, 2017 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2018 edition.

NFPA 2010, *Standard for Fixed Aerosol Fire-Extinguishing Systems*, 2015 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd Street, 4th Floor, New York, NY 10036.

ANSI Z535.1, *American National Standard for Safety Colors*, 2011.

ANSI Z535.2, *American National Standard for Environmental and Facility Safety Signs*, 2011.

ANSI Z535.3, *American National Standard for Criteria for Safety Symbols*, 2011.

ANSI Z535.4, *American National Standard for Product Safety Signs and Labels*, 2011.

ANSI Z535.5, *American National Standard for Safety Tags and Barricade Tapes*, 2011.

ANSI Z535.6, *American National Standard for Product Safety Information in Product Manuals, Instructions and Other Collateral Materials*, 2011.

2.3.2 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings*, 2017.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2016.

2.3.3 IAPMO Publications. International Association of Plumbing and Mechanical Officials, 4755 E. Philadelphia Street, Ontario, CA 91761.

Uniform Plumbing Code, 2015.

2.3.4 ICC Publications. International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.

International Plumbing Code, 2015.

2.3.5 IEEE Publications. IEEE, 3 Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE C2, *National Electrical Safety Code*, 2017.

2.3.6 NERC Publications. North American Electric Reliability Corporation, 1325 G Street, NW, Suite 600, Washington, DC 20005.

PRC-005, *Protection System, Automatic Reclosing, and Sudden Pressure Relaying Maintenance*, 2016.

2.3.7 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 263, *Standard for Fire Tests of Building Construction and Materials*, 2018.

UL 790, *Standard Test Methods for Fire Tests of Roof Coverings*, 2014.

UL 1564, *Standard for Industrial Battery Chargers*, 2013.

UL 1741, *Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2016.

UL 1778, *Uninterruptible Power Systems*, 2014, revised 2017.

UL 1973, *Standard for Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications*, 2016.

UL 1974, *Evaluation for Repurposing Batteries*, 2018.

UL 9540, *Safety of Energy Storage Systems and Equipment*, 2016.

UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, 2018.

2.3.8 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 30, *Flammable and Combustible Liquids Code*, 2018 edition.

NFPA 70®, *National Electrical Code*®, 2017 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*®, 2019 edition.

NFPA 101®, *Life Safety Code*®, 2018 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards,

including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1* Apartment Building. A building or portion thereof containing three or more dwelling units with independent cooking and bathroom facilities. (SAF-RES) [101, 2018]

3.3.2 Battery. A single cell or a group of cells connected together electrically in series, in parallel, or a combination of both.

3.3.2.1* Flow Battery. A type of storage battery that includes chemical components dissolved in liquids where the liquid flows through a reaction zone and stored chemical energy is converted to electrical energy.

3.3.3 Battery Management System (BMS). A system that monitors, controls, and optimizes performance of an individual or multiple battery modules in an energy storage system and has the ability to control the disconnection of the module(s) from the system in the event of abnormal conditions. This system can be completely independent of the ESMS.

3.3.4 Cell. The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy. [70:706.2]

3.3.5 Dwelling Unit. One or more rooms arranged for complete, independent housekeeping purposes with space for eating, living, and sleeping; facilities for cooking; and provisions for sanitation. (SAF-RES) [101, 2018]

3.3.5.1* One- and Two-Family Dwelling Unit. A building that contains not more than two dwelling units with independent cooking and bathroom facilities. (SAF-RES) [101, 2018]

3.3.5.2 One-Family Dwelling Unit. A building that consists solely of one dwelling unit with independent cooking and bathroom facilities. (SAF-RES) [101, 2018]

3.3.5.3 Two-Family Dwelling Unit. A building that consists solely of two dwelling units with independent cooking and bathroom facilities. (SAF-RES) [101, 2018]

3.3.6 Electric Utilities. All enterprises engaged in the production and/or distribution of electricity for public use including those that are typically designated or recognized by governmental law or regulation by public service/utility commissions and that install, operate, and maintain electric supply such as generation, transmission, or distribution systems.

3.3.7* Electrochemical Double Layer Capacitor (EDLC). A capacitor that has liquid electrolyte (e.g., acetonitrile) and electrodes with a highly porous surface that increases the surface area for holding charge resulting in much larger capacitance and energy density.

3.3.8* Energy Storage Management System (ESMS). A system that monitors, controls, and optimizes the performance of an energy storage system and has the ability to control the disconnection of the energy storage system in the event of abnormal conditions.

3.3.9* Energy Storage Systems (ESS). One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time to the local power loads, to the utility grid, or for grid support.

3.3.9.1 Capacitor Energy Storage System. An electrical energy storage system using capacitors as a storage media.

3.3.9.1.1* Electrochemical Energy Storage System. An energy storage system that converts and stores chemical energy to electrical energy and vice versa.

3.3.9.1.2* Mechanical Energy Storage System. An energy storage system that converts and stores mechanical energy to electrical energy and vice versa.

3.3.9.2 Energy Storage System Cabinet. A cabinet containing components of the energy storage system that is included in the UL 9540 listing for the system where personnel cannot enter the enclosure other than reaching in to access components for maintenance purposes.

3.3.9.3 Energy Storage System Dedicated-Use Building. A building constructed on-site that is only used for energy storage, energy generation, or electrical grid-related operations.

3.3.9.4 Energy Storage System Walk-In Unit. A prefabricated structure containing energy storage systems that includes doors that provide walk-in access for personnel to maintain, test, and service the equipment and is typically used in outdoor and mobile energy storage system applications.

3.3.9.5 Mobile Energy Storage System. An energy storage system capable of being moved and utilized as a temporary source of power.

3.3.9.6 Portable Energy Storage System. An energy storage system suitable to be lifted and moved by a single person without mechanical aids and not permanently connected to an electrical system.

3.3.9.7 Stationary Energy Storage System. An energy storage system that is permanently installed as fixed equipment.

3.3.10 Fire Area. An area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hour and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hour. [30, 2018]

3.3.11 Fire Command Center. The principal attended or unattended room or area where the status of the detection, alarm communications, control systems, and other emergency systems is displayed and from which the system(s) can be manually controlled. (SIG-ECS) [72, 2019]

3.3.12 Hazard Mitigation Analysis. An evaluation of potential energy storage system failure modes and the safety-related consequences attributed to the failures.

3.3.13 Large-Scale Fire Testing. Testing of a representative energy storage system that induces a significant fire into the device under test and evaluates whether the fire will spread to adjacent energy storage system units, surrounding equipment, or through an adjacent fire-resistance-rated barrier.

3.3.14 Living Area. Any normally occupiable space in a residential occupancy, other than sleeping rooms or rooms that are intended for combination sleeping/living, bathrooms, toilet compartments, kitchens, closets, halls, storage or utility spaces, and similar areas. (SAF-RES) [101, 2018]

3.3.15 Maximum Stored Energy. The quantity of energy storage permitted in a fire area prior to the area being considered a high hazard occupancy.

3.3.16 Off-Gassing. The event in which the cell case vents due to a rise in internal pressure of the cell.

3.3.17 Off-Specification Battery or Cell. A cell or battery that has been tested during the manufacturing quality control process and found not to be within the manufacturer's designed set of criteria for its intended use.

3.3.18 Open Parking Garage. A structure or portion of a structure with the openings on two or more sides that is used for the parking or storage of motor vehicles.

3.3.19 Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. (CMP-1) [70:Article 100]

3.3.20 Thermal Runaway. The condition when an electrochemical cell increases its temperature through self-heating in an uncontrollable fashion and progresses when the cell's heat generation is at a higher rate than it can dissipate, potentially leading to off-gassing, fire, or explosion.

3.3.21 Utility Interactive. An energy storage system intended for use in parallel with an electric utility to supply common loads that can deliver power to the utility.

Chapter 4 General

4.1* General. The design, construction, and installation of ESS and related equipment shall comply with Chapter 4 and as supplemented or modified by the technology-specific provisions in Chapters 9 through 13.

4.1.1* ESS Gas Release. ESS shall not release toxic or highly toxic gas creating conditions in excess of the permissible exposure limit (PEL) in the room or space in which they are located during normal charging, discharging, and use.

4.1.2 Construction Documents.

4.1.2.1 General.

4.1.2.1.1 The plans and specifications associated with an ESS and its intended installation, replacement or renewal, commissioning, and use shall be submitted to the AHJ for approval and include the following:

- (1) Location and layout diagram of the room or area in which the ESS is to be installed
- (2) Details on hourly fire-resistant-rated assemblies provided or relied upon in relation to the ESS
- (3) The quantities and types of ESS units
- (4) Manufacturer's specifications, ratings, and listings of ESS
- (5) Description of energy storage management systems and their operation
- (6) Location and content of required signage
- (7) Details on fire suppression, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration venting systems, if provided
- (8) Support arrangement associated with the installation, including any required seismic support

4.1.2.1.2 Plans and specifications associated with energy storage systems owned and operated by utilities as a component of the electric grid that are considered critical infrastructure documents, in accordance with the provisions of North American Electric Reliability Corporation and other applicable governmental laws and regulations shall be made available to the AHJ for viewing based on the requirements of the applicable governmental laws and regulations.

4.1.2.1.3 The following test data, evaluation information, and calculations shall be provided in addition to the plans and specifications in 4.1.2.1.1 where required elsewhere in this standard:

- (1) Large-scale fire test data in accordance with 4.1.5
- (2) Hazard mitigation analysis in accordance with 4.1.4
- (3) Calculations or modeling data to determine compliance with NFPA 68 and NFPA 69 in accordance with Section 4.12
- (4) Other test data, evaluation information, or calculations as required elsewhere in this standard

4.1.2.1.4 If modeling data is provided, validation of the modeling results shall also be included.

4.1.2.2 Building Owner. The construction documents described in this section shall be provided to the building owner or the owner's authorized agent prior to the system being put in service.

4.1.2.3 Manuals. An operations and maintenance manual shall be provided to both the ESS owner or their authorized agent and system operator before the system is put into operation and includes the following:

- (1) Submittal data stating the ESS size and selected options for each component of the system
- (2) Manufacturer's operation manuals and maintenance manuals for the entire ESS or for each component of the system requiring maintenance that clearly identify the required routine maintenance actions
- (3)* Contact information for a contracted service agency or responsible in-house personnel
- (4) A narrative of how the ESS and its components and controls are intended to operate, including recommended operational set points
- (5) A service record log that lists the schedule for all required service and maintenance actions with space for logging such actions that can be completed over time

4.1.2.3.1 The operations and maintenance manual shall be prepared prior to final approval of the ESS and be readily accessible to personnel responsible for the ESS.

4.1.2.3.2 A copy of the operations and maintenance manual shall be placed in an approved location to be accessible to AHJs and emergency responders.

4.1.2.4 Commissioning Plan. A commissioning plan meeting the provisions of Chapter 6 shall be provided to the building owner or their authorized agent and the AHJ.

4.1.3 Emergency Planning and Training.

4.1.3.1* General. Emergency planning and training shall be provided by the owner of the ESS or their authorized representative so that ESS facility operations and maintenance personnel and emergency responders can effectively address foreseeable hazards associated with the on-site systems.

4.1.3.2 Facility Staff Planning and Training. An emergency operations plan and associated training shall be established, maintained, and conducted by ESS facility operations and maintenance personnel.

4.1.3.2.1 Emergency Operations Plan.

4.1.3.2.1.1 An emergency operations plan shall be readily available for use by facility operations and maintenance personnel.

4.1.3.2.1.2 For normally occupied facilities, the emergency operations plan shall be on site.

4.1.3.2.1.3 The plan shall be updated when conditions that affect the response considerations and procedures change.

4.1.3.2.1.4 The emergency operations plan shall include the following:

- (1) Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions
- (2) Procedures for inspection and testing of associated alarms, interlocks, and controls
- (3)* Procedures to be followed in response to notifications from the energy storage management system (ESMS), when provided, that could signify potentially dangerous conditions, including shutting down equipment, summoning service and repair personnel, and providing agreed upon notification to fire department personnel for off-normal potentially hazardous conditions
- (4)* Emergency procedures to be followed in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions
- (5) Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment when an SDS is not required
- (6) Procedures for dealing with ESS equipment damaged in a fire or other emergency event, including contact information for personnel qualified to safely remove damaged ESS equipment from the facility
- (7) Other procedures as determined necessary by the AHJ to provide for the safety of occupants and emergency responders
- (8) Procedures and schedules for conducting drills of these procedures

4.1.3.2.1.5 The emergency operations plan in 4.1.3.2.1 shall not be required for electric utility facilities under the exclusive control of the electric utility located outdoors or in building spaces used exclusively for such installations.

4.1.3.2.2 Facility Staff Training.

4.1.3.2.2.1 Personnel responsible for the operation, maintenance, repair, servicing, and response of the ESS shall be trained in the procedures included in the emergency operations plan in 4.1.3.2.1.

4.1.3.2.2.2 Refresher training shall be conducted at least annually and records of such training retained in an approved manner.

4.1.4 Hazard Mitigation Analysis.

4.1.4.1* A hazard mitigation analysis shall be provided to the AHJ for review and approval when any of the following conditions are present:

- (1) When technologies not specifically addressed in Table 1.3 are provided.
- (2) More than one ESS technology is provided in a room or indoor area where adverse interaction between the technologies is possible.
- (3) When allowed as a basis for increasing maximum stored energy as specified in 4.8.1 and 4.8.2.

4.1.4.2 The analysis shall evaluate the consequences of the following failure modes and others deemed necessary by the AHJ:

- (1) Thermal runaway condition in a single module, array, or unit
- (2) Failure of an energy storage management system
- (3) Failure of a required ventilation or exhaust system
- (4) Failure of a required smoke detection, fire detection, fire suppression, or gas detection system

4.1.4.2.1 Only single failure modes shall be considered for each mode given in 4.1.4.2.

4.1.4.3 The AHJ shall be permitted to approve the hazardous mitigation analysis as documentation of the safety of the ESS installation provided the consequences of the analysis demonstrate the following:

- (1) Fires will be contained within unoccupied ESS rooms for the minimum duration of the fire resistance rating specified in 4.3.6.
- (2) Suitable deflagration protection is provided where required.
- (3) ESS cabinets in occupied work centers allow occupants to safely evacuate in fire conditions.
- (4) Toxic and highly toxic gases released during normal charging, discharging, and operation will not exceed the PEL in the area where the ESS is contained.
- (5) Toxic and highly toxic gases released during fires and other fault conditions will not reach concentrations in excess of immediately dangerous to life or health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate from that area.
- (6) Flammable gases released during charging, discharging, and normal operation will not exceed 25 percent of the LFL.

4.1.4.4 The hazard mitigation analysis shall be documented and made available to the AHJ and those authorized to design and operate the system.

4.1.4.5* Construction, equipment, and systems that are required for the ESS to comply with the hazardous mitigation analysis shall be installed, tested, and maintained in accordance with this standard and the manufacturer's instructions.

4.1.5 Large-Scale Fire Test.

4.1.5.1* Where required elsewhere in this standard, large-scale fire testing in accordance with 4.1.5 shall be conducted on a representative ESS in accordance with UL 9540A or equivalent test standard.

4.1.5.2 The testing shall be conducted or witnessed and reported by an approved testing laboratory and show that a fire involving one ESS unit will not propagate to an adjacent unit.

4.1.5.3 Where installed within buildings, the fire during the test shall be contained within the room or enclosed area for a duration equal to the fire resistance rating of the room separation specified in 4.3.6.

4.1.5.4* The test report shall be provided to the AHJ for review and approval.

4.1.6 Combustible Storage.

4.1.6.1 Combustible materials not related to the ESS shall not be stored in rooms, cabinets, or enclosures containing ESS equipment.

4.1.6.2 Combustible materials related to the ESS shall not be stored within 3 ft (914 mm) from ESS equipment.

4.1.6.3 Combustible materials in occupied work centers shall not be stored within 3 ft (914 mm) of ESS equipment.

4.1.6.4 Combustible materials in occupied work centers shall comply with Section 10.18 of NFPA 1 or other applicable fire codes.

4.1.6.5 Subsection 4.1.6 shall not apply to dwelling units.

4.2 Equipment.

4.2.1* Listings. ESS shall be listed in accordance with UL 9540, unless specifically exempted in other sections of this standard.

4.2.1.1 Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations that are in compliance with NFPA 76 are not required to be listed in accordance with UL 9540.

4.2.1.2* Lead-acid and nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations shall not be required to be listed in accordance with UL 9540.

4.2.1.3 Lead-acid battery systems in uninterruptible power supplies listed and labeled in accordance with UL 1778 and utilized for standby power applications shall not be required to be listed in accordance with UL 9540.

4.2.2 Repairs.

4.2.2.1 Repairs of ESS shall only be done by qualified persons and documented in the maintenance, testing, and events log required in 4.1.2.3.

4.2.2.2 Repairs with other than identical or equivalent parts shall be considered a retrofit and comply with 4.2.3.

4.2.3 Retrofits.

4.2.3.1 Retrofitting of ESS shall comply with the following:

- (1) Battery systems and modules and capacitor systems and modules shall be listed in accordance with UL 1973.

- (2) Battery management and other monitoring systems shall be connected and installed in accordance with the manufacturer's instructions.
- (3) The overall installation shall continue to comply with UL 9540 listing requirements, where applicable.
- (4) Retrofits shall be documented in the maintenance, testing, and events log required in 4.1.2.3.

4.2.3.2 Changing out or retrofitting existing lead-acid or nickel-cadmium battery systems with other lead-acid or nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations that are in compliance with NFPA 76 shall be considered repairs when there is no increase in system size or capacity greater than 10 percent from the original design.

4.2.3.3* Changing out or retrofitting existing lead-acid or nickel-cadmium battery systems with other lead-acid or nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations shall be considered repairs when there is no increase in system size or capacity greater than 10 percent from the original design.

4.2.3.4 Changing out or retrofitting existing lead-acid battery systems with other lead-acid battery systems in uninterruptible power supplies listed and labeled in accordance with UL 1778 and utilized for standby power applications shall be considered repairs where there is no increase in system size or capacity greater than 10 percent from the original design.

4.2.4 Replacements.

4.2.4.1 Replacement of ESS shall be considered new ESS installations and comply with the provisions applicable to new ESS.

4.2.4.2 The ESS being replaced shall be decommissioned in accordance with Chapter 8.

4.2.5 Increase in Power Rating or Maximum Stored Energy.

4.2.5.1 A complete new ESS that is added to an existing installation of one or more systems shall be treated as a new system and meet the applicable requirements of this standard.

4.2.5.2 An increase in maximum stored energy or power rating to an existing ESS shall be considered a retrofit and comply with 4.2.3.

4.2.6 Environment. The temperature, humidity, and other environmental conditions in which an ESS is located shall be maintained in accordance with the listing and the manufacturer's specifications.

4.2.7 Charge Controllers.

4.2.7.1 Charge controllers shall be compatible with the battery or ESS manufacturer's electrical ratings and charging specifications.

4.2.7.2 Charge controllers shall be listed and labeled in accordance with UL 1741 or provided as part of a listed ESS.

4.2.7.3 Battery chargers used for the charging of a battery system that is not utility interactive shall be permitted to be listed and labeled in accordance with UL 1564.

4.2.8 Inverters and Converters.

4.2.8.1 Inverters and converters shall be listed and labeled in accordance with UL 1741.

4.2.8.2* Only units listed and labeled for utility interactive system use and identified as interactive shall be allowed to operate in parallel with the electric utility power system.

4.2.9* Energy Storage Management System (ESMS).

4.2.9.1 Where required by the equipment listing in accordance with 4.2.1 or the hazard mitigation analysis in accordance with 4.1.4, an approved ESMS shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications.

4.2.9.2 The ESMS shall electrically isolate the components of the ESS or place it in a safe condition if potentially hazardous temperatures or other hazardous conditions are detected.

4.2.9.3* When required by the AHJ, visible annunciation shall be provided on the cabinet exterior or in an approved location to indicate potentially hazardous conditions associated with the ESS exist.

4.2.9.4 Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities located outdoors or in building spaces used exclusively for such installations that are in compliance with NFPA 76 are not required to comply with 4.2.9.1 through 4.2.9.3.

4.2.9.5* Lead-acid and nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.2.9.1 through 4.2.9.3.

4.2.10 Reused and Repurposed Equipment.

4.2.10.1 Storage batteries previously used in other applications, such as electric vehicle propulsion, shall not be permitted unless the equipment is repurposed by a UL 1974 compliant battery repurposing company when reused in ESS applications and the system complies with 4.2.1.

4.2.10.2 Materials, equipment, and devices shall not be reused or reinstalled unless such elements have been reconditioned, tested, and placed in good and proper working condition and approved.

4.3 Installation. ESS shall be installed in accordance with their listing, the manufacturer's installation instructions, and this standard.

4.3.1 Electrical Installation. The electrical installation shall be in accordance with *NFPA 70* or IEEE C2 based on the location of the ESS in relation to and its interaction with the electrical grid.

4.3.2* Working Space. At a minimum, ESS equipment shall be provided with working space in accordance with *NFPA 70* or

IEEE C2, as appropriate, for operation, inspection, troubleshooting, maintenance, or replacement.

4.3.3 Seismic Protection. ESS shall be seismically braced in accordance with the local building code.

4.3.4 Design Loads. The weight of the ESS and all associated equipment, components, and enclosure elements and their impact on the dead and live loads of the building or system foundation shall be in accordance with the local building code.

4.3.5* Signage.

4.3.5.1 Approved signage shall be provided in the following locations:

- (1) On the front of doors to rooms or areas containing ESS or in approved locations near entrances to ESS rooms
- (2) On the front of doors to outdoor occupiable ESS containers
- (3) In approved locations on outdoor ESS that are not enclosed in occupiable containers or otherwise enclosed

4.3.5.2* The signage required in 4.3.5.1 shall be in compliance with ANSI Z535 and include the following information as shown in Figure 4.3.5.2:

- (1) “Energy Storage Systems” with symbol of lightning bolt in a triangle
- (2) Type of technology associated with the ESS
- (3) Special hazards associated as identified in Chapters 9 through 15.
- (4) Type of suppression system installed in the area of the ESS
- (5) Emergency contact information

4.3.5.3 A permanent plaque or directory denoting the location of all electric power source disconnecting means on or in the premises shall be installed at each service equipment location and at the location(s) of the system disconnect(s) for all energy sources capable of being interconnected.

4.3.5.3.1 Energy storage located on property that is under the exclusive control of utilities, secured from public access, and in accordance with 90.2 B(5) of *NFPA 70* shall not be required to comply with 4.3.5.3.

4.3.5.3.2 Energy storage located in a dedicated-use building that is under the exclusive control of telecommunication utilities and secured from public access shall not be required to comply with 4.3.5.3.

4.3.5.4 Existing ESS shall be permitted to retain the signage required at installation except as modified by 4.3.5.5.

4.3.5.5 Existing ESS signage shall be updated to comply with the requirements for new ESS installations when the system is retrofitted or existing signs need to be replaced.

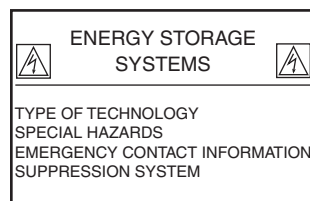


FIGURE 4.3.5.2 Example of ESS Signage.

4.3.5.6 Battery and ESS cabinets in occupied work centers covered by Section 4.7 shall be provided with exterior signs that identify the manufacturer and model number of the system and electrical rating (voltage and current) of the contained system, and any relevant electrical, chemical, and fire hazard.

4.3.6 Separation. Rooms or spaces containing ESS shall be separated from other areas of the building by fire barriers with a minimum 2-hour fire resistance rating and horizontal assemblies with a minimum 2-hour fire resistance rating, constructed in accordance with the local building code.

4.3.7 Impact Protection.

4.3.7.1 ESS shall be located or protected to prevent physical damage from impact where such risks are identified.

4.3.7.2 Vehicle impact protection consisting of guard posts or other approved means shall be provided where ESS are subject to impact by motor vehicles.

4.3.7.3* When guard posts are installed, they shall be designed as follows:

- (1) Posts shall be constructed of steel not less than 4 in. (100 mm) in diameter.
- (2) Posts shall be filled with concrete.
- (3) Posts shall be spaced not more than 4 ft (1.2 m) on center.
- (4) Posts shall be set not less than 3 ft (0.9 m) deep in a concrete footing of not less than 15 in. (380 mm) diameter.
- (5) The top of the posts shall be set not less than 3 ft (0.9 m) above ground.
- (6) Posts shall be located not less than 3 ft (0.9 m) from the ESS.

4.3.7.4* For residential garages, ESS shall not be installed in a location where subject to damage from impact by a motor vehicle.

4.3.8 Security of Installations.

4.3.8.1 ESS shall be secured against unauthorized entry and safeguarded in an approved manner.

4.3.8.2 Security barriers, fences, landscaping, and other enclosures shall not inhibit the required air flow to or exhaust from the ESS and its components.

4.3.9 Elevation. ESS shall be located only on floors that can be accessed by external fire department laddering capabilities unless a higher location is approved by the AHJ.

4.3.9.1 Belowgrade Installations.

4.3.9.1.1 ESS installations where the floor level is below the finished floor of the lowest level of exit discharge shall not be permitted unless the location is approved by the AHJ.

4.3.9.1.2 The ESS shall not be located inside an electrical room.

4.3.9.1.3 The ESS shall be accessible to emergency responders without traversing through an electrical room.

4.3.9.1.4 When approved by the AHJ, ESS installations in underground vaults constructed in accordance with Part III of Article 450 of *NFPA 70* shall be permitted.

4.3.9.2 When approved by the AHJ, ESS installations on rooftops of buildings that do not obstruct fire department rooftop operations shall be permitted.

4.3.9.3 The requirements in 4.3.9 shall not apply to the following:

- (1) Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that are in compliance with NFPA 76
- (2)* Lead-acid and nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations
- (3) Lead-acid battery systems in uninterruptible power supplies listed and labeled in accordance with UL 1778, utilized for standby power applications, which is limited to not more than 10 percent of the floor area on the floor on which the ESS is located

4.3.10 Means of Egress.

4.3.10.1 All areas containing ESS shall provide egress from the area in which they are located in accordance with the local building code.

4.3.10.2 Required egress doors shall be provided with emergency lighting as required by the local building code.

4.3.11 Open Rack Installations. Where installed in a room accessible only to authorized personnel, ESS shall be permitted to be installed on an open rack.

4.3.12 Fire Command Centers. In buildings containing ESS and equipped with a fire command center, the command center shall include signage or readily available documentation that describes the location and type of ESS, operating voltages, and location of electrical disconnects as required by NFPA 70.

4.4 Location.

4.4.1 ESS installed indoors, outdoors, on rooftops, and in open parking garages shall comply with this section.

4.4.2 Indoor Installations. Indoor ESS installations shall comply with this section and as detailed in Table 4.4.2.

4.4.2.1 Dedicated-Use Buildings. Dedicated-use ESS buildings shall be constructed in accordance with local building codes and comply with all the following:

- (1) The building shall only be used for energy storage, energy generation, and other electrical grid-related operations.
- (2) Occupants in the rooms and areas containing ESS shall be limited to personnel that operate, maintain, service, test, and repair the ESS and other energy systems.
- (3) No other occupancy types shall be permitted in the building.
- (4) Administrative and support personnel shall be permitted in incidental-use areas within the buildings that do not contain ESS, provided the following:

Table 4.4.2 Indoor ESS Installations

Compliance Required	Dedicated-Use Buildings ^a	Non-Dedicated-Use Buildings ^b	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.3
Size and separation	Yes ^c	Yes	Section 4.6
Maximum stored energy	No	Yes	Section 4.8
Elevation	Yes	Yes	4.3.9
Separation	NA	Yes	4.3.6
Smoke and fire detection	Yes ^d	Yes	Section 4.10
Fire control and suppression	Yes ^c	Yes	Section 4.11
Water supply	Yes ^c	Yes	Section 4.13
Signage	Yes	Yes	4.3.5
Occupied work centers	Not allowed	Yes	Section 4.7
Technology-specific protection	Yes	Yes	Chapters 9–13

NA: Not applicable.

^aSee 4.4.2.1.

^bSee 4.4.2.2.

^cWhere approved by the AHJ, the fire control and suppression systems, the size and separation requirements, and the water supply are permitted to be omitted in dedicated-use buildings located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.

^dWhen approved, alarm signals are not required to be transmitted to an approved location when local fire alarm annunciation is provided and trained personnel are always present.

- (a) The areas do not occupy more than 10 percent of the building area of the story in which they are located.
- (b) The areas are separated from the ESS and other rooms and areas containing ESS by 2-hour fire barriers and 2-hour fire resistance-rated horizontal assemblies constructed in accordance with the local building code, as appropriate.
- (c) A means of egress is provided from the incidental-use areas to a public way that does not require occupants to traverse through areas containing ESS or other energy systems.

4.4.2.2 Non-Dedicated-Use Buildings. Non-dedicated-use buildings shall include all buildings that contain ESS and do not comply with dedicated-use building requirements in 4.4.2.1.

4.4.2.3 Dwelling Units and Sleeping Units.

4.4.2.3.1 Stationary ESS shall not be installed in sleeping rooms or in living areas of dwelling units unless specifically allowed in Chapters 9 through 13.

4.4.2.3.2 Portable ESS shall be permitted to be used in sleeping rooms and in habitable spaces of dwelling units provided

they are listed and are used in accordance with the terms of their listing.

4.4.3 Outdoor Installations. Outdoor ESS installations shall comply with this section and as detailed in Table 4.4.3.

4.4.3.1 Classification. Outdoor ESS installations shall be classified as follows:

- (1) *Remote locations.* Remote outdoor locations include ESS located more than 100 ft (30.5 m) from buildings, lot lines that can be built upon, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.
- (2) *Locations near exposures.* Locations near exposures include all outdoor ESS locations that do not comply with remote outdoor location requirements.

4.4.3.2 Maximum Size.

4.4.3.2.1 Outdoor walk-in containers or enclosures housing ESS shall not exceed 53 ft × 8.5 ft × 9.5 ft (16.2 m × 2.6 m × 2.9 m), not including HVAC and other equipment.

Table 4.4.3 Outdoor Stationary ESS Installations

Compliance Required	Remote Locations ^a	Locations	
		Near Exposures ^b	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.3
Maximum size	Yes	Yes	4.4.3.2
Clearance to exposures	NA	Yes	4.4.3.3
Means of egress separation	NA	Yes	4.4.3.4
Walk-in units	Yes	Yes	4.4.3.5
Vegetation control	Yes	Yes	4.4.3.6
Enclosures	Yes	Yes	4.4.3.7
Size and separation	No	Yes ^c	Section 4.6
Maximum stored energy	No	Yes	Section 4.8
Smoke and fire detection	Yes	Yes	Section 4.10
Fire control and suppression	Yes ^d	Yes	Section 4.11
Water supply	Yes ^d	Yes	Section 4.13
Signage	Yes	Yes	4.3.5
Occupied work centers	Not allowed	Not allowed	Section 4.7
Technology-specific protection	Yes	Yes	Chapters 9–13

NA: Not applicable.

^aSee 4.4.3.1(1).

^bSee 4.4.3.1(2).

^cIn outdoor walk-in units, spacing is not required between ESS and the enclosure walls.

^dWhen agreeable with the ESS owner and approved by the AHJ, fire suppression systems and water supply are permitted to be omitted.

4.4.3.2.2 Units that exceed the dimensions in 4.4.3.2.1 shall be treated as indoor installations and comply with the requirements in 4.4.2.

4.4.3.3 Clearance to Exposures. ESS located outdoors shall be separated by a minimum 10 ft (3048 mm) from the following exposures:

- (1) Lot lines
- (2) Public ways
- (3) Buildings
- (4) Stored combustible materials
- (5) Hazardous materials
- (6) High-piled stock
- (7) Other exposure hazards not associated with electrical grid infrastructure

4.4.3.3.1 The required separation distances shall be permitted to be reduced to 3 ft (914 mm) when a 1-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and 5 ft (1.5 m) beyond the physical boundary of the ESS installation is provided to protect the exposure.

4.4.3.3.2 Clearances to buildings shall be permitted to be reduced to 3 ft (914 mm) where noncombustible exterior walls with no openings or combustible overhangs are provided on the wall adjacent to the ESS and the fire resistance rating of the exterior wall complies with the fire resistance requirements in 4.3.6.

4.4.3.3.3 Clearances to buildings shall be permitted to be reduced to 3 ft (914 mm) based on large-scale fire testing complying with 4.1.5.

4.4.3.3.4 Where approved, clearances to exposures other than buildings shall be permitted to be reduced to 3 ft (914 mm) where large-scale fire testing of the ESS in accordance with 4.1.5 demonstrates that a fire within the ESS enclosure will not generate radiant heat flux sufficient to ignite stored materials or otherwise threaten the exposure.

4.4.3.3.5 Clearances to buildings and exposures shall be permitted to be reduced to 3 ft (914 mm) where the enclosure of the ESS has a 2-hour fire resistance rating established in accordance with ASTM E119 or UL 263.

4.4.3.3.6 Exhaust outlets from an ESS that exhaust other than ventilation air shall be located at least 15 ft (4.572 m) from heating, ventilating, and air conditioning (HVAC) air intakes, windows, doors, loading docks, ignition sources, and other openings into buildings and facilities.

4.4.3.3.7 Exhaust outlet(s) from an ESS shall not be directed onto means of egress, walkways, or pedestrian or vehicular travel paths.

4.4.3.4 Means of Egress Separation.

4.4.3.4.1 ESS located outdoors shall be separated from any means of egress as required by the AHJ to ensure safe egress under fire conditions but in no case less than 10 ft (3048 mm).

4.4.3.4.2 Where approved by the AHJ, clearances to means of egress shall be permitted to be reduced to 3 ft (914 mm) where large-scale fire testing in accordance with 4.1.5 demonstrates that a fire within the ESS will not adversely impact the means of egress.

4.4.3.5 Walk-in Units.

4.4.3.5.1 Where an ESS includes an outer enclosure, the unit shall only be entered for inspection, maintenance, and repair of energy storage units and ancillary equipment and not be occupied for other purposes.

4.4.3.5.2* Walk-in units shall comply with this standard and local building code requirements.

4.4.3.6 Vegetation Control.

4.4.3.6.1 Areas within 10 ft (3 m) on each side of outdoor ESS shall be cleared of combustible vegetation and other combustible growth.

4.4.3.6.2 Single specimens of trees, shrubbery, or cultivated ground cover such as green grass, ivy, succulents, or similar plants used as ground covers shall be permitted to be exempt provided that they do not form a means of readily transmitting fire.

4.4.3.7 Enclosures.

4.4.3.7.1 ESS electrical circuitry shall be within weatherproof enclosures marked with the environmental rating suitable for the type of exposure required by *NFPA 70*.

4.4.3.7.2 Enclosures shall be of noncombustible construction.

4.4.3.8 Access Roads. Fire department access roads shall be provided to outdoor ESS installations in accordance with the local fire code.

4.4.3.9* Hazardous Atmospheres. The ESS shall not be located in a classified area as defined in *NFPA 70* or IEEE C2 unless listed and approved for the specific installation.

4.4.3.10 Exterior Wall Installations.

4.4.3.10.1 ESS shall be permitted to be installed outdoors on exterior walls of buildings when all of the following conditions are met:

- (1) The maximum stored energy of individual ESS units shall not exceed 20 kWh (72 MJ).
- (2) The ESS shall comply with applicable requirements in Chapter 4.
- (3) The ESS shall be installed in accordance with the manufacturer's instructions and their listing.
- (4) Individual ESS units shall be separated from each other by at least 3 ft (914 mm).
- (5) The ESS shall be separated from doors, windows, operable openings into buildings, or HVAC inlets by at least 5 ft (1524 mm).

4.4.3.10.2 Where approved by the AHJ, smaller separation distances in items (4) and (5) shall be permitted based on large scale fire testing in accordance with 4.1.5.

4.4.4 Rooftop and Open Parking Garage Installations. Rooftop and open parking garage ESS installations shall comply with this section and as detailed in Table 4.4.4.

4.4.4.1 ESS installations shall be classified as follows:

- (1) *Rooftop installations.* Rooftop ESS installations are those located on the roofs of buildings.
- (2) *Open parking garage installations.* Open parking garage ESS installations are those located in a structure or portion of a structure as defined in 3.3.18.

Table 4.4.4 Rooftop and Open Parking Garage ESS Installations

Compliance Required	Rooftops*	Open Parking Garages†	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.3
Maximum size	Yes	Yes	4.4.3.2
Means of egress separation	Yes	Yes	4.4.3.4
Walk-in units	Yes	Yes	4.4.3.5
Enclosures	Yes	Yes	4.4.3.7
Clearance to exposures	Yes	Yes	4.4.4.2
Fire suppression and control	Yes	Yes	Section 4.11
Rooftop installations	Yes	No	4.4.4.4
Open parking garages	No	Yes	4.4.4.5
Size and separation	Yes	Yes	Section 4.6
Maximum stored energy	Yes	Yes	Section 4.8
Elevation	Yes	Yes	4.3.9
Smoke and fire detection	Yes	Yes	Section 4.10
Signage	Yes	Yes	4.3.5
Occupied work centers	Not allowed	Not allowed	Section 4.7
Open rack installations	Not allowed	Not allowed	4.3.11
Technology-specific protection	Yes	Yes	Chapters 9–13

NA: Not applicable.

*See 4.4.4.1(1).

†See 4.4.4.1(2).

4.4.4.2 Clearance to Exposures.

4.4.4.2.1 ESS located on rooftops and in open parking garages shall be separated by a minimum 10 ft (3048 mm) from the following exposures:

- (1) Buildings, except the portion of the building on which rooftop ESS is mounted
- (2) Lot lines
- (3) Public ways
- (4) Stored combustible materials
- (5) Locations where motor vehicles can be parked
- (6) Hazardous materials
- (7) Other exposure hazards

4.4.4.2.2 Clearances shall be permitted to be reduced to 3 ft (914 mm) under the following conditions:

- (1) Where a 1-hour freestanding fire barrier, suitable for exterior use, and extending 5 ft (1.5 m) above and extending 5 ft (1.5 m) beyond the physical boundary of the ESS installation is provided to protect the exposure
- (2) Where the weatherproof ESS enclosure is constructed of noncombustible materials and it has been demonstrated

that a fire within the enclosure will not ignite combustible materials outside the enclosure based on large-scale fire testing complying with 4.1.5

4.4.4.3 Fire Suppression and Control.

4.4.4.3.1 ESS located in walk-in enclosures on rooftops or in open parking garages shall be provided with automatic fire control and suppression systems within the ESS enclosure in accordance with Section 4.11.

4.4.4.3.2 Areas containing ESS other than walk-in units in open parking structures not open above to the sky shall be provided with an automatic fire suppression system complying with Section 4.11.

4.4.4.3.3 When approved by the AHJ, ESS shall be permitted to be installed in open parking garages without the protection of an automatic fire control and suppression system where large-scale fire testing conducted in accordance with 4.1.5 indicates that an ESS fire does not present an exposure hazard to parked vehicles or compromise the means of egress.

4.4.4.4 Rooftop Installations.

4.4.4.4.1 Installations shall be permitted on rooftops of buildings that do not obstruct fire department rooftop operations when approved.

4.4.4.4.2 ESS and associated equipment that are located on rooftops and not enclosed by building construction shall comply with the following:

- (1) Stairway access to the roof for emergency response and fire department personnel shall be provided either through a bulkhead from the interior of the building or a stairway on the exterior of the building.
- (2) Service walkways at least 5 ft (1524 mm) in width shall be provided for service and emergency personnel from the point of access to the roof to the system.
- (3) ESS and associated equipment shall be located from the edge of the roof a distance equal to at least the height of the system, equipment, or component but not less than 5 ft (1.5 m).
- (4) The roofing materials under and within 5 ft (1524 mm) horizontally from an ESS or associated equipment shall be noncombustible or shall have a Class A rating when tested in accordance with ASTM E108 or UL 790.
- (5) A Class I standpipe outlet shall be installed at an approved location on the roof level of the building or in the stairway bulkhead at the top level.
- (6) Installations on rooftops over 75 ft (23 m) in height above grade shall be permitted when approved by the AHJ.
- (7) Access, service space, guards, and handrails shall be provided where required by the local building and mechanical codes.
- (8) A radiant energy-sensing fire detection system complying with Section 4.10 shall be provided to protect the ESS.
- (9) The ESS shall be a minimum of 10 ft (3.48 m) from the fire service access point on the rooftop.

4.4.4.5 Open Parking Garages. ESS and associated equipment that are located in open parking garages shall comply with all of the following:

- (1) ESS shall not be located within 50 ft (15.3 m) of air inlets for building HVAC systems. When approved, this distance is permitted to be reduced to 25 ft (7.6 m) if the auto-

matic fire alarm system monitoring the radiant energy-sensing detectors de-energizes the ventilation system connected to the air intakes upon detection of fire.

- (2) ESS shall not be located within 25 ft (7.6 m) of exits leading from the attached building when located on a covered level of the parking structure not directly open to the sky above. When approved, the separation distance is permitted to be reduced to 10 ft (3 m) based on large-scale fire and fault condition testing conducted in accordance with 4.1.5.
- (3) Means of egress separation shall comply with 4.4.3.4.
- (4) A radiant energy-sensing fire detection system complying with Section 4.10 shall be provided to protect the ESS.
- (5) An approved fence with a locked gate or other approved barrier shall be provided to keep the general public at least 5 ft (1.5 m) from the outer enclosure of the ESS.

4.5 Mobile ESS Equipment and Operations.

4.5.1 Charging and Storage. For the purpose of Section 4.5, charging and storage shall cover the operation where mobile ESS are charged and stored so they are ready for deployment to another site and where they are charged and stored after a deployment.

4.5.1.1 Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.5.1.

4.5.2 Deployment. For the purpose of Section 4.5, deployment shall cover operations where mobile ESS are located at a site other than the charging and storage site and are being used to provide power.

4.5.2.1 Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are designed in accordance with IEEE C2, used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility, and located outdoors or in building spaces used exclusively for such installations shall not be required to comply with 4.5.2.

4.5.3 Construction Documents. Construction documents complying with 4.1.2 shall be provided to the AHJ with any locally required construction permit applications for mobile ESS charging and storage locations.

4.5.4 Deployment Documents. The following information shall be provided to the AHJ with any locally required operational permit applications for mobile ESS deployments:

- (1) Relevant information for the mobile ESS equipment and protection measures in the construction documents required by 4.1.2
- (2) Location and layout diagram of the area in which the mobile ESS is to be deployed, including a scale diagram of all nearby exposures
- (3) Location and content of signage
- (4) Description of fencing to be provided around the ESS, including locking methods
- (5) Details on fire suppression, smoke and automatic fire detection, system monitoring, thermal management, exhaust ventilation, and explosion control, if provided

- (6) For deployment, the intended duration of operation, including anticipated connection and disconnection times and dates
- (7) Description of the temporary wiring, including connection methods, conductor type and size, and circuit over-current protection to be provided
- (8) Description of how fire suppression system connections to water supplies or extinguishing agents are to be provided
- (9) Contact information for personnel who are responsible for maintaining and servicing the equipment and responding to emergencies

4.5.5 Approved Locations. Locations where mobile ESS are charged, stored, and deployed shall be restricted to the locations approved by the AHJ.

4.5.6 Charging and Storage. Installations where mobile ESS are charged and stored shall be treated as permanent ESS installations and shall comply with the following sections, as applicable:

- (1) Indoor charging and storage shall comply with 4.4.2.
- (2) Outdoor charging and storage shall comply with 4.4.3.
- (3) Charging and storage on rooftops and in open parking garages shall comply with 4.4.4.

4.5.6.1 Electrical connections shall be permitted to be made using temporary wiring complying with the manufacturer's instructions, the UL 9540 listing, and *NFPA 70*.

4.5.6.2 Fire suppression system connections to the water supply shall be acceptable to the AHJ.

4.5.7 Deployed Mobile ESS Requirements. Deployed mobile ESS equipment and operations shall comply with this section and Table 4.5.7.

Table 4.5.7 Mobile Energy Storage Systems (ESS)

Compliance Required	Deployment ^a	Reference
Administrative	Yes	Chapters 1–3
General	Yes	Sections 4.1–4.3
Size and separation	Yes ^b	Section 4.6
Maximum stored energy	Yes	Section 4.8
Fire and smoke detection	Yes ^c	Section 4.10
Fire control and suppression	Yes ^{d,e}	Section 4.11
Maximum size	Yes	4.4.3.2
Vegetation control	Yes	4.4.3.6
Means of egress separation	Yes	4.4.3.4
Technology-specific protection	Yes	Chapters 9–13

^aSee 4.5.2.

^bIn walk-in units, spacing is not required between ESS units and the walls of the enclosure.

^cAlarm signals are not required to be transmitted to an approved location for mobile ESS deployed 30 days or less.

^dSee 4.5.7.2.

^eOnly required for walk-in units.

4.5.7.1 Mobile operations on wheeled vehicles or trailers shall not be required to comply with 4.3.3 seismic protection requirements.

4.5.7.2 Fire suppression system connections to the water supply shall be permitted to use approved temporary connections.

4.5.7.3 Duration.

4.5.7.3.1 Mobile ESS deployments that provide power for durations longer than 30 days shall comply with 4.5.6.

4.5.7.3.2 Mobile ESS deployments in excess of 30 days, for emergencies, shall not be required to comply with 4.5.6, with AHJ approval.

4.5.7.4 Restricted Locations. Deployed mobile ESS operations shall not be located indoors, in covered parking garages, on rooftops, below grade, or under building overhangs.

4.5.7.5 Clearance to Exposures.

4.5.7.5.1 Deployed mobile ESS shall be separated by a minimum 10 ft (3 m) from the following exposures:

- (1) Public ways
- (2) Buildings
- (3) Stored combustible materials
- (4) Hazardous materials
- (5) High-piled stock
- (6) Other exposure hazards not associated with electrical grid infrastructure

4.5.7.5.1.1 Required separation distances shall be permitted to be reduced in accordance with 4.4.3.3.1 through 4.4.3.3.4.

4.5.7.5.2 Deployed mobile ESS shall be separated by a minimum 50 ft (15.3 m) from public seating areas and from tents, canopies, and membrane structures with an occupant load of 30 or more.

4.5.7.6 Electrical Connections. Electrical connections shall be made in accordance with the manufacturer's instructions.

4.5.7.6.1 Temporary wiring for electrical power connections shall comply with *NFPA 70* or equivalent code.

4.5.7.6.2 Fixed electrical wiring shall not be permitted.

4.5.7.7 Local Staging. Mobile ESS in transit from the charging and storage location to the deployment location and back shall not be parked within 100 ft (30.5 m) of an occupied building for more than 1 hour during transit, unless specifically approved in advance by the AHJ.

4.5.7.8 Fencing.

4.5.7.8.1 An approved fence with a locked gate or other approved barrier shall be provided to keep the general public at least 5 ft (1024 mm) from the outer enclosure of a deployed mobile ESS.

4.5.7.8.2 A mobile ESS that is locked to prevent access by unauthorized persons shall be accepted as meeting 4.5.7.8.

4.6* Size and Separation.

4.6.1 ESS in the following locations shall comply with 4.6.2 and 4.6.3 unless otherwise permitted by 4.6.4 or 4.6.5.

- (1) Indoor ESS installations in non-dedicated-use buildings in accordance with 4.4.2

- (2) Outdoor ESS installations in locations near exposures as described in 4.4.3.1(2)

4.6.2 ESS shall be comprised of groups with a maximum stored energy of 50 kWh each.

4.6.3 Each group shall be spaced a minimum 3 ft (914 mm) from other groups and from walls in the storage room or area.

4.6.4 The AHJ shall be permitted to approve groups with larger energy capacities or smaller group spacing based on large-scale fire testing complying with 4.1.5.

4.6.5 Subsections 4.6.2 and 4.6.3 shall not apply to lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities in compliance with NFPA 76.

4.6.6* Subsections 4.6.2 and 4.6.3 shall not apply to lead-acid and nickel-cadmium battery systems designed in accordance with IEEE C2 and used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utility.

4.6.7 Subsections 4.6.2 and 4.6.3 shall not apply to lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with UL 1778, utilized for standby power applications, which is limited to not more than 10 percent of the floor area on the floor on which the ESS is located.

4.7* Occupied Work Centers. ESS in occupied work centers shall comply with this section.

4.7.1 ESS shall be permitted in the same room as the equipment that they support.

4.7.2 ESS shall be housed in a noncombustible, locked cabinet or other enclosure to prevent access by unauthorized personnel unless located in a separate equipment room accessible only to authorized personnel.

4.8 Maximum Stored Energy. ESS in the following locations shall comply with Section 4.8 as follows:

- (1) Fire areas within non-dedicated-use buildings containing ESS as described in 4.4.2.2 shall not exceed the maximum stored energy values in Table 4.8 except as permitted by 4.8.1.
- (2) Outdoor ESS installations in locations near exposures as described in 4.4.3.1(2) shall not exceed the maximum stored energy values in Table 4.8 except as permitted by 4.8.3.
- (3) ESS installations in open parking garages and on rooftops of buildings as described in 4.4.4.1 shall not exceed the maximum stored energy values in Table 4.8 except as permitted by 4.8.3.
- (4) Mobile ESS equipment as covered by Section 4.5 shall not exceed the maximum stored energy values in Table 4.8 except as permitted by 4.8.3.

4.8.1 Where approved by the AHJ, fire areas in non-dedicated-use buildings containing ESS that exceed the amounts in Table 4.8 shall be permitted based on a hazardous mitigation analysis in accordance with 4.1.4 and large-scale fire testing complying with 4.1.5.

4.8.2 Where approved by the AHJ, outdoor ESS installations, ESS installations in open parking garages and on rooftops of buildings, and mobile ESS equipment that exceed the amounts in Table 4.8 shall be permitted based on a hazardous mitigation

Table 4.8 Maximum Stored Energy

ESS Type	Maximum Stored Energy ^a (kWh)
Lead-acid batteries, all types	Unlimited
Nickel batteries ^b	Unlimited
Lithium-ion batteries, all types	600
Sodium nickel chloride batteries	600
Flow batteries ^c	600
Other battery technologies	200
Storage capacitors	20

^aFor ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

^bNickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

^cIncludes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

analysis in accordance with 4.1.4 and large-scale fire testing in accordance with 4.1.5.

4.8.3 Where more than one ESS technology is present within a fire area, the fire protection systems shall be designed to protect the greatest hazard.

4.8.4 Where a single fire area within a building or walk-in unit contains a combination of energy systems covered in Table 4.8, the maximum stored energy per fire area shall be determined based on the sum of percentages of each type divided by the maximum stored energy of each type.

4.8.5 The sum of the percentages calculated in 4.8.4 shall not exceed 100 percent except as permitted in 4.8.1 or 4.8.3.

4.9* Exhaust Ventilation.

4.9.1 General. Where required by Table 9.2 or elsewhere in this standard, exhaust ventilation shall be provided for rooms, enclosures, walk-in units, and cabinets in accordance with 4.9.2 or 4.9.3.

4.9.2* Exhaust Ventilation by Design. The ventilation system shall be designed to limit the maximum concentration of flammable gas to 25 percent of the lower flammable limit (LFL) of the total volume of the room, walk-in unit, enclosure, container, or cabinet during the worst-case event of simultaneous “boost” charging of all the batteries, in accordance with nationally recognized standards.

4.9.3 Mechanical Exhaust Ventilation.

4.9.3.1 Mechanical exhaust ventilation shall be provided at a rate of not less than 1 ft³/min/ft² (5.1 L/sec/m²) of floor area of the room, walk-in unit, enclosure, container, or cabinet.

4.9.3.1.1 The mechanical exhaust ventilation shall be either continuous or activated by a gas detection system in accordance with 4.9.3.2.

4.9.3.1.2 Required mechanical exhaust ventilation systems shall be installed in accordance with the manufacturer’s installation instructions and local building, mechanical, and fire codes.

4.9.3.1.3 Required mechanical exhaust ventilation systems shall be supervised by an approved central station, proprietary,