

NFPA®

855

Standard for
the Installation of Stationary
Energy Storage Systems

2023



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NFPA[®] 855

Standard for the Installation of Stationary Energy Storage Systems

2023 Edition



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NFPA® 855

Standard for the

Installation of Stationary Energy Storage Systems

2023 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 the NFPA membership during the 2022 NFPA Technical Meeting held June 8-9. It was issued by the Standards Council on August 12, 2022, with an effective date of September 1, 2022, and supersedes the previous edition.

This edition of NFPA 855 was approved as an American National Standard on September 1, 2022.

Origin and Development of NFPA 855

The energy storage system project that led to the 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 to address gaps in regulation identified in workshops held by the US 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 next 2 years, the technical committee met several times to review feedback from the public and to make improvements to the standard.

The first edition was issued by the Standards Council on August 5, 2019.

The 2023 edition includes a scope which covers all energy storage systems and lithium battery storage. Application of NFPA 855 to an ESS installation is left to the mandatory or voluntary adoption of the standard. Exemptions specific to installations under the exclusive control of utilities have been incorporated throughout the standard to address concerns if NFPA 855 is adopted for utility use.

In response to international incidents of ESS fires, requirements for fire detection and suppression, explosion control, exhaust ventilation, gas detection, and thermal runaway have been added or revised. The requirements for fire and explosion testing (formally large-scale fire testing) have been clarified.

Requirements from Chapters 4 and 10 specific to electrochemical ESS have been consolidated and reorganized in Chapter 9. Chapter 13 has been added to address flywheel ESS.

Information has been added in Annex B to provide guidance on the hazards associated with additional battery types. Annex G has been added as a guide for suppression and safety of lithium-ion battery ESS.

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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- 5	Chapter 10 (Reserved)	855- 27
1.1 Scope.	855- 5	Chapter 11 Fuel Cell Energy Storage Systems	855- 27
1.2 Purpose.	855- 5	11.1 Installation and Maintenance.	855- 27
1.3 Application.	855- 5	11.2 Fuel-Cell-Powered Vehicle Use.	855- 27
1.4 Retroactivity.	855- 5	Chapter 12 Superconducting Magnet Energy Storage (Reserved)	855- 27
1.5 Equivalency.	855- 5	Chapter 13 Flywheel Energy Storage Systems (FESS) ..	855- 27
1.6 Units and Formulas.	855- 6	13.1 Application.	855- 27
Chapter 2 Referenced Publications	855- 6	13.2 Protection Features.	855- 27
2.1 General.	855- 6	13.3 Commissioning.	855- 28
2.2 NFPA Publications.	855- 6	13.4 Operation and Maintenance.	855- 28
2.3 Other Publications.	855- 6	13.5 Decommissioning.	855- 29
2.4 References for Extracts in Mandatory Sections.	855- 7	Chapter 14 Storage of Lithium Metal or Lithium-ion Batteries	855- 29
Chapter 3 Definitions	855- 7	14.1 Batteries.	855- 29
3.1 General.	855- 7	14.2 Collection Locations.	855- 29
3.2 NFPA Official Definitions.	855- 7	14.3 Indoor Storage Locations.	855- 29
3.3 General Definitions.	855- 7	14.4 Prevention and Mitigation.	855- 30
Chapter 4 General	855- 9	14.5 Explosion Protection.	855- 30
4.1 General.	855- 9	14.6 Outdoor Storage Location.	855- 30
4.2 Construction Documents.	855- 9	Chapter 15 One- and Two-Family Dwellings and Townhouse Units	855- 30
4.3 Emergency Planning and Training.	855- 9	15.1 General.	855- 30
4.4 Hazard Mitigation Analysis (HMA).	855- 10	15.2 Equipment Listings.	855- 30
4.5 Combustible Storage.	855- 10	15.3 Installation.	855- 30
4.6 Equipment.	855- 10	15.4 Locations.	855- 30
4.7 Installation.	855- 11	15.5 Energy Ratings.	855- 31
4.8 Smoke and Fire Detection.	855- 13	15.6 Electrical Installation.	855- 31
4.9 Fire Control and Suppression.	855- 13	15.7 Fire Detection.	855- 31
4.10 Mobile ESS Equipment and Operations.	855- 14	15.8 Protection from Impact.	855- 31
Chapter 5 System Interconnections	855- 14	15.9 Exhaust Ventilation.	855- 31
5.1 General.	855- 14	15.10 ESS Toxic and Highly Toxic Gas Release During Normal Use.	855- 31
5.2 Disconnecting Means.	855- 14	15.11 Electric Vehicle Use.	855- 31
5.3 Nonelectrical Systems.	855- 14	Annex A Explanatory Material	855- 31
5.4 Support Systems.	855- 14	Annex B Battery Energy Storage System Hazards ...	855- 41
Chapter 6 Commissioning	855- 14	Annex C Firefighting Considerations (Operations) .	855- 52
6.1 System Commissioning.	855- 14	Annex D Overview of Energy Storage Systems Technologies	855- 56
6.2 Issues and Resolutions Documentation. (Reserved)	855- 15	Annex E Permits, Inspections, Approvals, and Connections	855- 60
6.3 Operations and Maintenance Documentation. .	855- 15	Annex F Fire and Building Codes A Short History on Stationary Storage Battery Systems	855- 60
6.4 Recommissioning of Existing Systems.	855- 15	Annex G Guide for Suppression and Safety of Lithium-Ion Battery (LIB) Energy Storage Systems (ESS)	855- 66
Chapter 7 Operation and Maintenance	855- 15	Annex H Informational References	855- 108
7.1 System Operation.	855- 15	Index	855- 111
7.2 System Maintenance.	855- 16		
7.3 System Testing.	855- 16		
Chapter 8 Decommissioning	855- 16		
8.1 Decommissioning Plan.	855- 16		
8.2 Decommissioning Process.	855- 17		
8.3 Decommissioning Report.	855- 17		
Chapter 9 Electrochemical Energy Storage Systems ..	855- 17		
9.1 General.	855- 17		
9.2 Equipment.	855- 17		
9.3 Location Classification.	855- 18		
9.4 Installation.	855- 18		
9.5 Location and Applications.	855- 19		
9.6 Protection and Remediation.	855- 23		

NFPA 855

Standard for the

Installation of Stationary Energy Storage Systems

2023 Edition

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

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

Chapter 1 Administration

Δ 1.1* Scope. This standard applies to the design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary energy storage systems (ESS), including mobile and portable ESS installed in a stationary situation and the storage of lithium metal or lithium-ion batteries.

1.2 Purpose. This standard provides the minimum requirements for mitigating the hazards associated with ESS and the storage of lithium metal or lithium-ion batteries.

1.3* Application. This standard shall apply to ESS installations exceeding the values shown in Table 1.3 and the storage of lithium metal or lithium-ion batteries.

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 be required to comply with Chapter 15.

Δ Table 1.3 Threshold Quantities per Each Fire Area or Outdoor Installation

ESS Technology	Aggregate Capacity ^a	
	kWh	MJ
Battery ESS		
Lead-acid, all types	70	252
Ni-Cad, Ni-MH, and Ni-Zn	70	252
Lithium-ion, all types	20	72
Sodium nickel chloride	20 (70 ^b)	72 (252 ^b)
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
Flywheel ESS (FESS)	0.5	1.8

^aFor ESS units rated in amp-hrs, kWh equals nominal rated voltage multiplied by amp-hr nameplate rating divided by 1000. For batteries rated in watts per cell, kWh equals the nameplate watts per cell multiplied by the number of cells divided by 1000 and multiplied by the nameplate minutes rating divided by 60.

^bFor sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

^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.

Δ 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 9.5.3.2.
- (2) The mobile ESS is only being used during periods in which a facility's stationary ESS is being tested, repaired, retrofitted, or replaced.

N 1.3.4 The storage of lithium metal or lithium-ion batteries shall only be required to comply with Chapter 14.

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*, 2021 edition.

NFPA 2, *Hydrogen Technologies Code*, 2023 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2022 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2022 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2022 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2022 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2021 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2023 edition.

NFPA 54, *National Fuel Gas Code*, 2021 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 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*®, 2023 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*®, 2022 edition.

NFPA 76, *Standard for the Fire Protection of Telecommunications Facilities*, 2020 edition.

NFPA 750, *Standard on Water Mist Fire Protection Systems*, 2023 edition.

NFPA 770, *Standard on Hybrid (Water and Inert Gas) Fire-Extinguishing Systems*, 2021 edition.

NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems*, 2020 edition.

NFPA 1142, *Standard on Water Supplies for Suburban and Rural Firefighting*, 2022 edition.

NFPA 2001, *Standard on Clean Agent Fire Extinguishing Systems*, 2022 edition.

NFPA 2010, *Standard for Fixed Aerosol Fire-Extinguishing Systems*, 2020 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 (for Temporary Hazards)*, 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*, 2020a.

ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, 2020.

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

Uniform Plumbing Code, 2021.

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

International Plumbing Code, 2021.

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-005-6, *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, *Fire Tests of Building Construction and Materials*, 2021.

UL 790, *Standard Test Methods for Fire Tests of Roof Coverings*, 2018.

UL 1012, *Power Units Other Than Class 2*, 2021.

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2021.

UL 1778, *Uninterruptible Power Systems*, 2017.

UL 1973, *Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*, 2018.

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

UL 9540, *Energy Storage Systems and Equipment*, 2020.

UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, 2019.

UL 60950-1, *Information Technology Equipment — Safety — Part 1: General Requirements*, 2007, revised 2019.

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment — Part 1: Safety Requirements*, 2021.

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*, 2021 edition.

NFPA 70®, *National Electrical Code®*, 2023 edition.

NFPA 72®, *National Fire Alarm and Signaling Code®*, 2022 edition.

NFPA 101®, *Life Safety Code®*, 2021 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2022 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 phrases “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.

Δ 3.3.1* Apartment Building. A building or portion thereof containing three or more dwelling units with independent cooking and bathroom facilities. [101, 2021]

Δ 3.3.2 Battery. One or more cells connected together electrically in series, parallel, or both, to provide the required operating voltage and current levels.

3.3.2.1* Flow Battery. A type of storage battery that includes one or more electrolyte solutions or suspensions in at least one storage tank, one or more energy converters where chemical energy is converted into electrical energy in a reversible process, and a circulation system that causes electrolyte to flow between the tank(s) and converter(s).

3.3.3* Battery Management System (BMS). A system that monitors, controls, and optimizes performance of an individual or multiple battery modules.

3.3.4 Cell. The basic electrochemical unit, characterized by an anode and a cathode, used to receive, store, and deliver electrical energy. [70:100]

Δ 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. [101, 2021]

Δ 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. [101, 2021]

Δ 3.3.5.2 One-Family Dwelling Unit. A building that consists solely of one dwelling unit with independent cooking and bathroom facilities. [101, 2021]

Δ 3.3.5.3 Two-Family Dwelling Unit. A building that consists solely of two dwelling units with independent cooking and bathroom facilities. [101, 2021]

Δ 3.3.6 Electric Utilities. All enterprises engaged in the production 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 and safety of an energy storage system.
- △ **3.3.9* Energy Storage Systems (ESS).** One or more devices, assembled together, capable of storing energy to supply electrical energy at a future time.
- 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.** An enclosure containing components of the energy storage system where personnel cannot enter the enclosure other than reaching in to access components for maintenance purposes.
- △ **3.3.9.3 Energy Storage System (ESS) Dedicated-Use Building.** A building that is only used for energy storage, or energy storage in conjunction with energy generation, electrical grid-related operations, or communications utility equipment.
- △ **3.3.9.4 Energy Storage System Walk-In Unit.** A 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 and Explosion Testing.** Testing of a representative energy storage system that evaluates the fire and explosion hazards produced by a propagating thermal runaway.
- 3.3.11 **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, 2021]
- △ **3.3.12 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. [72, 2022]
- N **3.3.13* Flywheel Energy Storage System (FESS).** A mechanical energy storage system composed of a spinning mass referred to as a rotor and an energy conversion mechanism that converts the stored mechanical energy to electrical energy.
- N **3.3.13.1* Braking.** Actively removing speed from the rotor without feeding power to the input or output.
- N **3.3.13.2* Spin Down.** A shutdown condition of the FESS, where energy is being dissipated and the flywheel rotor is slowing down to a stop.
- N **3.3.13.3 Standby FESS.** A condition of the flywheel energy storage system where the flywheel is rotating but not providing energy to external loads.
- 3.3.14 **Hazard Mitigation Analysis (HMA).** An evaluation of potential energy storage system failure modes and the safety-related consequences attributed to the failures.
- △ **3.3.15 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. [101, 2021]
- 3.3.16 **Maximum Stored Energy.** The quantity of energy storage permitted in a fire area prior to the area being considered a high hazard occupancy.
- 3.3.17 **Off-Gassing.** The event in which the cell case vents due to a rise in internal pressure of the cell.
- 3.3.18 **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.
- 3.3.19 **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.
- △ **3.3.20 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. [70:100]
- N **3.3.21 Recycle.** The process of collecting and processing materials that would otherwise be turned into trash and turning them into new products.
- N **3.3.22* Repurposed Battery.** A battery that was used in one application in the field that is subject to some level of analysis and reconfiguration for use in an ESS application.
- N **3.3.23 Standby Power Application.** An energy storage system utilizing a battery that is intended to remain on continuous float charge or in a high state of charge to support an event necessitating a discharge.
- N **3.3.24 Storage of Batteries.** The storage, keeping, or collecting of batteries for future use as needed, or for disposal; does not include batteries undergoing manufacture or testing.
- N **3.3.25 Stored-Energy Emergency Power Supply System (SEPSS).** A system consisting of a UPS, a rectifier plant, or a motor generator powered by a stored electrical energy source; a transfer switch designed to monitor preferred and alternate load power source and provide desired switching of the load; and all necessary control equipment to make the system functional. [111, 2022]
- △ **3.3.26* Thermal Runaway.** Self-heating of an electrochemical system in an uncontrollable fashion.
- 3.3.27 **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.

4.2 Construction Documents.

4.2.1 General.

Δ 4.2.1.1 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

4.2.1.2 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.

Δ 4.2.1.3 The following test data, evaluation information, and calculations shall be provided in addition to the plans and specifications in 4.2.1.1 where required elsewhere in this standard:

- (1) Fire and explosion testing data in accordance with 9.1.5
- (2) Hazard mitigation analysis (HMA) in accordance with Section 4.4
- (3) Calculations or modeling data to determine compliance with NFPA 68 and NFPA 69 in accordance with 9.6.5.6.3
- (4) Other test data, evaluation information, or calculations as required elsewhere in this standard

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

4.2.2 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.

4.2.3 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

4.2.3.1 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.

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

4.2.4 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.

4.3 Emergency Planning and Training.

Δ 4.3.1* General. For ESS installations that exceed the maximum stored energy limits of Table 9.4.1, 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 address foreseeable hazards associated with the on-site systems.

4.3.2 Facility Staff Planning and Training. For ESS installations that exceed the maximum stored energy limits of Table 9.4.1, an emergency operations plan and associated training shall be established, maintained, and conducted by ESS facility operations and maintenance personnel.

4.3.2.1 Emergency Operations Plan.

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

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

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

4.3.2.1.4 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 of system alarms or out-of-range conditions that could signify potentially dangerous conditions, including shutting down equipment, summoning service or repair personnel, and providing agreed-upon notification to fire department personnel, if required
- (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

4.3.2.1.5 The emergency operations plan in 4.3.2.1 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.

4.3.2.2 Facility Staff Training.

4.3.2.2.1 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 4.3.2.1.

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

4.4 Hazard Mitigation Analysis (HMA).

Δ 4.4.1* A hazard mitigation analysis shall be provided to the AHJ for review and approval where any of the following conditions are present:

- (1) Technologies not specifically addressed in Table 1.3 are provided
- (2) More than one ESS technology is provided in a single fire area where adverse interaction between the technologies is possible
- (3) Where allowed as a basis for increasing maximum stored energy as specified in 9.4.1.1 and 9.4.1.2
- (4) Where required by the AHJ to address a potential hazard with an ESS installation that is not addressed by existing requirements
- (5) Where required for existing lithium-ion ESS systems that are not UL 9540 listed in accordance with 9.2.2.1
- (6) Where required for outdoor lithium-ion battery ESS systems in accordance with 9.5.2.1

Δ 4.4.2 Failure Modes.

Δ 4.4.2.1* The hazard mitigation analysis shall evaluate the consequences of the following failure modes and others deemed necessary by the AHJ:

- (1) A thermal runaway or mechanical failure condition in a single ESS unit
- (2) Failure of an energy storage management system or protection system that is not covered by the product listing failure modes and effects analysis (FMEA)
- (3) Failure of a required protection system including, but not limited to, ventilation (HVAC), exhaust ventilation, smoke detection, fire detection, fire suppression, or gas detection

4.4.2.2 Only single failure modes shall be considered for each mode given in 4.4.2.1.

Δ 4.4.3 The AHJ shall be permitted to approve the hazard mitigation analysis as documentation of the safety of the ESS installation if 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 9.6.4.
- (2) Fires and products of combustion will not prevent occupants from evacuating to a safe location.
- (3) Deflagration hazards will be addressed by an explosion control or other system.

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

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

4.5 Combustible Storage.

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

4.5.2 Combustible materials related to the ESS shall not be stored within 3 ft (0.9 m) from ESS equipment.

4.5.3 Combustible materials in occupied work centers shall not be stored within 3 ft (0.9 m) of ESS equipment.

4.5.4 Combustible materials in occupied work centers shall comply with Section 10.19 of NFPA 1 or other applicable fire codes.

4.5.5 Section 4.5 shall not apply to dwelling units.

4.6 Equipment.

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

4.6.2 Repairs.

4.6.2.1 Repairs of ESS shall only be performed by qualified persons and documented in the maintenance, testing, and events log required in 4.2.3.

N 4.6.2.2 Where installed in an electrical substation or electrical power plant, repairs shall be documented in accordance with the operating practices adopted by the responsible electrical utility.

4.6.2.3 Repairs with other than identical or equivalent parts shall be considered a retrofit and comply with 4.6.3.

4.6.3 Retrofits.

4.6.3.1 Retrofits of ESS shall be approved and comply with the following unless modified in other sections:

- (1) Battery systems and modules and capacitor systems and modules shall be listed in accordance with UL 1973 and installed in accordance with the manufacturer's instructions.
- (2) ESS 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 4.2.3.

▲ **4.6.3.2*** Changing out or retrofitting existing lead-acid or nickel-cadmium batteries shall be considered repairs when there is no increase in system size or capacity greater than 10 percent from the original design.

● **4.6.3.3** Retrofitting of an ESS with a different ESS technology or chemistry shall be considered a replacement and comply with 4.6.4.

4.6.4 Replacements.

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

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

▲ **4.6.5 Reused Equipment.** 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.

4.6.6 Increase in Power Rating or Maximum Stored Energy.

4.6.6.1 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.

4.6.6.2 An increase in maximum stored energy or power rating to an existing ESS shall be considered a retrofit and comply with 4.6.3.

● **4.6.6.3** Where the original ESS was approved for the addition of maximum stored energy or power over the life of the asset without adding a new technology or adding different components, and the protection systems were designed, built, and tested to handle the anticipated maximum energy or power, this installation of additional energy storage shall be considered a retrofit and comply with 4.6.3.

4.6.7 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.

4.6.8 Charge Controllers.

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

4.6.8.2 Charge controllers shall be listed and labeled for the application or be provided as part of a listed ESS.

4.6.9 Inverters and Converters.

4.6.9.1* Inverters and converters shall be listed and labeled for the application.

4.6.9.2* 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.

4.6.10* Energy Storage Management System (ESMS). Where required elsewhere in this standard, areas containing ESS shall

be provided with an ESMS or BMS, unless modified in Chapters 9 through 13.

● **4.6.11* ESS Toxic and Highly Toxic Gas Release During Normal Use.** ESS shall not release toxic or highly toxic gases during normal charging, discharging, and use.

4.6.12 Enclosures.

4.6.12.1 Enclosures shall be of noncombustible construction.

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

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

4.7.1* 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.

● **4.7.1.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are 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* shall not be required to comply with 4.7.1.

● **4.7.1.2** Lead-acid and nickel-cadmium battery systems that are 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 4.7.1.

● **4.7.2 Seismic Protection.** ESS shall be seismically braced in accordance with the local building code.

4.7.3 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.

4.7.4* Signage.

4.7.4.1 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

▲ **4.7.4.2*** The signage required in 4.7.4.1 shall be in compliance with ANSI Z535 and include the following information as shown in Figure 4.7.4.2:

- (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

4.7.4.3 A permanent plaque or directory denoting the location of the disconnecting means for all ESS 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 ESS capable of being interconnected.

4.7.4.3.1 Energy storage located on property that is under the exclusive control of utilities, secured from public access, and in accordance with 90.2(D)(5) of NFPA 70 shall not be required to comply with 4.7.4.3.

4.7.4.3.2 Lead-acid and nickel-cadmium battery systems less than 50 V ac or 60 V dc in telecommunications facilities that are covered by and in compliance with NFPA 76 and secured from public access shall not be required to comply with 4.7.4.3.

4.7.4.4 Existing ESS shall be permitted to retain the signage required at installation except as modified by 4.7.4.5.

4.7.4.5 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.

- ▲ **4.7.4.6** Battery and ESS cabinets in occupied work centers covered by 9.5.1.2.1 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.

4.7.5 Impact Protection.

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

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

4.7.5.3* 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.

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

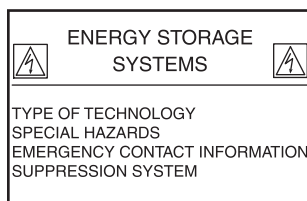


FIGURE 4.7.4.2 Example of ESS Signage.

4.7.6 Security of Installations.

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

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

4.7.7 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.

4.7.7.1 Belowgrade Installations.

4.7.7.1.1 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.

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

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

4.7.7.1.4 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.

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

- ▲ **4.7.7.3** The requirements in 4.7.7 shall not apply to the following:

- (1)* Lead-acid and nickel-cadmium battery systems less than 50 V ac or 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 comply with NFPA 76
- (2)* Lead-acid and nickel-cadmium battery systems that are 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 utilized exclusively in uninterruptible power supplies listed for their application and used for standby power applications, and limited to not more than 10 percent of the floor area on the floor on which the ESS is located

4.7.8 Means of Egress.

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

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

- N **4.7.8.3** Required egress door(s) shall open in the direction of egress.

- N **4.7.8.4** Required egress doors shall be equipped with listed panic hardware.

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

4.7.10 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*.

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

4.7.12* Hazardous (Classified) Locations. 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.

4.7.13 Fire Barriers. 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 and constructed in accordance with the local building code, unless modified in Chapters 9 through 13.

4.8 Smoke and Fire Detection.

4.8.1* Where required elsewhere in this standard, areas containing ESS systems shall be provided with a smoke detection or radiant energy-sensing system in accordance with *NFPA 72*, unless modified by the requirements in Chapters 9 through 13.

4.8.1.1* Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft² (139 m²) using lead-acid or nickel-cadmium battery technology shall not be required to have the detection required in 4.8.1.

4.8.1.2* Lead-acid and nickel-cadmium battery systems that are 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 allowed to use the process control system to monitor the smoke detectors required in 4.8.1.

4.8.2 Annunciation.

4.8.2.1 All required annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation. [72:10.18.3.2]

4.8.2.2* Multiple panels shall be aggregated to a master or annunciator panel at a location approved by the AHJ.

4.8.3* Smoke and fire detection systems protecting an ESS with lithium-ion batteries shall be required to provide a secondary power supply in accordance with *NFPA 72* capable of 24 hours in standby and 2 hours in alarm.

4.8.4 Alarm signals from detection systems shall be transmitted to a supervising station in accordance with *NFPA 72*.

4.9 Fire Control and Suppression.

4.9.1* Where required elsewhere in this standard, fire control and suppression for rooms or areas within buildings and outdoor walk-in units containing ESS shall be provided in accordance with this section, unless modified in Chapters 9 through 13.

4.9.1.1* Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are 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 comply with *NFPA 76* shall not be required to have a fire suppression system installed.

4.9.1.2 Lead-acid battery systems in uninterruptible power supplies listed and labeled in accordance with the application 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, shall not be required to have a fire suppression system installed.

4.9.1.3* Lead-acid and nickel-cadmium battery systems that are 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 have a fire suppression system installed.

4.9.1.4 When approved by the AHJ, ESS shall be permitted to be installed in open parking garages without the protection of an automatic fire suppression system where fire, explosion, and fault condition testing documents the system does not present an exposure hazard to parked vehicles when installed in accordance with manufacturer's instructions and this standard.

4.9.1.5 When approved by the AHJ, ESS shall be permitted to be installed in ESS dedicated-use buildings without the protection of an automatic fire control and suppression system where fire and explosion testing conducted in accordance with 9.1.5 documents that an ESS fire does not compromise the means of egress and does not present an exposure hazard to buildings, lot lines, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure.

4.9.1.6 When approved by the AHJ, ESS shall be permitted to be installed in outdoor walk-in enclosures without the protection of an automatic fire control and suppression system where fire and explosion testing conducted in accordance with 9.1.5 documents that an ESS fire does not compromise the means of egress and does not present an exposure hazard in accordance with 9.5.2.6.1 and 9.5.2.6.1.7.

4.9.2 Sprinkler System. Sprinkler systems shall be installed in accordance with *NFPA 13* or equivalent.

4.9.2.1 Sprinkler systems for ESS units (groups) with a maximum stored energy of 50 kWh, as described in 9.4.2.1, shall be designed using a minimum density of 0.3 gpm/ft² (12.2 mm/min) based over the area of the room or 2500 ft² (230 m²) design area, whichever is smaller, unless a lower density is approved based upon fire and explosion testing in accordance with 9.1.5.

4.9.2.2* Sprinkler systems for ESS units (groups) exceeding 50 kWh shall use a density based on fire and explosion testing in accordance with 9.1.5.

4.9.3 Alternate Automatic Fire Control and Suppression Systems.

4.9.3.1* Other automatic fire control and suppression systems shall be permitted based on reports issued as a result of fire and explosion testing in accordance with 9.1.5.

4.9.3.2* The automatic fire control and suppression systems shall comply with the following standards, or their equivalent, as appropriate:

- (1) NFPA 12
- (2) NFPA 15
- (3) NFPA 750
- (4) NFPA 770
- (5) NFPA 2001
- (6) NFPA 2010

4.9.4 Water Supply.

4.9.4.1* Where required elsewhere in this standard, sites where nonmechanical ESS are installed shall be provided with a permanent source of water for fire protection, unless modified in Chapters 9 through 13.

4.9.4.2 Where no permanent adequate and reliable water supply exists for firefighting purposes, the requirements of NFPA 1142 shall apply.

4.9.4.3 Accessible fire hydrants shall be provided for site ESS installations where a public or private water supply is available.

4.9.4.4 Fire hydrants installed on private fire service mains shall be installed in accordance with NFPA 24 or equivalent local requirement where NFPA 24 is not adopted.

4.10 Mobile ESS Equipment and Operations. Mobile ESS equipment and operations shall comply with 9.5.3.2, as applicable.

Chapter 5 System Interconnections

5.1 General. System interconnections shall comply with Section 5.2 through Section 5.4, as applicable.

5.2 Disconnecting Means. A readily accessible disconnecting means for the ESS shall be provided.

5.2.1 Lead-acid and nickel-cadmium battery systems less than 60 V dc shall not be required to comply with Section 5.2.

5.2.2 Lead-acid and nickel-cadmium battery systems that are 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 Section 5.2.

5.3 Nonelectrical Systems.

5.3.1 Natural Gas. Piping, valves, and fittings from the outlet of the supplier's piping to the outlet of the ESS shutoff valve shall be in accordance with NFPA 54.

5.3.2 Compressed Natural Gas (CNG). The design, location, and installation of piping, valves, and fittings from the outlet of the point of delivery from the supplier to the inlets of the equipment shutoff valves shall be in accordance with NFPA 52.

5.3.3 Liquefied Petroleum Gas (LP-Gas) Systems and Storage. The design, location, and installation of liquefied petroleum gas (LP-Gas) storage and piping systems shall comply with NFPA 58.

5.3.4 Hydrogen Fuel Systems and Storage. The design, location, and installation of hydrogen gas and liquid hydrogen storage and piping systems shall comply with NFPA 2.

5.3.5 Biogas. Storage tanks and their associated equipment, piping, valves, and regulators shall be designed and installed in accordance with NFPA 54.

5.3.6 Liquid Fuels. The design of liquid fuel piping systems and the location and storage of liquid fuels shall be in accordance with NFPA 30.

5.3.7 Water. Where the ESS requires a permanent water supply to operate, it shall be provided through a connection to an on-site water supply in accordance with ICC's *International Plumbing Code*, IAPMO's *Uniform Plumbing Code*, or local regulations; or through a self-contained water source.

5.4* Support Systems. All connections to and from an ESS or the components of an ESS to required plumbing, fire alarm, detection, or control circuits or to ventilation systems shall be in accordance with nationally recognized standards applicable to those systems, manufacturer's instructions, listings, and the applicable provisions of Chapters 4 and 5.

Chapter 6 Commissioning

6.1 System Commissioning.

6.1.1 ESS shall be evaluated and confirmed for proper operation by the system owner or their designated agent.

6.1.1.1 Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or walk-in units used exclusively for such installations that comply with NFPA 76 shall be permitted to have a commissioning plan complying with recognized industry practices in lieu of complying with 6.1.5.2.

6.1.1.2* Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utilities and located in building spaces or walk-in units used exclusively for such installations shall be permitted to have a commissioning plan in accordance with applicable governmental laws and regulations in lieu of developing a commissioning plan in accordance with 6.1.5.2.

6.1.2 System commissioning shall be conducted after the installation is complete but prior to final inspection and approval.

6.1.3 Commissioning Plan.

6.1.3.1 The system installer or commissioning agent shall prepare a written commissioning plan that provides a description of the means and methods necessary to document and verify that the system and its associated controls and safety systems, as required by this standard, are in proper working condition.

6.1.3.2 The commissioning plan shall include, but not be limited to, the following information:

- (1) An overview of the commissioning process developed specifically for the ESS to be installed and narrative description of the activities to be conducted
- (2) Roles and responsibilities for all those involved in the design, commissioning, construction, installation, or operation of the system(s)

- (3) Means and methods whereby the commissioning plan will be made available during the implementation of the ESS project(s)
- (4) Plans and specifications necessary to understand the operation of the ESS and all associated operational controls and safety systems
- (5) A detailed description of each activity to be conducted during the commissioning process, who will perform each activity, and at what point in time the activity is to be conducted
- (6) Procedures to be used in documenting the proper operation of the ESS and all associated operational controls and safety systems
- (7) Testing for any required fire detection or suppression and thermal management, ventilation, or exhaust systems associated with the installation and verification of proper operation of the safety controls
- (8) The following documentation:
 - (a) Commissioning checklist
 - (b) Relevant operational testing forms
 - (c) Necessary commissioning logs
 - (d) Progress reports
- (9) Means and methods whereby facility operation and maintenance staff will be trained on the system
- (10) Identification of personnel who are qualified to service and maintain the system and respond to incidents involving each system
- (11) A decommissioning plan meeting the provisions of Section 8.1 that covers the removal of the system from service and from the facility in which it is located and information on disposal of materials associated with each ESS

6.1.4 Commissioning Test.

6.1.4.1 ESS shall be evaluated for their proper operation by the system installer in accordance with the manufacturer's instructions, the commissioning plan, and the requirements of this section after the installation is complete but prior to final approval.

6.1.4.2 System testing shall be conducted as a component of the commissioning process and include functional performance testing of the ESS that demonstrates that the installation and operation of the system and associated components, controls, and safety-related systems are in accordance with approved plans and specifications and that the operation, function, and maintenance serviceability for each of the commissioned ESS is confirmed.

N 6.1.5 Commissioning Report.

Δ 6.1.5.1 The commissioning report shall be provided by the system installer or commissioning agent to the system(s) owner and the AHJ prior to final inspection and approval.

Δ 6.1.5.2 The commissioning report shall document the commissioning process and the results in accordance with 6.1.5.2.1, 6.1.5.2.2, and 6.1.5.2.3.

Δ 6.1.5.2.1 A commissioning report shall summarize the commissioning process and verify the proper operation of the system and associated operational controls and safety systems.

6.1.5.2.2 The report shall include the final commissioning plan, the results of the commissioning process, and a copy of

the plans and specifications associated with the as-built system design and installation.

6.1.5.2.3 The report shall include any issues identified during commissioning and the measures taken to resolve them.

N 6.1.5.3 Corrective Action Plan.

6.1.5.3.1 A corrective action plan acceptable to the AHJ shall be developed for any open or continuing issues that are allowed to be continued after commissioning.

N 6.1.5.3.2 The corrective action plan shall be accepted by the AHJ prior to the ESS being placed into service.

N 6.1.5.4 A copy of the commissioning report shall be kept with the ESS operations and maintenance manuals required by 4.2.3.

6.2 Issues and Resolutions Documentation. (Reserved)

6.3 Operations and Maintenance Documentation.

6.3.1 Operations and maintenance documentation shall be provided to the ESS owner.

6.3.2 The documentation shall include design, construction, installation, testing, and commissioning information associated with the ESS as initially approved after being commissioned.

6.3.3 A copy of the documentation shall be placed in an approved location to be accessible to facility personnel, fire code officials, and emergency responders.

6.4* Recommissioning of Existing Systems.

6.4.1 Recommissioning shall meet the provisions of Section 6.1 and include the entire system with issuance of a new commissioning report, identification of any new issues and resolutions documentation, and identification of any revisions to the operations and maintenance documentation.

6.4.2* When alterations, additions, repositioning, or renovations to the system or any of its components are warranted, they shall be permitted in accordance with Chapter 4 and be performed by qualified entities and the system recommissioned in accordance with Section 6.1.

6.4.3 Repairs or renewals to systems utilizing identical components shall not require recommissioning.

6.4.4* Listed ESS that has been modified in the field beyond the field-installed options that are part of the listing shall be investigated and found suitable by the organization that listed the equipment.

Chapter 7 Operation and Maintenance

7.1 System Operation. All ESS shall be operated in accordance with the manufacturer's instructions and the operation and maintenance documentation.

7.1.1 Electric Utilities Under NERC Jurisdiction.

7.1.1.1 Electric utilities under NERC jurisdiction shall comply with NERC PRC-005 requirements.

Δ 7.1.1.2 Electric utilities under NERC jurisdiction shall not be required to follow manufacturer's instructions for lead-acid and nickel-cadmium battery systems that are 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.

▲ **7.1.2** The operation and maintenance documentation shall include the following:

- (1) Procedures for the safe startup of the ESS system and associated equipment
- (2) Procedures for inspection and testing of associated alarms, interlocks, and controls
- (3) Procedures for maintenance and operation of the following, where applicable:
 - (a) Energy storage management systems (ESMS)
 - (b) Fire protection equipment and systems
 - (c) Spill control and neutralization systems
 - (d) Exhaust and ventilation equipment and systems
 - (e) Gas detection systems
 - (f) Other required safety equipment and systems
- (4) Response considerations similar to a safety data sheet (SDS) that address response safety concerns and extinguishment where an SDS is not required
- (5)* An instruction that equipment or system changes to the installation are required to be recorded by updating any engineering documentation

7.1.3 SDS for Hazardous Materials.

7.1.3.1 SDS for hazardous materials contained in the ESS shall be posted within sight of the disconnecting means of any ESS or at a location approved by the AHJ.

▲ **7.1.3.2** For ESS located outdoors, a means shall be provided to protect the SDS from the weather.

7.1.4 Where the operations and maintenance documentation calls for detailed procedures to be used for specific scheduled operational checks or assessments, an operations record that includes data associated with configurable system settings, system start-up, system shutdown (including emergency shutdown), and long-term shutdown (storage mode) shall be maintained by the system owner or their designated agent and be made available to the AHJ upon request.

• **7.1.5** The operations record shall be kept in a readily accessible location, or a sign indicating where the record is located shall be posted adjacent to the system.

▲ **7.1.5.1** For normally occupied facilities, the operations record shall be on site.

▲ **7.1.5.2** The operations record shall be permitted to be made available electronically.

7.2* System Maintenance. The ESS shall be maintained in accordance with the system manufacturer's instructions.

7.2.1 The maintenance documentation shall include a detailed maintenance schedule covering all affected equipment and the activities to be performed.

7.2.2 Maintenance shall be performed by qualified individuals.

7.2.3 Maintenance documentation indicating the maintenance action taken, the date of the action, who implemented the action, and the results associated with the action shall be maintained as required by Section 6.3.

7.2.4 Maintenance documentation shall record information on any repair, renewal, or renovation made to the ESS.

7.2.5 Training. Training shall be provided to all those responsible for system operation and maintenance.

7.2.5.1 Training on system operation and maintenance shall be provided by the system owner or their designated agent.

7.2.5.2 After recommissioning the system, training on any changes to the operation and maintenance documentation shall be provided.

7.2.5.3 Training records of site operations and maintenance personnel shall be retained and accessible to the AHJ, indicating the training taken, the name(s) of those taking the training, and the training date.

7.3 System Testing.

7.3.1 System testing shall be performed when required by the operating instructions or maintenance documentation in accordance with testing procedures provided by the ESS manufacturer.

7.3.2 A record of all testing shall be maintained in accordance with the requirements in Section 6.3.

■ **7.3.2.1** Testing records shall be permitted to be made available electronically.

Chapter 8 Decommissioning

8.1 Decommissioning Plan. Prior to decommissioning, the owner of an ESS or their designated agent(s) shall prepare a written decommissioning plan complying with 8.1.3 that provides the organization, documentation requirements, and methods and tools necessary to indicate how the safety systems as required by this standard and the ESS and its components will be decommissioned and the ESS removed from the site.

▲ **8.1.1** Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces or walk-in units used exclusively for such installations that are in compliance with NFPA 76 shall be permitted to have a decommissioning plan in compliance with recognized industry practices in lieu of complying with 8.1.3.

▲ **8.1.2*** Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shutdown of generating stations under the exclusive control of the electric utilities and located outdoors or in building spaces used exclusively for such installations shall be permitted to have a decommissioning plan complying with applicable governmental laws and regulations in lieu of complying with 8.1.3.

8.1.3* The decommissioning plan shall be provided to the AHJ and include the following information:

- (1) An overview of the decommissioning process developed specifically for the ESS that is to be decommissioned
- (2) Roles and responsibilities for all those involved in the decommissioning of the ESS and their removal from the site

- (3) Means and methods in the decommissioning plan submitted during the permitting process to be made available at a point in time corresponding to the decision to decommission the ESS
- (4) Plans and specifications necessary to understand the ESS and all associated operational controls and safety systems, as built, operated, and maintained
- (5) A detailed description of each activity to be conducted during the decommissioning process and who will perform that activity and at what point in time
- (6) Procedures to be used in documenting the ESS and all associated operational controls and safety systems that have been decommissioned
- (7) Guidelines and format for a decommissioning checklist and relevant operational testing forms and necessary decommissioning logs and progress reports
- (8) A description of how any changes to the surrounding areas and other systems adjacent to the ESS, including, but not limited to, structural elements, building penetrations, means of egress, and required fire detection and suppression systems, will be protected during decommissioning and confirmed as being acceptable after the system is removed

8.2 Decommissioning Process.

8.2.1 The AHJ shall be notified prior to decommissioning an ESS.

8.2.2 The ESS shall be decommissioned by the owner of the ESS or their designated agent(s) in accordance with the decommissioning plan.

8.3 Decommissioning Report. A decommissioning report shall be prepared by the ESS owner or their designated agent and summarize the decommissioning process of the system and associated operational controls and safety systems.

8.3.1 The report shall include the final decommissioning plan and the results of the decommissioning process.

8.3.2 The report shall include any issues identified during decommissioning and the measures taken to resolve them.

N 8.3.3 The decommissioning report shall be retained by the owner and provided to the AHJ upon request.

Chapter 9 Electrochemical Energy Storage Systems

9.1 General.

9.1.1* The requirements of this chapter shall apply to installations of electrochemical ESS, including, but not limited to, battery ESS and electrochemical double-layer capacitor (EDLC) ESS.

N 9.1.2 This chapter shall not apply to surge capacitors installed in accordance with Article 460 of *NFPA 70*.

N 9.1.3* This chapter shall not apply to capacitors and capacitor equipment for electric utilities and industrial facilities used in applications such as flexible ac transmission (FACTS) devices, filter capacitor banks, power factor correction, and standalone capacitor banks for voltage correction and stabilization.

9.1.4 Unless modified by this chapter, the requirements of Chapters 4 through 8 shall also apply.

N 9.1.5 Fire and Explosion Testing.

N 9.1.5.1* Where required elsewhere in this standard, fire and explosion testing in accordance with 9.1.5 shall be conducted on a representative ESS in accordance with UL 9540A or equivalent test standard.

N 9.1.5.1.1 Lead-acid and nickel-cadmium batteries used in standby power systems and listed to UL 1973 shall not require UL 9540A testing when they are installed with a charging system that is listed to UL 1012, UL 60950-1, or UL 62368-1, or a UPS listed to UL 1778.

N 9.1.5.1.2 The testing shall be conducted or witnessed and reported by an approved testing laboratory to characterize the composition of the gases generated and show that a fire involving one ESS unit will not propagate to an adjacent unit.

N 9.1.5.1.3* The representative cell, modules, and units tested, including any optional integral fire suppression system, shall match the intended installation configuration other than the addition of the cell failure mechanism utilized for cell thermal runaway initiation.

N 9.1.5.1.4 The testing shall include evaluation of deflagration mitigation measures when designed into ESS cabinets.

N 9.1.5.2* Test Reports.

N 9.1.5.2.1 The complete test report and its supporting data shall be provided to the AHJ for review and approval.

N 9.1.5.2.2 The test report shall be accompanied by a supplemental report prepared by a registered design professional with expertise in fire protection engineering that provides interpretation of the test data in relation to the installation requirements for the ESS.

N 9.2 Equipment.

N 9.2.1 Listing.

N 9.2.1.1 ESS shall be listed in accordance with UL 9540, unless specifically exempted elsewhere in this standard.

N 9.2.1.2 Lead-Acid and Nickel-Cadmium Battery Systems.

N 9.2.1.2.1* Lead-acid and nickel-cadmium batteries, where used in a stationary standby service with 600 V dc or less, shall be permitted to be listed to UL 1973.

N 9.2.1.2.2* 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 used in stationary standby service and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 shall not be required to be listed in accordance with UL 9540.

N 9.2.1.2.3* Lead-acid and nickel-cadmium battery systems that are 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.

N 9.2.1.2.4 Lead-acid battery systems in uninterruptible power supplies listed and labeled in accordance with UL 1778 and utilized for standby power applications, which are limited to not more than 10 percent of the floor area on the floor on

which the ESS is located, shall not be required to be listed in accordance with UL 9540.

N 9.2.2 HMA for Existing Lithium-Ion ESS.

N 9.2.2.1 Existing lithium-ion ESS that are not UL 9540 listed shall require a hazard mitigation analysis in accordance with Section 4.4.

N 9.2.2.2 Lithium-ion ESS shall be upgraded with additional hazard mitigation measures where required by the AHJ based on the findings in the hazard mitigation analysis.

N 9.2.3 Energy Storage Management System (ESMS).

N 9.2.3.1* Where required by the equipment listing in accordance with 4.6.1 or the hazard mitigation analysis in accordance with Section 4.4, an approved ESMS or BMS shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications, unless modified in accordance with Chapters 9 through 13.

N 9.2.3.2* The ESMS or BMS shall electrically isolate the ESS or affected components of the ESS or place the system in a safe condition if potentially hazardous conditions are detected.

N 9.2.3.3* 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.

N 9.2.3.4 Lead-Acid and Nickel-Cadmium Battery Systems.

N 9.2.3.4.1* 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 comply with NFPA 76 shall not be required to comply with 9.2.3.1 through 9.2.3.3.

N 9.2.3.4.2* Lead-acid and nickel-cadmium battery systems that are 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 9.2.3.1 through 9.2.3.3.

N 9.2.3.4.3 Lead-acid and nickel-cadmium battery systems in uninterruptible power supplies listed and labeled in accordance with UL 1778 and used in standby power applications shall not be required to comply with 9.2.3.1 through 9.2.3.3.

N 9.2.4 Repurposed and Refurbished Batteries.

N 9.2.4.1 Batteries that have been repurposed or refurbished shall meet the applicable technology-specific requirements in Table 9.6.5.

N 9.2.4.2* 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 where reused in ESS applications and the system complies with 4.6.1.

N 9.3 Location Classification. Installation locations shall be classified as specified in 9.3.1 or 9.3.2.

N 9.3.1 Indoor Installations. Indoor installations shall be classified in accordance with 9.3.1.1 or 9.3.1.2.

N 9.3.1.1 Energy Storage System (ESS) Dedicated-Use Buildings.

ESS dedicated-use 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, or energy storage in conjunction with energy generation, electrical grid-related operations, or communications utility equipment.
- (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 or communication 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 if the following conditions are met:
 - (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.

N 9.3.1.2 Non-Dedicated-Use Buildings. Non-dedicated-use buildings shall include all buildings that contain ESS and do not comply with ESS dedicated-use building requirements in 9.3.1.1.

N 9.3.2 Outdoor Installations. Outdoor ESS installations shall be classified as follows:

- (1) *Remote locations:* 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:* all outdoor ESS locations that do not comply with remote outdoor location requirements
- (3) Specific outdoor locations, as follows:
 - (1) *Rooftop installations:* ESS installations located on the roofs of buildings
 - (2) *Open parking garage installations:* ESS installations located in a structure or portion of a structure as defined in 3.3.19
 - (3) Mobile ESS installations

N 9.4 Installation.

N 9.4.1 Maximum Stored Energy. ESS in the following locations shall comply with Section 9.4 as follows:

- (1) Fire areas within non-dedicated-use buildings containing ESS shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.1.
- (2) Outdoor ESS installations in locations near exposures shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.
- (3) ESS installations in open parking garages and on rooftops of buildings shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.

- (4) Mobile ESS equipment as covered by 9.5.3.2 shall not exceed the maximum stored energy values in Table 9.4.1 except as permitted by 9.4.1.2.

N 9.4.1.1 Where approved by the AHJ, fire areas in non-dedicated-use buildings containing ESS that exceed the amounts in Table 9.4.1 shall be permitted based on a hazard mitigation analysis in accordance with Section 4.4 and fire and explosion testing complying with 9.1.5.

N 9.4.1.2 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 9.4.1 shall be permitted based on a hazard mitigation analysis in accordance with Section 4.4 and fire and explosion testing in accordance with 9.1.5.

N 9.4.1.3 Where a single fire area within a building or walk-in unit contains a combination of energy systems covered in Table 9.4.1, 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.

N 9.4.1.4 The sum of the percentages calculated in 9.4.1.3 shall not exceed 100 percent except as permitted in 9.4.1.1 or 9.6.2.3.

N 9.4.2* Size and Separation.

N 9.4.2.1 ESS shall be comprised of groups with a maximum stored energy of 50 kWh each.

N 9.4.2.2 Each group shall be spaced a minimum 3 ft (0.9 m) from other groups and from walls in the storage room or area.

N 9.4.2.3 The AHJ shall be permitted to approve groups with larger energy capacities or smaller group spacing based on performance criteria from fire and explosion testing complying with 9.1.5.

N 9.4.2.4 Lead-Acid and Nickel-Cadmium Battery Systems.

N 9.4.2.4.1* Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities that comply with NFPA 76.

N 9.4.2.4.2* Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or safe shut-down of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

N 9.4.2.4.3 Paragraphs 9.4.2.1 and 9.4.2.2 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.

N 9.4.2.4.4 Lead-acid and nickel-cadmium batteries listed to UL 1973 and used in stationary standby applications shall be comprised of groups with a maximum stored energy of 250 kWh each.

N 9.5 Location and Applications.

N 9.5.1 Indoor Installations. Indoor ESS installations shall comply with this section and as detailed in Table 9.5.1.

N 9.5.1.1 ESS Dedicated Use Buildings.

N 9.5.1.1.1 Where approved by the AHJ, the fire control and suppression systems, the size and separation requirements, and the water supply shall be permitted to be omitted in ESS 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.

N 9.5.1.1.2 When approved, alarm signals shall not be required to be transmitted to an approved location when local fire alarm annunciation is provided and trained personnel are always present.

N Table 9.5.1 Indoor ESS Installations

Compliance Required	ESS Dedicated-Use Buildings	Non-Dedicated-Use Buildings	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Size and separation	Yes	Yes	9.4.2
Maximum stored energy	No	Yes	9.4.1
Elevation	Yes	Yes	4.7.7
Fire barriers	NA	Yes	9.6.4
Smoke and fire detection	Yes	Yes	9.6.1
Fire control and suppression	Yes	Yes	9.6.2
Water supply	Yes	Yes	9.6.3
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Yes	9.5.1.2.1
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N Table 9.4.1 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.

Shaded text = Revisions. **Δ** = Text deletions and figure/table revisions.

• = Section deletions.

N = New material.



N 9.5.1.2 Non-Dedicated-Use Buildings.

N 9.5.1.2.1* Occupied Work Centers. ESS in occupied work centers shall comply with this section.

N 9.5.1.2.1.1 ESS shall be permitted in the same room as the equipment that they support.

N 9.5.1.2.1.2 ESS shall be housed in a noncombustible, locked cabinet or other enclosure to prevent access by unauthorized personnel unless located in an equipment room accessible only to authorized personnel.

N 9.5.1.2.2 Dwelling Units and Sleeping Units.

N 9.5.1.2.2.1 Stationary ESS shall not be installed in sleeping rooms or closets or spaces opening directly into sleeping rooms.

N 9.5.1.2.2.2 Stationary ESS shall not be installed in living areas of dwelling units unless specifically allowed in Chapters 9 through 13.

N 9.5.1.2.2.3 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.

N 9.5.2 Outdoor Installations. Outdoor ESS installations shall comply with this section and as detailed in Table 9.5.2.

N 9.5.2.1 HMA. A HMA shall be required for lithium-ion ESS that exceed 600 kWh (2,160 MJ) for outdoor ESS installations,

ESS installations in open parking garages and on rooftops of buildings, and mobile ESS equipment.

N 9.5.2.2 Vegetation Control.

N 9.5.2.2.1 Areas within 10 ft (3 m) on each side of outdoor ESS shall be cleared of combustible vegetation and other combustible growth.

N 9.5.2.2.2 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.

N 9.5.2.3 Walk-in Units.

N 9.5.2.3.1 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.

N 9.5.2.3.2* Walk-in units shall comply with this standard and local building code requirements.

N 9.5.2.3.3 Spacing shall not be required between the ESS and the enclosure walls in outdoor walk-in units.

N 9.5.2.4 Maximum Size.

N 9.5.2.4.1 Outdoor ESS walk-in units or ESS cabinets 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.

N 9.5.2.4.2 Outdoor ESS walk-in units or ESS cabinets that exceed the dimensions in 9.5.2.4.1 shall be treated as indoor installations and comply with the requirements in 9.5.1.

N 9.5.2.5 Remote Locations. When agreeable with the ESS owner and approved by the AHJ, fire suppression systems and water supply shall not be required.

N 9.5.2.6 Locations Near Exposures.

N 9.5.2.6.1 Clearance to Exposures. ESS located outdoors shall be separated by a minimum 10 ft (3 m) 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

N 9.5.2.6.1.1 The required separation distances shall be permitted to be reduced to 3 ft (0.9 m) 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.

N 9.5.2.6.1.2 Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) 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 9.6.4.

N Table 9.5.2 Outdoor Stationary ESS Installations

Compliance Required	Remote Locations	Locations Near Exposures	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Maximum size	Yes	Yes	9.5.2.4
Clearance to exposures	NA	Yes	9.5.2.6.1
Means of egress separation	NA	Yes	9.5.2.6.1.7
Walk-in units	Yes	Yes	9.5.2.3
Vegetation control	Yes	Yes	9.5.2.2
Enclosures	Yes	Yes	4.6.12
Size and separation	No	Yes	9.4.2
Maximum stored energy	No	Yes	9.4.1
Smoke and fire detection	Yes	Yes	9.6.1
Fire control and suppression	Yes	Yes	9.6.2
Water supply	Yes	Yes	9.6.3
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Not allowed	9.5.1.2.1
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N 9.5.2.6.1.3 Clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) based on fire and explosion testing complying with 9.1.5.

N 9.5.2.6.1.4 Where approved, clearances to exposures other than buildings shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing of the ESS in accordance with 9.1.5 demonstrates that a fire within the ESS enclosure will not generate radiant heat flux sufficient to ignite stored materials or otherwise threaten the exposure.

N 9.5.2.6.1.5 Clearances to buildings and exposures shall be permitted to be reduced to 3 ft (0.9 m) where the enclosure of the ESS has a 2-hour fire resistance rating established in accordance with ASTM E119 or UL 263.

N 9.5.2.6.1.6 ESS Exhaust Outlets. ESS exhaust outlets shall comply with the following:

- (1) Exhaust outlets from an ESS that exhaust other than ventilation air shall be located at least 15 ft (4.57 m) from heating, ventilating, and air conditioning (HVAC) air intakes, windows, doors, loading docks, ignition sources, and other openings into buildings and facilities.
- (2) Exhaust outlet(s) from an ESS shall not be directed onto means of egress, walkways, or pedestrian or vehicular travel paths.

N 9.5.2.6.1.7 Means of Egress Separation.

N (A) ESS located outdoors shall be separated from any accessible means of egress as required by the AHJ to ensure safe egress under fire conditions but in no case less than 10 ft (3 m).

N (B) Where approved by the AHJ, clearances to accessible means of egress shall be permitted to be reduced to 3 ft (0.9 m) where fire and explosion testing in accordance with 9.1.5 demonstrates that a fire within the ESS will not adversely impact the means of egress.

N 9.5.2.6.1.8 Exterior Wall Installations.

N (A) 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 (0.9 m).
- (5) The ESS shall be separated from doors, windows, operable openings into buildings, or HVAC inlets by at least 5 ft (1.5 m).

N (B) Where approved by the AHJ, smaller separation distances in 9.5.2.6.1.8(A)(4) and 9.5.2.6.1.8(A)(5) shall be permitted based on fire and explosion testing in accordance with 9.1.5.

N 9.5.3 Specific Outdoor Locations.

N 9.5.3.1 Rooftop and Open Parking Garage Installations. Rooftop and open parking garage ESS installations shall comply with this section and as detailed in Table 9.5.3.1.

N Table 9.5.3.1 Rooftop and Open Parking Garage ESS Installations

Compliance Required	Rooftops	Open Parking Garages	Reference
Administrative	Yes	Yes	Chapters 1–3
General	Yes	Yes	Sections 4.1–4.7
Maximum size	Yes	Yes	9.5.2.4
Means of egress separation	Yes	Yes	9.5.2.6.1.7
Walk-in units	Yes	Yes	9.5.2.3
Enclosures	Yes	Yes	4.6.12
Clearance to exposures	Yes	Yes	9.5.3.1.3
Fire suppression and control	Yes	Yes	9.5.3.1.4
Size and separation	Yes	Yes	9.4.2
Maximum stored energy	Yes	Yes	9.4.1
Elevation	Yes	Yes	4.7.7
Smoke and fire detection	Yes	Yes	9.6.1
Signage	Yes	Yes	4.7.4
Occupied work centers	Not allowed	Not allowed	9.5.1.2.1
Open rack installations	Not allowed	Not allowed	4.7.9
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

N 9.5.3.1.1 Rooftop Installations.

N 9.5.3.1.1.1 Installations shall be permitted on rooftops of buildings that do not obstruct fire department rooftop operations when approved.

N 9.5.3.1.1.2 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 (1.5 m) 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 (1.5 m) 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 4.8 shall be provided to protect the ESS.
- (9) The ESS shall be a minimum of 10 ft (3 m) from the fire service access point on the rooftop.

N 9.5.3.1.2 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 automatic 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 fire, explosion, and fault condition testing conducted in accordance with 9.1.5.
- (3) Means of egress separation shall comply with 9.5.2.6.1.7.
- (4) A radiant energy-sensing fire detection system complying with Section 4.8 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.

N 9.5.3.1.3 Clearance to Exposures.

N 9.5.3.1.3.1 ESS located on rooftops and in open parking garages shall be separated by a minimum 10 ft (3 m) 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

N 9.5.3.1.3.2 Clearances shall be permitted to be reduced to 3 ft (0.9 m) 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 fire and explosion testing complying with 9.1.5

N 9.5.3.1.4 Fire Suppression and Control.

N 9.5.3.1.4.1 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 4.9.

N 9.5.3.1.4.2 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 4.9.

N 9.5.3.1.4.3 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 fire and explosion testing conducted in accordance with 9.1.5 indicates that an ESS fire does not present an exposure hazard to parked vehicles or compromise the means of egress.

N 9.5.3.2 Mobile ESS Equipment and Operations. Mobile ESS operation shall be classified as specified in 9.5.3.2.1 or 9.5.3.2.2.

N 9.5.3.2.1 Charging and Storage.

N 9.5.3.2.1.1 For the purpose of 9.5.3.2, 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.

N 9.5.3.2.1.2 Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are 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 9.5.3.2.1.

N 9.5.3.2.2 Deployment.

N 9.5.3.2.2.1 For the purpose of 9.5.3.2, 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.

N 9.5.3.2.2.2 Mobile ESS used to temporarily provide power to lead-acid and nickel-cadmium battery systems that are 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 9.5.3.2.2.

N 9.5.3.2.3 Approved Locations. Locations where mobile ESS are charged, stored, and deployed shall be restricted to the locations approved by the AHJ.

N 9.5.3.2.4 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.

N 9.5.3.2.5 Charging and Storage Requirements. 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 9.5.2.4.1.
- (2) Outdoor charging and storage shall comply with 9.5.2.
- (3) Charging and storage on rooftops and in open parking garages shall comply with 9.5.3.1.

N 9.5.3.2.5.1 Construction documents complying with Section 4.2 shall be provided to the AHJ with any locally required construction permit applications for mobile ESS charging and storage locations.

N 9.5.3.2.5.2 Electrical connections shall be permitted to be made using temporary wiring complying with the manufacturer's instructions, the UL 9540 listing, and *NFPA 70*.

N 9.5.3.2.5.3 Fire suppression system connections to the water supply shall be acceptable to the AHJ.

N 9.5.3.2.6 Deployed Mobile ESS Requirements. Deployed mobile ESS equipment and operations shall comply with this section and Table 9.5.3.2.6.

N 9.5.3.2.6.1 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 Section 4.2
- (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

N 9.5.3.2.6.2 Restricted Locations. Deployed mobile ESS operations shall not be located indoors, in covered parking garages, on rooftops, below grade, or under building overhangs.

N 9.5.3.2.6.3 Wheeled Vehicles. Mobile operations on wheeled vehicles or trailers shall not be required to comply with 4.7.2 seismic protection requirements.

N 9.5.3.2.6.4 Fire Suppression Connections. Fire suppression system connections to the water supply shall be permitted to use approved temporary connections.

N 9.5.3.2.6.5 Duration.

N (A) Mobile ESS deployments that provide power for durations longer than 30 days shall comply with 9.5.3.2.5.

N (B) Mobile ESS deployments in excess of 30 days, for emergencies, shall not be required to comply with 9.5.3.2.5, with AHJ approval.

N 9.5.3.2.6.6 Clearance to Exposures.

N (A) 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

N (B) Required separation distances shall be permitted to be reduced in accordance with 9.5.2.6.1.1 through 9.5.2.6.1.4.

N (C) 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.

N 9.5.3.2.6.7 Electrical Connections. Electrical connections shall be made in accordance with the manufacturer's instructions.

N (A) Temporary wiring for electrical power connections shall comply with *NFPA 70* or equivalent code.

N (B) Fixed electrical wiring shall not be permitted.

N 9.5.3.2.6.8 Fencing.

N (A) 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.

N (B) A mobile ESS that is locked to prevent access by unauthorized persons shall be permitted to comply with 9.5.3.2.6.8(A).

N 9.6 Protection and Remediation.

N 9.6.1 Smoke and Fire Detection. Areas containing ESS systems located within buildings or structures shall be provided with a smoke detection or radiant energy-sensing system in accordance with Section 4.8, unless modified by this chapter.

N Table 9.5.3.2.6 Mobile Energy Storage Systems (ESS)

Compliance Required	Deployment	Reference
Administrative	Yes	Chapters 1–3
General	Yes	Sections 4.1–4.7
Size and separation	Yes ^a	9.4.2
Maximum stored energy	Yes	9.4.1
Fire and smoke detection	Yes ^b	9.6.1
Fire control and suppression	Yes ^c	9.6.2
Maximum size	Yes	9.5.2.4
Vegetation control	Yes	9.5.2.2
Means of egress separation	Yes	9.5.2.6.1.7
Technology-specific protection	Yes	9.6.5

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

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

^cOnly required for walk-in units.

N 9.6.2 Fire Control and Suppression.

N 9.6.2.1 Fire control and suppression for rooms or areas within buildings and outdoor walk-in units containing ESS shall be provided in accordance with Section 4.9, unless modified by this chapter.

N 9.6.2.2 Lead-Acid and Nickel-Cadmium Battery Systems.

N 9.6.2.2.1 Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are 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 comply with NFPA 76 shall not be required to have a fire suppression system installed.

N 9.6.2.2.2 Lead-acid battery systems in uninterruptable power supplies listed and labeled in accordance with the application used 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, shall not be required to have a fire suppression system installed.

N 9.6.2.2.3* Lead-acid and nickel-cadmium battery systems that are 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 have a fire suppression system installed.

N 9.6.2.3 Where more than one ESS technology is present within a fire area, the fire protection systems shall be designed to protect the greatest hazard.

N 9.6.3 Water Supply.

N 9.6.3.1 Sites where nonmechanical ESS are installed shall be provided with a permanent source of water for fire protection in accordance with 4.9.4, unless modified by this chapter.

N 9.6.3.2 Lead-Acid and Nickel-Cadmium Systems.

N 9.6.3.2.1* Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft² (139 m²) with lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc that are 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 comply with NFPA 76 shall not be required to have a fire water supply.

N 9.6.3.2.2 Lead-acid and nickel-cadmium battery systems that are 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 have a fire water supply.

N 9.6.4 Fire Barriers. 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.

N 9.6.4.1 Rooms or spaces, containing only ESS listed to UL 9540 and that are marked as meeting the cell-level performance criteria of UL 9540A, shall be permitted to be separated from other areas of the building with a minimum 1-hour fire resistance rating constructed in accordance with local building codes.

N 9.6.4.2 Lead-acid and nickel cadmium battery systems that are 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 have a 2-hour fire resistance separation from the rest of the building.

9.6.5 Technology-Specific Requirements. Electrochemical ESS shall comply with the applicable sections of Chapters 4 and 9 as specified in Table 9.6.5.

N 9.6.5.1* Exhaust Ventilation During Normal Operation. Where required by Table 9.6.5 or elsewhere in this standard, exhaust ventilation during normal operation shall be provided for rooms, enclosures, walk-in units, and cabinets as follows:

- (1) ESS rooms and walk-in units shall use mechanical exhaust ventilation in accordance with 9.6.5.1.5.
- (2) Outdoor ESS cabinets shall use either mechanical or natural exhaust ventilation in accordance with 9.6.5.1.4 or 9.6.5.1.5.

Δ Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

Compliance Required	Battery Technology				Sodium Nickel Chloride	EDLC Energy Storage	Other Electrochemical ESS and Battery Technologies*	Reference
	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow				
Exhaust ventilation	Yes	Yes	No	Yes	No	Yes	Yes	9.6.5.1
Spill control	Yes †	Yes †	No	Yes	No	Yes	Yes	9.6.5.2
Neutralization	Yes †	Yes †	No	Yes	No	Yes	Yes	9.6.5.3
Safety caps	Yes	Yes	No	No	No	Yes	Yes	9.6.5.4
Thermal runaway	Yes	Yes	Yes	No	Yes	Yes	Yes	9.6.5.5
Explosion control	Yes	Yes	Yes	No	Yes	Yes	Yes	9.6.5.6

*The protection in this column is not required if documentation acceptable to the AHJ, including a hazard mitigation analysis complying with Section 4.4, provides justification that the protection is not necessary based on the technology used.

†Applicable only to vented (e.g., flooded) batteries.

N 9.6.5.1.1 Ni-MH Batteries. Exhaust ventilation shall not be required for Ni-MH batteries.

N 9.6.5.1.2 Abnormal Conditions. Protection against the release of flammable gases during abnormal charging or thermal runaway conditions shall be in accordance with 9.6.5.6.

N 9.6.5.1.3 Indoor ESS Cabinets. Exhaust ventilation for ESS cabinets installed indoors shall evaluate air movement through the cabinet and exhaust from the room.

N 9.6.5.1.4* Natural Exhaust Ventilation. Exhaust ventilation 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 outdoor cabinet during the worst-case event of simultaneous “boost” charging of all the batteries, in accordance with nationally recognized standards.

N 9.6.5.1.5 Mechanical Exhaust Ventilation. Exhaust ventilation shall be provided in accordance with the applicable mechanical code and one of the following:

- (1) Where hydrogen is the gas generated, an exhaust ventilation rate based on hydrogen generation estimates sufficient to limit the maximum concentration of hydrogen to 1.0 percent of the total volume of the room, walk-in unit, or cabinet during the worst-case event of simultaneous “boost” charging of all the batteries, in accordance with nationally recognized standards
- (2) An exhaust ventilation rate based on the area 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

N 9.6.5.1.5.1 Mechanical exhaust ventilation shall be either continuous or activated by a gas detection system in accordance with 9.6.5.1.5.4.

N 9.6.5.1.5.2 Required mechanical exhaust ventilation systems shall be installed in accordance with the manufacturer’s installation instructions and local building, mechanical, and fire codes.

N 9.6.5.1.5.3 Required mechanical exhaust ventilation systems shall either be supervised by an approved central, proprietary, or remote station service in accordance with *NFPA 72* or initiate an audible and visual signal at an approved, constantly attended location.

N 9.6.5.1.5.4* Where gas detection is used to activate exhaust ventilation in accordance with 9.6.5.1.5.1, rooms, walk-in units, enclosures, walk-in containers, and cabinets containing ESS shall be protected by an approved continuous gas detection system that complies with the following:

- (1) The gas detection system shall be designed to activate the mechanical exhaust ventilation system when the level of flammable gas detected in the room, walk-in unit, enclosure, container, and cabinet exceeds 25 percent of the LFL of the flammable gas mixture.
- (2) The mechanical exhaust ventilation system shall remain on until the flammable gas detected is less than 25 percent of the LFL of the flammable gas mixture.
- (3) The gas detection system shall be provided with a minimum of 2 hours of standby power.
- (4) Failure of the gas detection system shall annunciate a trouble signal at an approved central, proprietary, or remote station in accordance with *NFPA 72* or at an approved, constantly attended location.

N 9.6.5.2 Spill Control.

N 9.6.5.2.1 Rooms, buildings, or areas containing ESS with free-flowing liquid electrolyte in individual vessels having a capacity of more than 55 gal (208 L) or multiple vessels having an aggregate capacity exceeding 1000 gal (3785 L) shall be provided with spill control to prevent the flow of liquids to adjoining areas.

N 9.6.5.2.2* An approved method and materials for the control of a spill of electrolyte or other hazardous liquid shall be provided that will be capable of controlling a spill from the single largest vessel.

N 9.6.5.2.3 In rooms, buildings, or areas protected by water-based fire protection systems, the capacity of the spill containment system shall accommodate the capacity of the expected fire protection system discharge for a period of 10 minutes.

N 9.6.5.2.4 The capacity increase in 9.6.5.2.3 shall not apply to integral spill containment systems that are shielded from the fire protection system discharge.

N 9.6.5.2.5 Sealed valve-regulated lead-acid (VRLA) batteries and other ESS equipment with immobilized electrolyte and immobilized hazardous liquids shall not require spill control.

N 9.6.5.2.6 Rooms, buildings, or areas containing other hazardous materials shall include spill control as required in *NFPA 1*.

N 9.6.5.3 Neutralization.

N 9.6.5.3.1* An approved method to neutralize spills from ESS with free-flowing electrolyte shall be provided.

N 9.6.5.3.2 Neutralization shall not be required for ESS with immobilized electrolyte.

N 9.6.5.3.3 The method shall be capable of neutralizing a spill from the largest battery or vessel to a pH between 5.0 and 9.0.

9.6.5.4* Safety Caps. Where required by Table 9.6.5, vented batteries used in ESS shall be provided with flame-arresting safety caps.

9.6.5.5* Thermal Runaway Protection. Where required by Table 9.6.5, a listed device evaluated as part of the ESS or other approved method shall be provided to manage charging and discharging during normal operation of the ESS to maintain batteries and capacitors within their safe operating parameters and preclude thermal runaway.

N 9.6.5.5.1 Thermal runaway protection shall not be required for vented (e.g., flooded) lead-acid and Ni-Cd batteries.

N 9.6.5.5.2 Thermal runaway protection shall be permitted to be provided by the battery management system or a capacitor ESS management system that has been evaluated as part of the UL 1973 or UL 9540 listing.

N 9.6.5.6* Explosion Control.

N 9.6.5.6.1 Where required elsewhere in this standard, explosion prevention or deflagration venting shall be provided in accordance with this section.

N 9.6.5.6.1.1 Explosion prevention and deflagration venting shall not be required where approved by the AHJ based on fire and explosion testing in accordance with 9.1.5 and a deflagration hazard study demonstrating that flammable gas concentrations cannot exceed 25 percent of the LFL.

N 9.6.5.6.1.2 Explosion control shall not be required for the following:

- (1) Lead-acid and Ni-Cd 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 in building spaces or walk-in units used exclusively for such installations that comply with NFPA 76
- (2) Lead-acid and Ni-Cd battery systems that are 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 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 the application used for standby power applications, and housed in a single cabinet in a single fire area in buildings or walk-in units
- (4) Lead-acid and Ni-Cd batteries listed in accordance with UL 1973
- (5) Batteries listed in accordance with UL 1973 that do not go into thermal runaway or produce flammable gas in the UL 9540A cell level test or equivalent test

N 9.6.5.6.2 Protection against the release of flammable gases during normal operation shall be in accordance with 9.6.5.1.

N 9.6.5.6.3* ESS installed within a room, building, ESS cabinet, ESS walk-in unit, or otherwise nonoccupiable enclosure shall be provided with one of the following:

- (1) Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with NFPA 69
- (2) Deflagration venting installed and maintained in accordance with NFPA 68

N 9.6.5.6.4* Where approved, ESS cabinets designed to ensure that no hazardous pressure waves, debris, shrapnel, or enclosure pieces are ejected, as validated by installation level fire and explosion testing and an engineering evaluation complying with 9.1.5 that includes the cabinet, shall be permitted in lieu of providing explosion control that complies with NFPA 68 or NFPA 69.

N 9.6.5.6.5 ESS enclosures and cabinets shall be designed so explosive discharge of gases or projectiles are not ejected during fire and explosion testing complying with 9.1.5 that includes the ESS enclosure and cabinets.

N 9.6.5.6.6* Where ESS batteries or cabinets are installed in a container outdoors, other than a walk-in unit, the installation shall comply with one of the following:

- (1) The container shall be provided with explosion control complying with 9.6.5.6.3.
- (2) Combination of the container and cabinets shall be tested together to show compliance with 9.6.5.6.1.1.

N 9.6.5.6.7 Where gas detection is used to activate a combustible gas concentration reduction system and based on an appropriate NFPA 69 deflagration study, enclosures containing ESS shall be protected by an approved continuous gas detection system that complies with the following:

- (1) The gas detection system shall be designed to activate the combustible gas concentration reduction system on detection of flammable gases at no more than 10 percent

of the LFL of the gas mixture or of the individual components.

- (2) The combustible gas concentration reduction system shall remain on to ensure the flammable gas does not exceed 25 percent of the LFL of the gas mixture or of the individual components.
- (3) The gas detection system and combustible gas concentration reduction system shall be provided with a minimum of 2 hours of standby power.
- (4) For lithium-ion batteries, the gas detection system shall be provided with a minimum of 24 hours of standby power and 2 hours in alarm or as required by the HMA.
- (5) The gas detection system shall annunciate the following at an approved central, proprietary, or remote station in accordance with NFPA 72, or at an approved constantly attended location:
 - (a) A trouble signal upon failure of the gas detection system
 - (b) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

N 9.6.5.6.8 Compartmentalization created by cold and hot aisle arrangements within the ESS enclosure shall be addressed in accordance with the following:

- (1) For NFPA 69 designs, the performance of ventilation systems shall be independently verified for a thermal runaway event in either aisle/subcompartment.
- (2) For NFPA 68 designs, the placement of explosion relief panels shall ensure that the explosion hazard is addressed for both hot and cold aisles/subcompartments.
- (3) The gas detection system shall be designed to activate on detection of flammable gas in either aisle/subcompartment.

N 9.6.5.6.9 The protection design shall demonstrate that deflagrations are not propagated to interconnected or adjacent cabinets, enclosures, or rooms.

N 9.6.6 Remediation Measures.

N 9.6.6.1* Authorized Service Personnel. Where a fire or other event has damaged the ESS and ignition or reignition of the ESS is possible, the owner, agent, or lessee shall dispatch authorized service personnel to assist emergency first responders to mitigate the hazard or remove damaged equipment from the premises with a response time approved by the AHJ.

N 9.6.6.2* Hazard Support Personnel. Where required by the AHJ for public safety, the owner or their authorized agent shall provide hazard support personnel at the owner's expense.

N 9.6.6.2.1* Trained hazard support personnel shall be approved by the AHJ.

N 9.6.6.2.2 Trained hazard support personnel shall be available to respond to possible ignition or re-ignition of the damaged ESS, within the response time noted in the approved emergency operations plan.

N 9.6.6.2.3 The authorized service personnel shall be permitted to perform the duties of the hazard support personnel.

N 9.6.6.2.4* Required hazard support personnel shall monitor the ESS continuously in a method approved by the AHJ from the time the fire department releases the emergency scene until the hazard is mitigated and the AHJ gives authorization to

the owner or their authorized agent that onsite hazard support personnel are no longer required.

N 9.6.6.2.5* On-duty hazard support personnel shall have the following responsibilities:

- (1) Ensure the security and safety of the ESS site in accordance with the emergency operation plan and decommissioning plan
- (2) Keep diligent watch for fires or signs of off-gassing, obstructions to means of egress, and other hazards for the time required in accordance with 9.6.6.2.4
- (3) Ensure a means of communication is available to immediately contact the fire department if their assistance is needed to mitigate any hazards
- (4) Take prompt measures for remediation of hazards
- (5) Take prompt measures to assist in the evacuation of the public from the structures in accordance with the emergency operations plan
- (6) Allow only authorized personnel to enter the ESS site
- (7) Ensure authorized personnel are wearing proper PPE
- (8) Where required by the AHJ, maintain a written or electronic log of all personnel entering/leaving the portion of the site containing the ESS
- (9) Record all postincident tasks performed

Chapter 10 (Reserved)

Chapter 11 Fuel Cell Energy Storage Systems

11.1 Installation and Maintenance.

Δ 11.1.1 Stationary fuel cell ESS shall comply with the following requirements of Chapter 4:

- (1) Charge controllers (*see 4.6.8*)
- (2) Inverters and converters (*see 4.6.9*)
- (3) Energy storage management system (ESMS) (*see 4.6.10*)
- (4) Impact protection (*see 4.7.5*)
- (5) Smoke and fire detection (*see Section 4.8*)
- (6) Fire control and suppression (*see Section 4.9*)
- (7) Water supply (*see 4.9.4*)
- (8) Signage (*see 4.7.4*)
- (9) Combustible storage (*see Section 4.5*)
- (10) Hazard mitigation analysis (*see Section 4.4*)
- (11) Emergency planning and training (*see Section 4.3*)
- (12) Construction documents (*see Section 4.2*)

11.1.2 Non-hydrogen-fueled stationary fuel cell ESS shall be installed and maintained in accordance with *NFPA 70*, *NFPA 853*, the manufacturer's instructions, and the equipment listing.

11.1.3 Hydrogen-fueled stationary fuel cell ESS shall be installed and maintained in accordance with *NFPA 2*, *NFPA 70*, *NFPA 853*, the manufacturer's instructions, and the equipment listing.

11.2 Fuel-Cell-Powered Vehicle Use.

11.2.1 The temporary use of the dwelling unit owner's or occupant's fuel-cell-powered vehicle to power the dwelling in a one- and two-family dwelling or townhouse unit while parked in an attached or detached garage or outside shall only be required to comply with the vehicle manufacturer's instructions and *NFPA 70*.

11.2.2 The temporary use of the dwelling unit owner's or occupant's fuel-cell-powered vehicle to power the dwelling in a one- and two-family dwelling or townhouse unit while parked in an attached or detached garage or outside shall not be for more than 30 days.

Chapter 12 Superconducting Magnet Energy Storage (Reserved)

Chapter 13 Flywheel Energy Storage Systems (FESS)

13.1 Application.

N 13.1.1 The requirements of this chapter shall apply to the installation of flywheel ESS (FESS).

N 13.1.2* This chapter shall not apply to FESS for electric utilities under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

N 13.1.3* FESS shall not be installed in individual one- or two-family dwellings or in townhouse units.

N 13.2 Protection Features. FESS installations shall comply with the requirements of Chapters 4 through 8, except as specified in Table 13.2.

N 13.2.1 The construction documents required by 4.2.1.1 shall apply to FESS except for 4.2.1.1(2) and 4.2.1.1(7).

N 13.2.2 The requirements in 4.3.2.1.4 for the emergency operations plan shall apply except for 4.3.2.1.4(5) and 4.3.2.1.4(6).

N 13.2.3 A hazard mitigation analysis shall only be required for FESS in accordance with 4.4.1(2).

N 13.2.4 FESS shall be listed in accordance with UL 9540.

N 13.2.5* FESS shall not be installed in locations that could stress the bearing systems and impact their operation.

N 13.2.6* The energy storage management system (ESMS) of a FESS shall include bearing monitoring for magnetic bearings.

N 13.2.6.1 There shall be some means (e.g., alarm, hazard light, warning signal to control panel) to annunciate when bearing changes are due.

N 13.2.6.2* The ESMS shall monitor and record temperature and vibration of the FESS.

N 13.2.7 FESS installed on elevated parking garages or roof tops, or in high-rise buildings shall meet the seismic requirements for that installation.

N 13.2.7.1 The seismic ratings of the FESS and suitability of mounting means shall be verified during installation.

N 13.2.7.2 The engineering analysis for a FESS installation in an elevated location shall address stresses on floor loading due to wind forces.

N 13.2.8* An enclosure means to contain moving parts of the FESS shall be provided.

N 13.2.9* The rotor of mobile FESS shall be completely stopped (i.e., contain no energy) prior to transportation.

Table 13.2 FESS Technology-Specific Requirements

Compliance Required	Applicable Chapter Reference	Chapter 13 Modifications
Construction documents	4.2	4.2.1.1 applies except as modified in 13.2.1 and 13.2.2 4.2.1.2—N/A 4.2.1.3—N/A 4.2.1.4—N/A
Emergency planning and training	4.3	4.3.2.1.4 applies except as noted in 13.2.2 4.3.2.1.5—N/A (<i>see 13.1.2</i>)
Hazard mitigation analysis (HMA)	4.4	4.4.1 applies except as noted in 13.2.3
Fire and explosion testing	9.1.5	N/A
Equipment	Section 4.6	See also 13.2.4 and 13.1.2
Retrofits	4.6.3	4.6.3.2—N/A 4.6.3.3—N/A (<i>see 13.1.2</i>)
Environment	4.6.7	See also 13.2.5
Charge controllers	4.6.8	N/A
Energy storage management systems	4.6.10	See also 13.2.6 and 13.2.6.1
Reused equipment	4.6.5	N/A
Seismic protection	4.7.2	See also 13.2.7 and 13.2.7.1
Fire barriers	9.6.4	N/A
Elevation	4.7.7	N/A (<i>see 13.2.7.2</i>)
Open rack installation	4.7.9	N/A
ESS dedicated-use buildings	9.3.1.1	N/A
Non-dedicated-use buildings	9.3.1.2	N/A
Outdoor installations	9.3.2	N/A
Enclosures	4.6.12	See also 13.2.8
Rooftop and open parking garage installations	9.5.3.1	N/A except as noted in 13.2.7, 13.2.7.1, and 13.2.7.2
Mobile ESS equipment and operations	9.5.3.2	9.5.3.2.1.2—N/A 9.5.3.2 applies (<i>see 13.2.9</i>) 9.5.3.2.2.2—N/A 9.5.3.2.5.3—N/A 9.5.3.2.6—N/A; requirements for deployed mobile FESS in accordance with Chapter 13
Size and separation	9.4.2	N/A
Maximum stored energy	9.4.1	N/A
Exhaust ventilation	9.6.5.1	N/A
Smoke and fire detection	Section 4.8	N/A (<i>see 13.2.10</i>)
Fire control and suppression	Section 4.9	N/A (<i>see 13.2.11</i>)
Explosion control	9.6.5.6	N/A (<i>see 13.2.8</i>)
Water supply	4.9.4	N/A
System interconnection	Chapter 5	Section 5.3—N/A
Commissioning	Chapter 6	See also Section 13.3
Operation and maintenance	Chapter 7	See also Section 13.4 7.1.3—N/A
Decommissioning	Chapter 8	See also Section 13.5

N/A: Not applicable.

13.2.10 Smoke and fire detection for FESS installations shall be in accordance with the local building code.

13.2.11 Fire control and suppression for FESS installation shall be in accordance with the local building code.

13.2.12* Separation or barriers shall be used to ensure that catastrophic failure of a flywheel does not propagate to other flywheels or energy storage systems in the area.

13.3* Commissioning. Prior to commissioning, correct installation for mechanical securement and containment shall be confirmed.

13.4* Operation and Maintenance. As part of routine maintenance there shall be procedures for monitoring/checking for bearing wear.

13.4.1 During installation, the AHJ shall confirm that the maintenance procedures have both a process for determining the bearing change interval and follow-up procedures.

13.4.2* The AHJ shall confirm that the maintenance procedures include a check of the status of the vacuum on a periodic basis.

N 13.4.3 Spin Down.

N 13.4.3.1 The maximum time to spin down shall be included in the maintenance documentation to ensure that the rotor has coasted down to zero prior to maintenance or moving the FESS.

N 13.4.3.2 The technician shall make certain that they have confirmed the maximum spin down time for safety reasons.

N 13.5 Decommissioning.

N 13.5.1* For decommissioning, all the energy shall be completely dissipated from the FESS prior to FESS removal.

N 13.5.2 Rotor braking shall be required unless enough time is provided in the decommissioning procedures to allow it to spin down.

Δ Chapter 14 Storage of Lithium Metal or Lithium-ion Batteries

Δ 14.1 Batteries. Areas associated with the collection or storage of lithium metal or lithium-ion batteries shall comply with this chapter.

Δ 14.1.1 The following areas shall be exempt from the requirements of this chapter:

- (1) Areas within a facility that are operated in accordance with procedures that provide for the state of charge of the lithium metal or lithium-ion batteries to be 30 percent or less
- (2) Areas where fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving the batteries in storage will be limited to the design area of an automatic sprinkler system installed in accordance with NFPA 13 and will not adversely impact occupant egress from the building or adversely impact adjacent stored materials or the building structure
- (3) Areas where new or refurbished batteries are installed for use in the devices, equipment, or vehicles they are designed to power
- (4) Areas where new or refurbished batteries are packed for use with the devices, equipment, or vehicles they are designed to power
- (5) Areas where new or refurbished batteries rated at no more than 300 Watt-hours (1.08 MJ) and lithium metal batteries containing no more than 25 g of lithium metal are in their original retail packaging
- (6) Areas where batteries are staged in the manufacturing area or along assembly lines during the manufacturing process

14.1.2 The procedures and test report specified in 14.1.1 shall be provided to the AHJ for review and approval.

14.2 Collection Locations. All areas located indoors in any occupancy where used lithium metal or lithium-ion batteries are collected from employees or the public shall comply with 14.2.1 through 14.2.3.

14.2.1* Individual containers shall not exceed 7.5 ft³ (0.21 m³) in size each, with an aggregate limit of 15 ft³ (0.42 m³).

14.2.2 Containers shall comply with all of the following:

- (1) Have a minimum of 3 ft (0.9 m) of open space from other battery collection containers and combustible materials
- (2) Be located a minimum of 5 ft (1.5 m) from exits from the room, space, or building
- (3) Be open-top and noncombustible or approved for battery collection use

14.2.3 Where combustible materials are located within the space between collection containers, the containers shall be spaced a minimum 10 ft (3 m) apart.

14.3 Indoor Storage Locations.**14.3.1 General.**

Δ 14.3.1.1 Batteries stored indoors shall be stored in accordance with one or more of the methods provided for in 14.3.2.1 through 14.3.2.4.

14.3.1.2 Battery terminals shall be protected either through battery design methods or a protective packaging method to prevent short-circuit of the battery.

14.3.2 Storage Methods.

Δ 14.3.2.1 Rooms or Spaces. Batteries shall be permitted to be stored in rooms or spaces complying with 14.3.2.1.1 and 14.3.2.1.3.

14.3.2.1.1 The rooms or spaces shall be separated from the remainder of the building areas by fire barriers with a 2-hour fire resistance rating and with horizontal assemblies with a 2-hour fire resistance rating constructed in accordance with the local building code.

Δ 14.3.2.1.2 The rooms or spaces shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with NFPA 72.

N 14.3.2.1.3 The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.

Δ 14.3.2.2 Prefabricated Portable Structure. Batteries shall be permitted to be stored in prefabricated portable buildings or containers complying with 14.3.2.2.1 and 14.3.2.2.3.

N 14.3.2.2.1 The prefabricated portable buildings or containers shall be listed or approved with a 2-hour fire resistance rating.

N 14.3.2.2.2 The prefabricated portable buildings or containers shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with NFPA 72.

N 14.3.2.2.3 The prefabricated portable buildings or containers shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.3.2.3 Metal Drums. Batteries shall be permitted to be stored in metal drums with batteries separated from each other by vermiculite or other approved material or in containers approved for battery collection and storage activities complying with 14.3.2.3.1 and 14.3.2.3.3.

Δ 14.3.2.3.1 Each area containing such metal drums or approved containers shall be both of the following:

- (1) Not exceeding 900 ft² (61 m²) in area
- (2) Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.3.2 Each area containing metal drums or approved containers with batteries shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with NFPA 72.

N 14.3.2.3.3 Each area containing metal drums or approved containers with batteries shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.3.2.4 Containers Approved for Transportation. Batteries shall be permitted to be stored in containers approved for use in transportation that will prevent an event from propagating beyond the container complying with 14.3.2.4.1 and 14.3.2.4.3.

Δ 14.3.2.4.1 Each area containing the approved transportation containers shall be both of the following:

- (1) Not exceeding 900 ft² (61 m²) in area
- (2) Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.4.2 Each area containing the approved transportation containers shall be provided with a fire alarm system activated by an air-aspirating smoke detector system or a radiant-energy detection system with occupant notification installed in accordance with NFPA 72.

N 14.3.2.4.3 Each area containing the approved transportation containers shall be provided with an approved automatic fire sprinkler system installed in accordance with NFPA 13.

14.4 Prevention and Mitigation. A plan that provides for the prevention of fire incidents and includes early detection mitigation measures shall be provided to the AHJ for review and approval.

N 14.5 Explosion Protection.

N 14.5.1 Deflagration Potential.

N 14.5.1.1 The potential for a deflagration involving the off-gassing of flammable gases during a thermal runaway shall be analyzed.

N 14.5.1.2 Explosion protection shall be installed if the potential for a deflagration involving the off-gassing of flammable gases during a thermal runaway exists.

N 14.5.2 A written hazard analysis prepared by a registered design professional with expertise in fire protection engineering shall be submitted to the AHJ for review and approval.

14.6 Outdoor Storage Location.

14.6.1 Outdoor storage locations for lithium metal or lithium-ion batteries shall comply with the following:

- (1) Individual pile sizes shall be limited to 900 ft² (83.6 m²) in area separated from other piles by 10 ft (3 m).
- (2) Piles located outdoors shall be separated by a minimum 20 ft (6.1 m) from the following exposures:
 - (a) Lot lines
 - (b) Public ways
 - (c) Buildings
 - (d) Other storage
 - (e) Hazardous materials
 - (f) Other exposure hazards

14.6.2 Clearances shall be permitted to be reduced to 3 ft (0.9 m) where a 3-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 pile is provided to protect the exposure.

N 14.6.3 Weather Protection. Where weather protection is provided for sheltering outdoor battery storage areas, such areas shall be considered outdoor storage areas if all of the following conditions are met:

- (1) Supports and walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage area.
- (2) The distance from the structure and the structural supports to buildings, lot lines, public ways, or means of egress to a public way shall be not less than the distance required by 14.6.1 for outdoor storage of batteries without weather protection.
- (3) The structure shall be of approved noncombustible construction and not exceed 3,600 ft² (334.5 m²) in area.

N 14.6.4 Outdoor storage areas with an aggregate area greater than 400 ft² (37.1 m²) shall be provided with a fire alarm system activated by a radiant-energy detection system with occupant notification installed in accordance with NFPA 72.

Chapter 15 One- and Two-Family Dwellings and Townhouse Units

15.1* General. ESS installations with a rating of 1 kWh (3.6 MJ) or greater and associated with one- or two-family dwellings or townhouse units shall comply with the requirements of this chapter.

15.2 Equipment Listings.

Δ 15.2.1 ESS shall be listed and labeled in accordance with UL 9540.

15.3 Installation. ESS shall be installed in accordance with the manufacturer's instructions and their listing.

15.3.1 ESS Spacing. Individual ESS units shall be separated from each other by a minimum of 3 ft (914 mm) unless smaller separation distances are documented to be adequate based on fire and explosion testing complying with 9.1.5.

N 15.3.2 Labeling. A label containing emergency contact information for the qualified service and maintenance providers shall be provided on the exterior of the installed ESS.

15.4 Locations.

15.4.1 ESS shall only be installed in the following locations:

- (1) In attached garages separated from the dwelling unit living area and sleeping units in accordance with the local building code
- (2) In detached garages and detached accessory structures
- (3) Outdoors on exterior walls or on the ground located a minimum of 3 ft (914 mm) from doors and windows directly entering the dwelling unit

- (4) In enclosed utility closets and storage or utility spaces where approved by the AHJ

15.4.2 If the room or space where the ESS is to be installed is not finished or noncombustible, the walls and ceilings of the room or space shall be protected with not less than 5/8 in. Type X gypsum board.

15.4.3 ESS shall not be installed in sleeping rooms, or in closets or spaces opening directly into sleeping rooms.

Δ 15.5 Energy Ratings.

N 15.5.1 Individual ESS units shall have a maximum stored energy of 20 kWh.

15.5.2 The aggregate rating of the ESS shall not exceed the following for each location listed:

- (1) 40 kWh within utility closets, basements, and storage or utility spaces
- (2) 80 kWh in attached or detached garages and detached accessory structures
- (3) 80 kWh where outdoor wall mounted
- (4) 80 kWh where outdoor ground mounted

15.5.3 ESS installations exceeding the individual or aggregate ratings allowed by 15.5.1 or 15.5.2 shall comply with Chapters 4 through 9.

15.5.4* The use of an electric-powered vehicle to power the dwelling while parked shall comply with Section 15.11.

15.6 Electrical Installation. ESS shall be installed in accordance with NFPA 70.

15.6.1 Inverters shall be listed and labeled in accordance with UL 1741 or provided as part of the UL 9540 listing.

15.6.2* Systems connected to the utility grid shall use inverters listed for utility interaction.

15.7 Fire Detection.

15.7.1 Rooms and areas within dwelling units, basements, and attached garages in which ESS are installed shall be protected by interconnected smoke alarms in accordance with the local building code.

15.7.2 A heat detector or alarm, listed and interconnected to the smoke alarms, shall be installed in locations within dwelling units and attached garages where smoke alarms cannot be installed in accordance with their listing.

15.8 Protection from Impact. ESS installed in a location subject to vehicle damage shall be protected by approved barriers.

Δ 15.9 Exhaust Ventilation. Indoor installations of ESS that include batteries that produce hydrogen or other flammable gases during charging shall meet the exhaust ventilation requirements in accordance with 9.6.5.1.

15.10 ESS Toxic and Highly Toxic Gas Release During Normal Use. ESS that have the potential to release toxic or highly toxic gas during charging, discharging, and normal use conditions shall be installed outdoors.

15.11 Electric Vehicle Use.

15.11.1 The temporary use of the dwelling unit owner's or occupant's electric-powered vehicle to power the dwelling

while parked in an attached or detached garage or outside shall comply with the vehicle manufacturer's instructions and NFPA 70.

15.11.2 Temporary emergency use of the dwelling unit owner's or occupant's electric-powered vehicle to power the dwelling while parked in an attached or detached garage or outside shall be permitted.

Annex A Explanatory Material

Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.

N A.1.1 Energy generation equipment—even if it is tied to the ESS—is not covered under the scope. An example of this is a solar energy farm that feeds ESS on the same property. The solar generation and collection equipment are not governed by this standard. NFPA 850 or other relevant standard should be applied for the design, construction, installation, commissioning, operation, and maintenance of generation facilities.

A.1.3 It is not the intent of NFPA 855 to regulate equipment with integral standby power systems below the amounts in Table 1.3, such as emergency lighting units, fire alarm control units, computers, tablets, and other appliances and equipment.

Flywheel ESS have a lower energy threshold quantity because the stored energy can be released much more quickly in the case of a catastrophic failure. They are normally utilized for short-term and high-power applications. Although flywheel ESS do not represent the potential for fire hazards in the same manner as electrochemical systems, their total energy and size should be limited because of concerns with hazardous moving parts and structural concerns associated with containing those parts.

N A.1.3.1 Where approved by the AHJ, alternate safety requirements can be applied for purpose of research, development, or testing.

A.1.4.2 In order to help determine if an existing ESS installation presents an unacceptable risk and that retroactivity should apply, the AHJ can request a hazard mitigation analysis be submitted by the owner in accordance with Section 4.4.

Based on the hazardous mitigation analysis, the AHJ can apply retroactively any portions of this standard deemed appropriate to mitigate any hazards that could be identified in the risk assessment as unacceptable.

A.1.5 Data and analysis that documents equivalency with the intent of this standard should be prepared and submitted to the AHJ.

Δ A.3.2.1 Approved. The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment, or materials, the "authority having jurisdiction" may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The "authority having jurisdiction" may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in

a position to determine compliance with appropriate standards for the current production of listed items.

A.3.2.2 Authority Having Jurisdiction (AHJ). The phrase “authority having jurisdiction,” or its acronym AHJ, is used in NFPA standards in a broad manner because jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

A.3.2.4 Listed. The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

A.3.3.1 Apartment Building. NFPA 101 specifies that, wherever there are three or more living units in a building, the building is considered an apartment building and is required to comply with either the provision of Chapter 30 or Chapter 31 of NFPA 101, as appropriate. Townhouse units are considered to be apartment buildings if there are three or more units in the building. The type of wall required between units in order to consider them to be separate buildings is normally established by the authority having jurisdiction. If the units are separated by a wall of sufficient fire resistance and structural integrity to be considered as separate buildings, then the provisions of Chapter 24 of NFPA 101 apply to each townhouse. Condominium status is a form of ownership, not occupancy; for example, there are condominium warehouses, condominium apartments, and condominium offices. [101, 2021]

A.3.3.2.1 Flow Battery. Typically, a flow battery includes storage tanks and pumps.

A.3.3.3 Battery Management System (BMS). The BMS can include functions necessary to control charging, discharging, thermal management, shutdown, and mitigation in both normal and abnormal conditions. The BMS can be completely independent of the ESMS.

A.3.3.5.1 One- and Two-Family Dwelling Unit. The application statement of 24.1.1.1 of NFPA 101 limits each dwelling unit to being “occupied by members of a single family with not more than three outsiders.” NFPA 101 does not define the term *family*. The definition of family is subject to federal, state, and local regulations and might not be restricted to a person or a couple (two people) and their children. The following examples aid in differentiating between a single-family dwelling and a lodging or rooming house:

- (1) An individual or a couple (two people) who rent a house from a landlord and then sublease space for up to three individuals should be considered a family renting to a maximum of three outsiders, and the house should be

regulated as a single-family dwelling in accordance with Chapter 24 of NFPA 101.

- (2) A house rented from a landlord by an individual or a couple (two people) in which space is subleased to 4 or more individuals, but not more than 16, should be considered and regulated as a lodging or rooming house in accordance with Chapter 26 of NFPA 101.
- (3) A residential building that is occupied by 4 or more individuals, but not more than 16, each renting from a landlord, without separate cooking facilities, should be considered and regulated as a lodging or rooming house in accordance with Chapter 26 of NFPA 101.

[101, 2021]

A.3.3.7 Electrochemical Double Layer Capacitor (EDLC). These capacitors can also be referred to as ultra-capacitors, super capacitors, double layer capacitors, electrochemical capacitors, and so forth.

A.3.3.8 Energy Storage Management System (ESMS). Some standards refer to this as an energy management system (EMS). This system can control one or more individual management systems, such as battery management systems (BMS).

A.3.3.9 Energy Storage Systems (ESS). ESS include but are not limited to the following categories:

- (1) Chemical: hydrogen storage
- (2) Thermal: thermal energy storage
- (3) Electrochemical:
 - (a) Batteries
 - (b) Flow batteries
- (4) Mechanical:
 - (a) Flywheel
 - (b) Pumped hydro
 - (c) Compressed air energy storage (CAES)
- (5) Electrical:
 - (a) Capacitors
 - (b) Superconducting magnetic energy storage (SMES)

These systems can have ac or dc output for utilization and can include inverters and converters to change stored energy into electrical energy. It is not the intention for ESS to include energy generation systems.

Energy storage systems can include, but are not limited to, batteries, capacitors, and kinetic energy devices (e.g., flywheels). Energy storage systems can include inverters or converters to change voltage levels or to make a change between an ac or a dc system. These systems differ from other storage systems such as a UPS system, which is a power supply used to provide alternating current power to a load for some period of time in the event of a power failure.

A.3.3.9.1.1 Electrochemical Energy Storage System. The electrochemical energy is related to fuel cells, photoelectrochemical cells, and systems such as batteries.

A.3.3.9.1.2 Mechanical Energy Storage System. The mechanical energy is related to fly wheels, pump storage, compressed air systems, and systems such as reservoirs, pressure vessels, or magnets.

A.3.3.13 Flywheel Energy Storage System (FESS). There are primarily two types of rotor constructions—solid-metal-mass design and composite fiber design.