Public Input No. 372-NFPA 855-2023 [Global Input]

UL 9540 and UL 9540A are in the process of being updated via the ANSI consensus process to address proposed revisions from interested stakeholders. Consideration should be given to updating these referenced standards editions and dates if they are completed in time for inclusion in the next edition of NFPA 855.

Reason: The content of the next edition of these ANSI consensus standards has not yet been finalized.

Statement of Problem and Substantiation for Public Input

We would like to ensure that the most current edition of UL 9540 and UL 9540A are referenced in the next edition of NFPA 855.

Submitter Information Verification

Submitter Full Name: LaTanya Schwalb

Organization: UL Solutions

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 18:26:43 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-34-NFPA 855-2023

Statement: Standards are being updated to current editions.

Public Input No. 374-NFPA 855-2023 [Global Input]

Annex G should be revised to remove conflicts with requirements in the body of NFPA 855 and its referenced standards, and to correlate with current protection strategies in the standard. It should also remove content that duplicates, but differs slightly from requirements in the body of the standard.

Statement of Problem and Substantiation for Public Input

A significant amount of work went into the development of Annex G, which includes some useful information. However we have seen situations where code users are citing information in this Annex, which differs from the actual requirements in the standard, which creates problems. There are several examples of this in the Annex G fire suppression and fire detection sections, where the terminology and recommendation differ from the NFPA referenced standards and NFPA 855. For example the term fire extinguishment is included in this annex, but the standard uses the term fire control and suppression. In addition the standard recognizes radiant energy–sensing detection systems, and the Annex is silent on those systems, but does include criteria for flame detection which is not recognized in the body of the standard.

Another example - the Annex includes G.1.3 Minimum Installation Information that is similar to, but different from, the construction document requirements in Section 4.2. This entire section can be removed to avoid conflicts.

It may be useful for a work group to examine this Annex and eliminate duplications and conflicts.

Submitter Information Verification

Submitter Full Name: Howard Hopper

Organization: UL Solutions

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 19:06:20 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The public input offers no specific modifications as such cannot be accept.

Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]

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.

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

[a]For 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.

[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Additional Proposed Changes

File Name	Description	Approved
855_TG8_Draft_Changes_-_1.3_Table_Changes_OBrian.pdf	Additional Technologies, NFPA 855 Table 1.3	

Statement of Problem and Substantiation for Public Input

Due to the complexity of modification of tables in Terra View, please see the attached document to indicate the additional line changes to table 1.3

The following proposal has been submitted by task group 8 "new technology" of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized in table 1.3 in a new category besides "other battery technologies." The task group heard 7 presentations from various manufactures and evaluated the submitted information through the open task group process.

The new technology line items added include Lithium Metal, Nickel-Hydrogen, Zinc Bromide and Zinc Manganese Dioxide batteries which through submitted presentations indicated that through testing appeared to meet the same results or improved results as typically found in Lithium Ion chemistries. The task group is recommending that that material be recognized similar to lithium ion batteries for the aggregate capacity.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 182-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 183-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	
Public Input No. 184-NFPA 855-2023 [Section No. B.5.4]	
Public Input No. 182-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 183-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	
Public Input No. 184-NFPA 855-2023 [Section No. B.5.4]	
Public Input No. 236-NFPA 855-2023 [New Section after B.5]	
Public Input No. 237-NFPA 855-2023 [New Section after B.5]	

Submitter Information Verification

Submitter Full Name: Michael O`Brian
Organization: Code Savvy Consultants
Street Address:
City:
State:
Zip:
Submittal Date: Mon May 29 19:03:09 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-3-NFPA 855-2023

Statement: This first revision includes the new technologies to highlight lithium metal, nickel-hydrogen, zinc bromide, and zinc manganese dioxide. Nickel iron, zinc-air and iron-air are aqueous alkaline battery chemistries just like Ni-Cd, Ni-MH and Ni-Zn.

This revision updates the correct terminology for Ni-Cd batteries.

The revision adds capacity requirements for hybrid supercapacitors with aggregate capacity similar to lithium-ion batteries. Hybrid supercapacitors are part battery and part capacitor which reduces the risk relative to pure capacitors.

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.
Table 1.3

Table 1.3 **Threshold Quantities per Each Fire Area or Outdoor Installation**		
	Aggregate Capacity [a]	
ESS Technology	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])
Lithium Metal	20	72
Nickel-Hydrogen	20	72
Zinc Bromide	20	72
Zinc Manganese Dioxide ($Zn\text{-}MnO_2$)	20	72
Flow batteries [c]	20	72
Other battery technologies	10	36
Batteries in one- and two-family dwellings and townhouse units	1	3.6
Capacitor ESS		
Electrochemical double layer capacitors[d]	3	10.8
Other ESS		
All Other ESS	70	252
Flywheel ESS (FESS)	0.5	1.8

[a]For 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.
[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.
[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Public Input No. 221-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]

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.

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~~ Cd , 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

[a]For 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.

[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Statement of Problem and Substantiation for Public Input

Revised so that the conventional "Ni-Cd" reference is used.

Submitter Information Verification

Submitter Full Name: Kevin Fok
Organization: LG Energy Solution Vertech
Street Address:
City:

State:

Zip:

Submittal Date: Wed May 31 14:45:51 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-3-NFPA 855-2023

Statement: This first revision includes the new technologies to highlight lithium metal, nickel-hydrogen, zinc bromide, and zinc manganese dioxide. Nickel iron, zinc-air and iron-air are aqueous alkaline battery chemistries just like Ni-Cd, Ni-MH and Ni-Zn.

This revision updates the correct terminology for Ni-Cd batteries.

The revision adds capacity requirements for hybrid supercapacitors with aggregate capacity similar to lithium-ion batteries. Hybrid supercapacitors are part battery and part capacitor which reduces the risk relative to pure capacitors.

Public Input No. 229-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]

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.

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
Iron-air	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

[a]For 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.

[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Additional Proposed Changes

File Name	Description	Approved
Table_1.3-_NFPA_855_Public_Input_for_Iron-Air_Updates.pdf	Form Energy Proposed Updates - Table 1.3	

Statement of Problem and Substantiation for Public Input

Form Energy is proposing that iron-air technology be added to Table 1.3 as an ESS Technology. It is recommended that iron-air technology be separately listed (and not covered under "other" technologies) because it has safety benefits that will be seen in other sections of the code (Table 9.6.5).

20 kWh is recommended because iron-air is demonstrated to be equivalent to or safer than other chemistries listed at those threshold quantities. Form Energy has test data available to present to the committee to support this claim.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 231-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 292-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Alli Nansel

Organization: Form Energy

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 31 16:55:46 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-3-NFPA 855-2023

Statement: This first revision includes the new technologies to highlight lithium metal, nickel-hydrogen, zinc bromide, and zinc manganese dioxide. Nickel iron, zinc-air and iron-air are aqueous alkaline battery chemistries just like Ni-Cd, Ni-MH and Ni-Zn.

This revision updates the correct terminology for Ni-Cd batteries.

The revision adds capacity requirements for hybrid supercapacitors with aggregate capacity similar to lithium-ion batteries. Hybrid supercapacitors are part battery and part capacitor which reduces the risk relative to pure capacitors.

NFPA 855: Public Input Submittal for Iron-Air Updates

The following document outlines Form Energy's submission for the NFPA 855 Public Input Period. Changes to the current edition are outlined in red.

Table 1.3 Threshold Quantities per Each Fire Area or Outdoor Installation

ESS Technology	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)	72 (252)
Flow batteries	20	72
Iron-air	20	72
Other battery technologies	10	36
Batteries in one- and two-family dwellings and townhouse units	1	3.6

Rationale: *Form Energy is proposing that iron-air technology be added to Table 1.3 as an ESS Technology.*

20 kWh is recommended because iron-air is demonstrated to be equivalent to or safer than other chemistries listed at those threshold quantities. Form Energy has test data available to present to the committee to support this claim.

It is also recommended that iron-air technology be separately listed (and not covered under "other" technologies) because it has safety benefits that will be seen in other sections of the code (Table 9.6.5).

Public Input No. 265-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]

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.

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
Hybrid supercapacitors	70	252
Other ESS		-
All other ESS	70	252
Flywheel ESS (FESS)	0.5	1.8

[a]For 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.

[b]For sodium-nickel-chloride batteries that have been listed to UL 1973 and meet the cell-level performance requirements in UL 9540A.

[c]Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

[d]Capacitors used for power factor correction, filtering, and reactive power flow are exempt.

Additional Proposed Changes

File Name	Description	Approved
ANW2032_ATX_Hybrid_Supercapacitor_Abuse_Test_Report_2023.pdf	Test report on abuse testing	

Statement of Problem and Substantiation for Public Input

Hybrid capacitors do not present thermal runaway problems and as a result require recognition and a higher application threshold.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 266-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 267-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	
Public Input No. 266-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 267-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Robert Davidson

Organization: Davidson Code Concepts, Llc

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 31 23:40:55 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-3-NFPA 855-2023

Statement: This first revision includes the new technologies to highlight lithium metal, nickel-hydrogen, zinc bromide, and zinc manganese dioxide. Nickel iron, zinc-air and iron-air are aqueous alkaline battery chemistries just like Ni-Cd, Ni-MH and Ni-Zn.

This revision updates the correct terminology for Ni-Cd batteries.

The revision adds capacity requirements for hybrid supercapacitors with aggregate capacity similar to lithium-ion batteries. Hybrid supercapacitors are part battery and part capacitor which reduces the risk relative to pure capacitors.

Public Input No. 123-NFPA 855-2023 [New Section after 1.3.4]

1.3.5

This standard does not apply to product research, development, and testing conducted at laboratory occupancies and pilot plants.

Statement of Problem and Substantiation for Public Input

This proposal moves the topic covered by existing text from A1.3.1 into the normative text, 1.3.5. The intention is to provide a path to compliance for institutions and manufacturers engaged in research, development, and testing. These institutions are involved in pre-product development and required installation requirements and listings such as UL 9540 are not typically present. For example, products need to be tested, complete and functioning in order to obtain listings. Products routinely are set up and tested by third party laboratory occupancies.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 124-NFPA 855-2023 [Section No. A.1.3.1]	Annex Material

Submitter Information Verification

Submitter Full Name: Matthew Paiss
Organization: Pacific Northwest National Lab
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 16 13:58:10 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-20-NFPA 855-2023 The proposed language was too wide open in allowing anything to go into a lab or even pilot plant, without any fire safety professional or AHJ reviewing the possible hazards.

Statement: Labs doing testing need a way to test newer products not yet covered adequately by existing codes and standards.

Public Input No. 173-NFPA 855-2023 [Section No. 2.2]

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 18A, Standard on Water Additives for Fire Control and Vapor Mitigation

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.

Statement of Problem and Substantiation for Public Input

Added reference to NFPA 18A because it provides an alternative solution with the use Encapsulating Agent (EA) to fight BESS system fires.

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
Organization: Hazard Control Technologies
Street Address:
City:
State:

Zip:
Submittal Date: Thu May 25 08:44:08 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: NFPA 18A is not referenced in the standard.

Public Input No. 375-NFPA 855-2023 [Section No. 2.2]

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 18A, Standard for Water Additives for Fire Control and Vapor Mitigation, 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.

Statement of Problem and Substantiation for Public Input

NFPA 18A, standard for Water Additives for Fire Control and Vapor Mitigation. Agents able to pass section 7.7 Spherical Micelle Stability Test have been extensively tested and shown to be very effective extinguishing agents for lithium-ion batteries fires. The Third-party agencies are listed in Annex 4.3. Section 12 covers Design Guidelines for all the Class of fire Agents passing the section 7.7 testing are effective on, including 3 dimensional fires and combustible and flammable vapors.

Submitter Information Verification

Submitter Full Name: Jeffrey Bonkoski

Organization: JB Hazmat Consulting, LLC.

Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 20:40:12 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: NFPA 18A is not referenced in the standard.

Public Input No. 209-NFPA 855-2023 [Section No. 2.3]

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~~ 2022 .

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

UL 9540, *Energy Storage Systems and Equipment*, ~~2020~~ 2023 .

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.

Statement of Problem and Substantiation for Public Input

This updates the versions of UL 1973 (2022 version) and UL 9540 (Edition 3 expected to be published in June 2023). Other publication dates and versions in this section should be updated as well.

Submitter Information Verification

Submitter Full Name: Kevin Fok
Organization: LG Energy Solution Vertech
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 10:50:01 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-34-NFPA 855-2023
Statement: Standards are being updated to current editions.

Public Input No. 376-NFPA 855-2023 [Section No. 2.3]

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.

NTA 8133:2021, Portable Fire Extinguisher - Performance requirements, test methods and markings suitability for extinguishing lithium-ion battery fires

Statement of Problem and Substantiation for Public Input

Lithium-ion batteries are a multi-class fire hazard Class A, Class B and Class C, currently, approved fire extinguisher have been proven to be ineffective at being able to extinguish lithium-ion batteries. The Dutch NTA 8133:2021 is a test procedure that has been developed to test the effectiveness of extinguishers to extinguish rate and has approved marking for passing fire extinguishers.

Submitter Information Verification

Submitter Full Name:	Jeffrey Bonkoski
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Street Address:	
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Zip:	
Submittal Date:	Thu Jun 01 20:43:54 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The proposed document is not referenced in the standard.

Public Input No. 133-NFPA 855-2023 [Section No. 2.3.2]

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~~ 2022 .

Statement of Problem and Substantiation for Public Input

date update

Submitter Information Verification

Submitter Full Name: Marcelo Hirschler
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Submittal Date: Thu May 18 16:56:26 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-53-NFPA 855-2023
Statement: This updates the publication to the current date of publication.

Public Input No. 264-NFPA 855-2023 [Section No. 2.3.7]

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.

Statement of Problem and Substantiation for Public Input

This proposes to delete the reference to UL 9540A. Unfortunately, the manner in which laboratories are conducting the large-scale fire testing under this standard does not create the large-scale fire event the standard requires for assessment of a catastrophic event or any fire at all. When laboratory leadership has been questioned on this the response has been that they always assumed an event would be a spontaneous thermal runaway of a cell or two which is incredulous because that was discussed before UL 9540A existed, rejected and it was identified the expectation was a catastrophic event not associated with a cell failure would be the cause. That the fire occurred. This intent has long been captured by the annex note to this section. Since four separate editions of UL 9540A and how the lab conducts the testing have failed to address this lack of fire data the standard calls for it no longer makes sense to reference this document. An additional reason is that the standard as written does not encompass various battery technology since the standard is lithium-ion technology centric, causing difficulties for other technologies required to comply with the large-scale fire and explsosion testing requirements.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 263-NFPA 855-2023 [Section No. 9.1.5.1 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Robert Davidson

Organization: Davidson Code Concepts, Llc
Street Address:
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Submittal Date: Wed May 31 23:33:42 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-34-NFPA 855-2023
Statement: Standards are being updated to current editions.

Public Input No. 302-NFPA 855-2023 [Section No. 2.3.7]

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~~ 2011, revised 2022 .

UL 790, *Standard Test Methods for Fire Tests of Roof Coverings*, ~~2018~~ 2022 .

UL 1012, *Power Units Other Than Class 2*, 2010, revised 2021.

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2021, revised 2023 .

UL 1778, *Uninterruptible Power Systems*, ~~2017~~ 2014, revised 2023 .

UL 1973, *Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications*, ~~2018~~ 2022 .

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

CAN/ UL 9540, *Energy Storage Systems and Equipment*, ~~2020~~ 2021 .

CAN/ 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.

Statement of Problem and Substantiation for Public Input

Update UL standards to the current edition and revision.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 304-NFPA 855-2023 [Section No. H.1.2.11]	
Public Input No. 306-NFPA 855-2023 [Section No. H.1.2.14.2.3]	

Submitter Information Verification

Submitter Full Name: Kelly Nicolello

Organization: UL Solutions

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Submittal Date: Thu Jun 01 11:36:33 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-34-NFPA 855-2023

Statement: Standards are being updated to current editions.

Public Input No. 340-NFPA 855-2023 [Section No. 2.3.7]

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 3202, *Outline of Investigation for EV Charging Systems Utilizing Energy Storage, 2023*

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.

Statement of Problem and Substantiation for Public Input

This public input relates to a new proposed section 4.6.1.1. The UL 3202 Outline of Investigation is expected to be published by the end of 2023.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 335-NFPA 855-2023 [Section No. 4.6.1]	

Submitter Information Verification

Submitter Full Name: Howard Hopper

Organization: UL Solutions

Street Address:

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Submittal Date: Thu Jun 01 13:43:59 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The proposed standard is not currently published,

Public Input No. 261-NFPA 855-2023 [New Section after 3.1]

3.3.X Fire Command Center

The principal attended or unattended room or area where the status of the detection, alarm communications, control systems, and other emergency systems is displayed and from which the system(s) can be manually controlled. (SIG-ECS) NFPA 72.[72:3.3.119] ..

Statement of Problem and Substantiation for Public Input

The extraction of this definition from NFPA 72 is part of a series of proposals that address detection requirements, correlates with NFPA 72 and clarifies the location of aggregated fire alarm signals.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	

Submitter Information Verification

Submitter Full Name: Robert Davidson
Organization: Davidson Code Concepts, Llc
Street Address:
City:
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Submittal Date: Wed May 31 23:04:57 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The definition is already in 3.3.12.

Public Input No. 176-NFPA 855-2023 [New Section after 3.3]

3.3.28 Thermal Walkaway

Thermal walkaway is a slow heating process driven by an external current source and caused by abuse,neglect or internal cell failure that results in overheating and increased gas production in a lead-acid or nickel-cadmium (or other aqueous chemistry) battery. It can be stopped by removal of the charging source or reduction of the charging current.

Statement of Problem and Substantiation for Public Input

There is a need to clarify misconceptions regarding aqueous battery thermal "runaway." Thermal walkaway occurs in aqueous batteries, which develops over a period of months/year, and requires the contribution of an external current source. It is easily controlled with temperature compensated charging and/or recommended maintenance. In contrast, thermal runaway in lithium-ion batteries is usually a very fast occurring process with limited or no warning and cannot be prevented at least at the individual cell level. Lithium-ion thermal runaway can occur without an external current source. The quantities of heat and combustible gasses produced by a lithium-ion thermal runaway event are orders of magnitude greater than those produced by an aqueous battery thermal walkaway.

Submitter Information Verification

Submitter Full Name: Chris Searles
Organization: Ieee Essb Committee
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Street Address:
City:
State:
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Submittal Date: Thu May 25 16:27:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-42-NFPA 855-2023 Sentences were combined for improved readability.

Statement: There is a need to differentiate between the rapidly progressing thermal runaway that occurs in Li-ion batteries, and which can occur without an external current source; and the much slower process of thermal walkaway that occurs in aqueous batteries, which can be detected early with proper monitoring/maintenance and can be stopped by control or removal of charging current.

Public Input No. 101-NFPA 855-2023 [Section No. 3.3.8]

3.3.8* Energy Storage Management System (ESMS).

A system that monitors, controls, and optimizes the performance and/or safety of an energy storage system.

Statement of Problem and Substantiation for Public Input

At typical ESMS monitors, controls, and optimizes performance, but only monitors safety

Submitter Information Verification

Submitter Full Name: Chris Groves

Organization: Wartsila North America

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City:

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Submittal Date: Tue May 09 14:11:51 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-36-NFPA 855-2023 And/or is not allowed by the NFPA Manual of Style. There are two options to properly resolve this. One would be to make two separate sentences in the definition (one for what the ESMS can do for performance, and the other for what it can do for safety). Because what it can do for safety involves a more complex interaction with more explanation, this material better-belonged in an annex since the ESMS is actually not doing the “controlling” for safety.

Statement: What the ESMS can do itself to “control” safety is limited, so other site systems must be leveraged to minimize risk. Therefore, the safety portion of this definition was further elaborated on in annex material so as not to confuse which parts of the beginning of the sentence apply to performance, and which apply to safety.

Public Input No. 344-NFPA 855-2023 [Section No. 3.3.9]

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.

3.3.9.8 Stored Energy.

Maximum stored energy for Energy storage systems is defined as its maximum rating per the listing.

Statement of Problem and Substantiation for Public Input

Reason statement: The term "stored energy" is found in many places across the standard, however, there are no standards to determine maximum stored energy. Rather, the maximum rating is determined during the evaluation process.

Submitter Information Verification

Submitter Full Mark Rodriguez

Name:

Organization: Sunrun

Affiliation: Mark Rodriguez-Sunrun, Jeff PSies-Planet Plansets, CALSSA

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Submittal Date: Thu Jun 01 14:25:41 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-41-NFPA 855-2023

Statement: The term "stored energy" is found in many places across the standard, but is not defined.

Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]

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.

A.3.3.9.4 In applying this definition the concept of "walk-in access" means the ability or need for any portion of the body to enter the space other than the arms. In crafting the technical language and definition the committee relied on a review of the definition of entry for confined spaces found at Code of Federal Regulations 1910.146.(b) "Entry means the action by which a person passes through an opening into a permit-required confined space". Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space. Though the confined space definition is if any part of the body crosses the plane, the committee determined that reaching in to service equipment was acceptable. Its important to note that many of these structures and containers would be considered confined spaces.

Statement of Problem and Substantiation for Public Input

This added annex note explains how the definition of walk-in unit was developed and clarifies when entry has occured. It is part of series of proposals addressing walk-in units.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 261-NFPA 855-2023 [New Section after 3.1]	

Submitter Information Verification

Submitter Full Name: Robert Davidson
Organization: Davidson Code Concepts, Llc
Street Address:
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Zip:

Submittal Date: Wed May 31 23:00:35 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-198-NFPA 855-2023

Statement: The power back up requirements within NFPA 855 for critical safety system was consistently applied across multiple chapters. Additional definitions and a new Section 4.10 have been created to consolidate the power requirements and provide consistency.

Public Input No. 283-NFPA 855-2023 [Section No. 3.3.16]

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~~ without additional analysis, testing and AHJ approval .

Statement of Problem and Substantiation for Public Input

Nothing in the standard besides the definition indicates energy storage above the MAQs is considered a high hazard occupancy. If that is the case, it would be better to state this in the body of the standard. The revised definition is more aligned with the MAQ section of 9.4.1.

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 08:18:21 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-39-NFPA 855-2023

Statement: Nothing in the standard besides the definition indicates energy storage above the maximum stored energy (formerly MAQ) is considered a high hazard occupancy. The revised definition is more aligned with the maximum stored energy section of 9.4.1.

Annex material was added to clarify that the “maximum” in an area includes an aggregate of all energy storage systems in that area. The rated energy from the listing was added to define “maximum” stored energy, similar to what is done in the footnotes of Tables 1.3, and 9.4.1 to properly define kWh.

Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]

3.3.20 Qualified Person.

One who has skills ~~and knowledge related~~ , knowledge, training, and experience, related to the construction and operation of ~~the electrical equipment and~~ energy storage systems installations and has received safety training to recognize and ~~avoid~~ mitigate the hazards involved. [**70:**100]

Statement of Problem and Substantiation for Public Input

"Qualified" is used in different configurations thru out the standard. Updating the definition to align with the use in the standard. Additional updating the usage to be consistently applied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	Qualified Persons
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	Qualified Persons
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	Qualified Persons
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	Qualified Persons
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	Qualified Persons
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	Qualified Persons
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
Affiliation: none
Street Address:
City:
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Zip:
Submittal Date: Sun Apr 23 11:38:49 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-40-NFPA 855-2023

Statement: The existing NFPA 70 definition is not specific to energy storage (for example, it doesn't include non-electrical hazards found in ESS). The NFPA 70 definition also differs from OSHA [29CFR Part 1926.32(m)], NFPA 70E and NFPA 70B definitions. All of these definitions were considered to formulate the optimal verbiage. The extract reference was removed because the definition was changed from what is in NFPA 70.

Public Input No. 238-NFPA 855-2023 [New Section after 3.3.27]

3.xx Energy Storage System Limited-Production Certification (LPC):

Performed by Recognized Laboratories for Energy Storage Systems to verify compliance of the requirements of Appropriate Test Standard, the Limited Production Certification process enables system integrators, original equipment manufacturers, to field assemble, test, commission, and certify energy storage systems as satisfying the requirements of the Appropriate Test Standard.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes

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Affiliation: none

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Submittal Date: Wed May 31 20:20:40 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-50-NFPA 855-2023

Statement: An LPC is a viable pathway for certification of BESS system that are limited in number of units produced. It may also apply to due to production methodologies, such as different sub listings and manufacturing facilities cannot meet the UL 9540 requirements for listing a system.

Public Input No. 240-NFPA 855-2023 [New Section after 3.3.27]

3.xx Appropriate Test Standard:

A document which specifies the safety requirements for specific equipment or class of equipment and satisfies the requirements of 29 CFR 1910.7(C).

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name:	Paul Hayes
Organization:	American Fire Technologies
Affiliation:	None
Street Address:	
City:	
State:	
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Submittal Date:	Wed May 31 20:40:35 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-51-NFPA 855-2023

Statement: The requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide UL 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Public Input No. 241-NFPA 855-2023 [New Section after 3.3.27]

3. xx *ESS Field Evaluation: Performed by an AC354 Accredited Field Evaluation Body (FEB) as approved by the authority having jurisdiction, an Energy Storage System Field Evaluation is based on Appropriate Test Standard to verify the failure of structures, systems, or components do not result in fire, electrical shock, or injury of personnel. The ESS Field Evaluation is the process used to determine conformance with requirements for one-of-a-kind, limited-production, used, or modified products that are not listed or labeled under a certification program .

A.3.xx

The International Accreditation Service ® (IAS) verifies the competency of independent, third-party accreditation of field evaluation bodies (FEBs) using Accreditation Criteria for Field Evaluation of Unlisted Electrical Equipment (AC354). The AC354 accreditation process requires each FEB to demonstrate compliance with both NFPA 790 and NFPA 791. Field Evaluations do not verify compliance to the Appropriate Test Standard.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes

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Affiliation: None

Street Address:

City:

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Zip:

Submittal Date: Wed May 31 20:42:10 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-52-NFPA 855-2023

Statement: This definition aligns with new 4.6.2 on field evaluations. This provides an alternate method of compliance with UL 9540 without lessening safety when due to production methods or separate listing such as UL 1741, UL 1973 and separate evaluations that UL 9540 cannot be accomplish.

The technical committee is seeking public comment as it is applicable to repurposed batteries that do not have a UL 1973 listing.

Public Input No. 242-NFPA 855-2023 [New Section after 3.3.27]

3.xx Recognized Laboratory:

an organization that is approved by OSHA as meeting the requirements of 29CFR 1910.7 to provide independent third-party product safety testing in accordance with Appropriate Test Standards and certification of compliance thereof.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

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Submittal Date:	Wed May 31 20:46:08 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This definition is not required as it is taken care with existing definitions and labeling,

Public Input No. 243-NFPA 855-2023 [New Section after 3.3.27]

3.xx Listed Energy Storage System.

equipment, materials, or services included in a list published by an Recognized Laboratory concerned with evaluation of energy storage products or services, that maintains periodic inspection of production of listed energy storage equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service that satisfies the minimum requirements of Appropriate Test Standard

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

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Submittal Date: Wed May 31 20:53:22 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: This definition is not required as it taken care with existing definitions and labeling.

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]

3.3.28 *Toxic Gas.*

A gas with a median lethal concentration (LC_{50}) in air of more than 200 ppm but not more than 2000 ppm by volume of gas or vapor, or more than 2 mg/L but not more than 20 mg/L of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [55, 2020]

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics. Definitions added from NFPA 1.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	Toxics Task Group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group

Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 11:46:00 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-81-NFPA 855-2023

Statement: Toxic emissions are not adequately addressed in the current addition of NFPA 855. Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Definitions of terms used in NFPA 855 have been added from NFPA 55.

Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]

3.3.29 *Highly Toxic Gas.*

A chemical that has a median lethal concentration (LC_{50}) in air of 200 ppm by volume or less of gas or vapor, or 2 mg/L or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [55, 2020]

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics. Definitions added from NFPA 1.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 11:52:54 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-82-NFPA 855-2023

Statement: Toxic emissions are not adequately addressed in the current addition of NFPA 855. Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Definitions of terms used in NFPA 855 have been added from NFPA 55.

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]

3.3.17 Minimum Approach Distance (MAD) The distance from the perimeter of an Energy Storage System at which a Qualified Person or first responder can reasonably expect to avoid health impacts from heat, pressure, and toxic risks associated with a failure of the Energy Storage System, as determined by the Hazard Mitigation Analysis and/or fire and explosion testing, without the use of personnel protective equipment.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics. MAD is also associate with Pressure ways, deflagrations and heat defined distances

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 11:55:14 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-83-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. This adds a definition of the term used in NFPA 855. MAD is also associated with pressure waves, deflagrations and heat defined distances.

Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]

3.3.30 * Toxic Emissions

Toxic species (gases, particulate, liquid or solid) released (into the environment where humans may be exposed.

A.3.3.30

While many ESS technologies use toxic materials and can produce toxic byproducts (particularly during an abnormal event, such as thermal runaway or fire), there is a difference between generation and emission. If the toxic species is generated internal to the battery (or by fire suppression system interaction with the ESS) but is consumed internally or is combusted or reacts to form other non-toxic compounds prior to human exposure it is not considered to be "emitted".

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group

Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics Task Group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date:	Sat Apr 22 11:57:55 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: CI-84-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Toxic emissions are not adequately addressed in the current addition of 855. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. This adds a definition of the term used in NFPA 855.

Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]

3.3.x REGISTERED DESIGN PROFESSIONAL. An individual who is registered or licensed to practice fire protection engineering with experience in Energy Storage System and their respective safety systems as defined by the statutory requirements of the professional registration laws of the jurisdiction in which the project is to be constructed.

Statement of Problem and Substantiation for Public Input

The term "Registered design professional" is used and required for evaluation of multiple required reports in the standard. I definition needs to be added to cover the requirements of term.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	Qualified Persons
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	Qualified Persons
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	Qualified Persons
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	Qualified Persons
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	Qualified Persons
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	

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Submittal Date: Sun Apr 23 11:45:54 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-117-NFPA 855-2023
Statement: This definition of term used throughout the standard is extracted from NFPA 5000.

Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]

Failure Modes and Effects Analysis (FMEA)

- **"Failure modes" means the ways, or modes, in which something might fail. Failures are any errors or defects, especially ones that affect the End user, and can be potential or actual.**
- **"Effects analysis" refers to studying the consequences of those failures.**

Failures are prioritized according to how serious their consequences are, how frequently they occur, and how easily they can be detected. It is used during design to help mitigate against failures. It is to take actions to eliminate or reduce failures, starting with the highest-priority ones. It begins during the earliest conceptual stages of design and continues throughout the life of the BESS products and services.

Statement of Problem and Substantiation for Public Input

Currently FMEA is used 6 time in the 855 Standard. It is not defined with in the standard not NFPA codes. FMEA is part of the HMA process.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

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Committee:	ESS-AAA

Committee Statement

Resolution: The proposed revision is not a definition of the term. Clarification should be submitted as a public comment.

Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]

3.3.X Fire Risk Assessment (FRA).

A process to characterize the risk associated with fire that addresses the fire scenario or fire scenarios of concern, their probability, and their potential consequences. Other documents may use other terms, such as *fire risk analysis* , *fire hazard* , *hazard analysis* , and *fire hazard analysis assessment* , to characterize fire risk assessment as used in this guide.

Statement of Problem and Substantiation for Public Input

Fire Risk Assessment (FRA) is used 5 time in 855. It is not defined in the standard. It is part of the HMA process requirements. Utilizing the definition from NFPA 551 to incorporate into 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

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Submittal Date:	Thu Apr 27 09:30:10 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-135-NFPA 855-2023

Statement: Fire risk assessment (FRA) is used 5 times in NFPA 855. It is not defined in the standard. It is part of the HMA process requirements. Utilizing the definition from NFPA 551 to incorporate into NFPA 855.

Public Input No. 22-NFPA 855-2023 [Chapter 4 [Title Only]]

~~General~~ A targeted water system, such as a one that provides direct water injection into the seat of a thermal runaway event, can mitigate the propagation of thermal runaway to adjacent cells. This can be an effective method to limit the spread of an event to adjacent lithium-ion battery racks within a BESS container.

Statement of Problem and Substantiation for Public Input

By adding my comments to the code, it acknowledges that a targeted water system can be effective at limiting thermal runaway to the cells that are in thermal runaway and to prevent propagation of a thermal runaway event to adjacent cells, modules and racks within a BESS container.

Submitter Information Verification

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Submittal Date: Tue Mar 28 11:44:51 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The submitter should clarify this through a public comment complying with the NFPA regulations for submittal of a comment.

Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]

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~~ explosion control in accordance with 9.6.5.6.3

(4) Other test data, evaluation information, or calculations as required elsewhere in this standard

Statement of Problem and Substantiation for Public Input

NFPA 855 Task group on explosion controls. Recommendation that guides be explosion control and not specific to NFPA 68/69 as 68 may not be an viable options and other options such as testing may be applicable.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

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Submittal Date:	Thu Apr 27 10:14:31 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution:	FR-136-NFPA 855-2023
Statement:	Simplified to not be specific to NFPA 68 and 69 as NFPA 68 may not be a viable options and other options such as testing may be applicable.

Public Input No. 159-NFPA 855-2023 [Section No. 4.3.1]

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.

Statement of Problem and Substantiation for Public Input

Task Group 11 determined that the current edition had a very high threshold for when emergency planning and training is required. This PI intends to reduce the threshold so that all battery system regulated by NFPA 855 have this crucial emergency planning and training. The task group discussed if requiring all battery systems to provide planning and training would inflict an overwhelming burden on the facilities. The consensus of the task group was that the burden of creating emergency planning and training was not that difficult and the benefit to the ESS personnel, first responders and the community easily outweighed the work necessary to create planning and training.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 225-NFPA 855-2023 [Section No. 4.3.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Brian Scholl
Organization: Phoenix Fire Department
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Submittal Date: Tue May 23 18:45:35 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-15-NFPA 855-2023

Statement: The current edition had a very high threshold for when emergency planning and training is required. This revision reduces the threshold so that all battery systems regulated by NFPA 855 have this crucial emergency planning and training.

Public Input No. 158-NFPA 855-2023 [New Section after 4.3.2]

4.3.3 Emeregncy Response Plan

4.3.3.1

For ESS installations, an emergency response plan and associated training shall be established, maintained, and conducted so that ESS facility operations personnel and emergency responders can address foreseeable hazards associated with the on-site emergencies.

4.3.3.2

The emergency response plan shall be in accordance with chapters 17 through 23 of NFPA 1660 and shall, at a minimum, address:

(1) Mitigation

(2) Preparedness

(3) Response

(4) Recovery

4.3.3.3 Training

4.3.3.3.1 P ersonnel responsible for the installation of the ESS shall be trained prior to the ESS arriving onsite, in the procedures included in the emergency response plan in 4.3.3.

Personnel responsible for the operation, maintenance, repair, servicing, and response of the ESS shall be trained prior to the commissioning of the ESS, in the procedures included in the emergency response plan in 4.3.3 .

4.3.3.4 Refresher Training

4.3.3.3. 2 Refresher training shall be conducted by ESS facility operations personnel at least annually, and records of such training retained in an approved manner.

4.3.3.5 Notification

Emergency responders shall be notified of the training dates and locations.

Statement of Problem and Substantiation for Public Input

This PI adds a new section that is going to require an emergency response plan. The emergency response plan differs from the previously required emergency operations plan as this plan lays out a series of steps the facility will take during a critical event, such as a fire or active shooter threat, to ensure employees' safety and minimize the impact on critical operations. The plan also brings in certain requirements from NFPA 1660 on how to mitigate an event, how to prepare for a event, how to respond to a event and how to recover from an event in order to get back to normal operations. Some of these items will be a collaboration with the local first responders especially on the response topic. The rest of the new section uses similar language from previous sections regarding training and refresher training. The last part of the new section is notification. This is a requirement that the facility needs to contact the local emergency responders of the when and where for the required training. This doesn't necessarily mean that the emergency responder will participate in every training; its just a notification of the training. The task group believes that this new section brings in a new plan that was previously missing in the standard which is aimed at everyone working together if there is an incident at the facility.

Submitter Information Verification

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Submittal Date: Tue May 23 18:39:01 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-17-NFPA 855-2023

Statement: This new section requires an emergency response plan. The emergency response plan differs from the previously required emergency operations plan as this plan lays out a series of steps the facility will take during a critical event, such as a fire or active shooter threat, to ensure employees' safety and minimize the impact on critical operations. The plan also brings in certain requirements from NFPA 1660 on how to mitigate an event, how to prepare for an event, how to respond to an event and how to recover from an event in order to get back to normal operations. Some of these items will be a collaboration with the local first responders especially on the response topic. The rest of the new section uses similar language from previous sections regarding training and refresher training. The last part of the new section is notification. This is a requirement that the facility needs to contact the local emergency responders of the when and where for the required training. This doesn't necessarily mean that the emergency responder will participate in every training; its just a notification of the training. This new section brings in a new plan that was previously missing in the standard which is aimed at everyone working together if there is an incident at the facility.

Public Input No. 225-NFPA 855-2023 [Section No. 4.3.2 [Excluding any Sub-Sections]]

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.

Statement of Problem and Substantiation for Public Input

Task Group 11 determined that the current edition had a very high threshold for when an emergency operations plan and associated training is required. This PI intends to reduce the threshold so that all battery system regulated by NFPA 855 have this critical emergency operations plan and associated training. The task group discussed if requiring all battery systems to provide an emergency operations plan and associated training would inflict an overwhelming burden on the facilities. The consensus of the task group was that the burden of creating this plan and training was not that difficult and the benefit to the ESS facility operations and maintenance personnel, first responders and the community easily outweighed the work necessary to create planning and training.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 159-NFPA 855-2023 [Section No. 4.3.1]	Similar PIs

Submitter Information Verification

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Submittal Date: Wed May 31 15:21:27 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-16-NFPA 855-2023

Statement: The current edition had a very high threshold for when an emergency operations plan and associated training is required. This revision reduces the threshold so that all battery system regulated by NFPA 855 have this critical emergency operations plan and associated training.

Public Input No. 226-NFPA 855-2023 [Section No. 4.3.2.1.2]

4.3.2.1.2

~~For normally occupied facilities, the~~ The emergency operations plan shall be on ~~site~~ site in an approved location or available digitally where approved by the AHJ .

Statement of Problem and Substantiation for Public Input

The current verbiage in the standard only requires this required emergency operations plan to be provided onsite for "normally occupied facilities". Task Group 11 determined that an emergency operations plan should be provided onsite or digitally for all ESS installations. Our first responders need to understand what the emergency operations plan is and how they fit into this plan. Having that plan onsite or digitally for all ESS installations will allow our first responders to review the plan once they get onsite to ensure that both the first responders and facility personnel are on the same page when it comes to mitigating the hazard. Having this plan available on site is even more critical when there is no one at the facility to talk to. The emergency operations plan is already required, this public input just provides clarification that the plan needs to be provided to the first responders either on site or through a digital means in order to keep everyone on the same page and safe.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 227-NFPA 855-2023 [Section No. 4.3.2.1.5]	

Submitter Information Verification

Submitter Full Name: Brian Scholl
Organization: Phoenix Fire Department
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 15:25:51 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-86-NFPA 855-2023

Statement: The emergency operations plan is already required, this revision provides clarification that the plan needs to be provided to the first responders either on site or through a digital means in order to keep everyone on the same page and safe.

Public Input No. 216-NFPA 855-2023 [Section No. 4.3.2.1.4]

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 <u>that address safety concerns covering response, mitigation, and extinguishment,</u> similar to <u>those found in</u> a safety data sheet (SDS) ~~that will address response safety concerns and extinguishment~~ , <u>even</u> 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

Statement of Problem and Substantiation for Public Input

This attempts to clarify the intent.

Submitter Information Verification

Submitter Full Name: Kevin Fok
Organization: LG Energy Solution Vertech
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 13:35:34 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: This public input does not add any benefit to the standard compared to the current language. Under the Global Harmonization System all SDSs have the same sections, so the proposed subjects are already addressed.

Public Input No. 285-NFPA 855-2023 [Section No. 4.3.2.1.4]

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

Statement of Problem and Substantiation for Public Input

It is not necessary for the Emergency Operations Plan to address the safe re-start up procedures. Depending on the event, those procedures may need to be developed after full understanding of the event and may take a long time to customize. It is sufficient for the EOP to assure safe shut-down.

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 08:29:30 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-87-NFPA 855-2023

Statement: It is not necessary for the emergency operations plan to address the safe re-start up procedures. Start up following an emergency needs to be in accordance with the commissioning plan and not the EOP.

Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]

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~~ for a qualified person 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

Statement of Problem and Substantiation for Public Input

"Qualified" is used in different configurations thru out the standard. Updating the definition to align with the use in the standard. Additional updating the usage to be consistently applied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	Qualified Persons
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	Qualified Persons
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	Qualified Persons
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	Qualified Persons
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	Qualified Persons
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Sun Apr 23 12:08:21 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The term “qualified person”, which is defined in 3.3.20, deals with persons that have knowledge of the construction and operation of a BESS. The person required in this section is a person qualified to remove damaged batteries which requires special knowledge and training.

Public Input No. 191-NFPA 855-2023 [New Section after 4.3.2.1.5]

4.3.2.1.6

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 NFPP 76 shall not require emergency operations plan in 4.3.2.1.

Statement of Problem and Substantiation for Public Input

Electric utility spaces under exclusive control of electric utilities are not required to follow the emergency operations plan of 4.3.2.1. A similar carve out should be available for telecommunications with conditions and restrictions limiting the exemption to the traditional installations using lead-acid and ni-cd batteries for less than 60V dc standby power and meeting NFPA 76 criteria.

Submitter Information Verification

Submitter Full Name:	Randy Schubert
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 30 15:02:30 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: NFPA 76 does have requirements for an emergency operations plan, the threshold when these are required is too high for this critical emergency operations plan and associated training. The burden of creating this plan and training is not that difficult and the benefit to the ESS facility operations and maintenance personnel, first responders and the community easily outweighed the work necessary to create planning and training.

Public Input No. 109-NFPA 855-2023 [Section No. 4.3.2.1.5]

4.3.2.1.5

The emergency operations plan in 4.3.2.1 shall not be required for electric or communications utility facilities under the exclusive control of ~~the electric utility~~ the utility located outdoors or in building spaces used exclusively for such installations.

Statement of Problem and Substantiation for Public Input

Both electric and communications utilities should be included in the exemption for an Emergency Operations Plan. Communications providers rely on standby batteries that are below 60Vdc and have an excellent record for safety.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon May 15 18:15:58 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This proposed exemption is too broad. Buildings and enclosures, even outdoors, need EOP. The burden of creating this plan and training is not that difficult and the benefit to the ESS facility operations and maintenance personnel, first responders and the community easily outweighed the work necessary to create planning and training.

Public Input No. 227-NFPA 855-2023 [Section No. 4.3.2.1.5]

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.~~

Statement of Problem and Substantiation for Public Input

The current verbiage in the standard does not require a critical safety plan to be required for electric utilities under the exclusive control of the electrical utility located outdoors or in a building space used exclusively for such installations. Task group 11 determined that an emergency operations plan needs to be required for all ESS installations, even those under control of the utilities. Having this plan allows are first responders to understand their role in mitigating the incident as well as providing support to the utility company personnel. Not having this plan, leaves are first responders in the dark as to what they should or should not be doing at these types of facilities which creates an unnecessary hazardous situation for our first responders.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 226-NFPA 855-2023 [Section No. 4.3.2.1.2]	Same section of the standard

Submitter Information Verification

Submitter Full Name: Brian Scholl
Organization: Phoenix Fire Department
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 15:39:27 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-88-NFPA 855-2023

Statement: The current verbiage in the standard does not require a critical safety plan to be required for electric utilities under the exclusive control of the electrical utility located outdoors or in a building space used exclusively for such installations. An emergency operations plan needs to be required for all ESS installations, even those under control of the utilities. Having this plan allows are first responders to understand their role in mitigating the incident as well as providing support to the utility company personnel. Not having this plan, leaves are first responders in the dark as to what they should or should not be doing at these types of facilities which creates an unnecessary hazardous situation for our first responders.

Public Input No. 160-NFPA 855-2023 [Section No. 4.3.2.2.1]

4.3.2.2.1

Personnel responsible for the installation of the ESS shall be trained prior to the ESS arriving onsite, in the procedures included in the emergency operations plan in 4.3.2.1 .

Personnel responsible for the operation, maintenance, repair, servicing, and response of the ESS shall be trained prior to the commissioning of the ESS, in the procedures included in the emergency operations plan in 4.3.2.1.

Statement of Problem and Substantiation for Public Input

The goal of this PI from task group 11 was to clarify when training is needed to occur for two different groups of facility personnel. Personnel that are part of the initial installation of the ESS need to be trained prior to the ESS arriving onsite so that they are prepared once the ESS arrives. Those personnel that are responsible for the operation, maintenance, repair, serving and response after the ESS is installed, must be trained prior to the ESS being commissioned. The task group believes that splitting up when the training is required will benefit both groups so they receive relevant training and so they are prepared for any incidents during the phase of installation that falls within their scope of responsibility.

Submitter Information Verification

Submitter Full Name: Brian Scholl
Organization: Phoenix Fire Department
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 23 18:50:24 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-89-NFPA 855-2023

Statement: This revision clarifies when training is needed to occur for two different groups of facility personnel. Personnel that are part of the initial installation of the ESS need to be trained prior to the ESS arriving onsite so that they are prepared once the ESS arrives. Those personnel that are responsible for the operation, maintenance, repair, serving and response after the ESS is installed, must be trained prior to the ESS being commissioned. Splitting up when the training is required will benefit both groups so they receive relevant training and so they are prepared for any incidents during the phase of installation that falls within their scope of responsibility.

Public Input No. 286-NFPA 855-2023 [Section No. 4.3.2.2.1]

4.3.2.2.1

Personnel responsible for the operation, maintenance ~~, repair, servicing, and response of~~ and repair of the ESS shall be trained in the procedures included in the emergency operations plan in 4.3.2.1.

Statement of Problem and Substantiation for Public Input

Servicing and response are addressed by operation, maintenance and repair. These terms can be removed and the requirement would be more straightforward.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 08:36:32 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-89-NFPA 855-2023

Statement: This revision clarifies when training is needed to occur for two different groups of facility personnel. Personnel that are part of the initial installation of the ESS need to be trained prior to the ESS arriving onsite so that they are prepared once the ESS arrives. Those personnel that are responsible for the operation, maintenance, repair, serving and response after the ESS is installed, must be trained prior to the ESS being commissioned. Splitting up when the training is required will benefit both groups so they receive relevant training and so they are prepared for any incidents during the phase of installation that falls within their scope of responsibility.

Public Input No. 17-NFPA 855-2023 [Section No. 4.4.1]

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

(7) Where required by the AHJ for existing systems (retroactivity) in accordance with 1.4.2

Statement of Problem and Substantiation for Public Input

This was done as part of an effort by the retroactivity TG18 (Curtis Ashton, Jose Marrero, Gary Balash, Paul Hayes, Brian Scholl, Jan Gromadzki, and Steven Crane) to strengthen the ability of an AHJ to call for review and possible modification of older systems installed before UL 9540 and 9540A certification/testing were available, due to the fires that have occurred at higher rates in these systems

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 14-NFPA 855-2023 [New Section after 1.4.2]	
Public Input No. 15-NFPA 855-2023 [Section No. 1.4.2]	
Public Input No. 16-NFPA 855-2023 [Section No. A.1.4.2]	
Public Input No. 88-NFPA 855-2023 [Section No. A.1.4.2]	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: American Power Systems/ East P

Affiliation: TG18 of the NFPA 855 committee

Street Address:

City:

State:

Zip:

Submittal Date: Sat Jan 07 11:00:19 EST 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-24-NFPA 855-2023

Statement: This was done to strengthen the ability of an AHJ to call for review and possible modification of older systems installed before UL 9540 and UL 9540A certification/testing were available, due to the fires that have occurred at higher rates in these systems.

Public Input No. 288-NFPA 855-2023 [Section No. 4.4.1]

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

Statement of Problem and Substantiation for Public Input

Maybe consider prohibiting mixing technologies in a single fire area when there is a risk of adverse interaction. That would be safer. Suggest adding a prohibition to this effect in Section 4.7 Installation instead of trying to manage this via the HMA.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 289-NFPA 855-2023 [New Section after 4.7]	

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 08:46:18 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: There are so many different potential adverse interactions, especially as technology evolves, that they need to be evaluated by a fire safety professional via an HMA to determine how truly dangerous or not they are. More guidance on “adverse” interactions is provided in new annex text.

Public Input No. 68-NFPA 855-2023 [Section No. 4.4.2]

4.4.2 Failure Modes.

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)

~~Failure of a required protection system including, but not limited to, ventilation (HVAC), exhaust ventilation, smoke detection, fire detection, fire suppression, or gas detection~~

(3) As identified in a site level Fire Risk Assesement (FRA) or a Site level FMEA .

4.4.2.2

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

Statement of Problem and Substantiation for Public Input

There is interpretation in the industry that a signal failure mode would be defined as either a battery failure or a protection system and not both. As a protection system must function in single failure mode, it needs to be separate, defined and evaluated independent of a FMEA and equipment failure. It need to function and provide protection during a event, similar to the requirements of reliable power and back up power under the requirement of NFPA 72.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 69-NFPA 855-2023 [New Section after 4.4.2.2]	Single Fault
Public Input No. 69-NFPA 855-2023 [New Section after 4.4.2.2]	

Submitter Information Verification

Submitter Full Name:	Paul Hayes
Organization:	The Hiller Companies/American
Affiliation:	None
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Apr 27 10:18:42 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-137-NFPA 855-2023

Statement: There is interpretation in the industry that a signal failure mode would be defined as either a battery failure or a protection system and not both. As a critical safety system must function in single failure mode. , iIt needs to be separate, defined and evaluated independent of a FMEA and equipment failure. Required system and critical system have been separated to be evaluated separately.

Public Input No. 110-NFPA 855-2023 [Section No. 4.4.2.1]

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~~ a protection system that is ~~not covered by the product listing failure modes and effects analysis (FMEA)~~ provided outside of the listed ESS

(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

Statement of Problem and Substantiation for Public Input

As written, the statement implies that failure modes not covered by the product listing's FMEA need to be assessed. This seems to excessive. If the product is listed, all of the product failure modes of concern should have been assessed. It seems maybe the statement should address failure of hardware outside the scope of the product listing.

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Mon May 15 18:24:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: There are partial systems that are not part of the UL 9540 listing that haven't been evaluated as part of the complete systems. The proposed text would lock the AHJ into accepting these systems.

Public Input No. 69-NFPA 855-2023 [New Section after 4.4.2.2]

4.4.2.3* Failure of a required or integral protection system including, but not limited to, ventilation (HVAC), exhaust ventilation, smoke detection, fire detection, fire suppression, or gas detection shall be evaluated to confirm they will operate and support mitigation measures in a single failure mode.

A.4.4.2.3 Failure of an integral safety system such as the fire alarm and explosion control system is not considered a dual fault condition. An example may be the loss of primary power or secondary power.

Statement of Problem and Substantiation for Public Input

There is interpretation in the industry that a signal failure mode would be defined as either a battery failure or a protection system and not both. As a protection system must function in single failure mode, it needs to be separate, defined and evaluated independent of a FMEA and equipment failure. It need to function and provide protection during a event, similar to the requirements of reliable power and back up power under the requirement of NFPA 72.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 68-NFPA 855-2023 [Section No. 4.4.2]	Single Fault
Public Input No. 68-NFPA 855-2023 [Section No. 4.4.2]	

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
Affiliation: None
Street Address:
City:
State:
Zip:
Submittal Date: Thu Apr 27 11:29:08 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-138-NFPA 855-2023

Statement: There is an interpretation in the industry that a signal failure mode or failure event would be defined as either a battery failure or a protection system and not both. A critical safety system must function in failure event, to be separate, defined and evaluated independent of a FMEA and equipment failure. These systems need to function and provide protection during an event, similar to the requirements of reliable power and backup power under the requirement of NFPA 72.

Public Input No. 89-NFPA 855-2023 [Section No. 4.4.5]

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, product listings and the manufacturer's instructions.

Statement of Problem and Substantiation for Public Input

This change is intended to ensure that the installation and maintenance is completed in accordance with the requirements of the product listing. Safety systems that are required as a result of the HMA may have specific requirements in order to remain within the product listing.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

Submitter Full Name: Steve Edley

Organization: NFPA 855 Task Group 20

Street Address:

City:

State:

Zip:

Submittal Date: Mon May 08 14:18:27 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The manufacturer’s instructions are covered by the product listing.

Public Input No. 164-NFPA 855-2023 [Section No. 4.6.1]

4.6.1* Listings.

ESS shall be listed in accordance with UL 9540, unless specifically exempted in other sections of this standard. ESS that are not listed in accordance with UL 9540 should be documented and verified by an approved third-party certification organization as meeting the provisions of this standard using the equivalency requirements in Section 1.5, where technical documentation provided shows the ESS that is proposed results in a system that is no less safe than a system meeting the construction and performance requirements of UL 9540.

Statement of Problem and Substantiation for Public Input

Public Input #163 includes proposed changes for A4.6.1 and this Public Input is intended to provide opportunity to demonstrate equivalency to UL 9540 using an approved third party certification organization since the Annex sections of NFPA 855 are not necessarily directly carried over to other codes.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 163-NFPA 855-2023 [Section No. A.4.6.1]	Related Annex

Submitter Information Verification

Submitter Full Name: Kevin Fok

Organization: Lg Energy Solution Vertech

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 24 10:58:54 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The proposed text would provide a pathway to circumvent the required listing.

Public Input No. 244-NFPA 855-2023 [Section No. 4.6.1]

4.6.1* Listings.

ESS shall be ~~listed~~ evaluated, tested and listed by a recognized laboratory in accordance with the appropriate test standard (UL 9540) , unless specifically exempted in other sections of this standard.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: American Fire Technologies
Affiliation: None
Street Address:
City:
State:
Zip:

Submittal Date: Wed May 31 20:55:10 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The proposed text would provide a pathway to circumvent the required listing.

Public Input No. 335-NFPA 855-2023 [Section No. 4.6.1]

4.6.1* Listings.

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

4.6.1.1* EV Chargers Containing ESS

EV chargers containing ESS shall be listed in accordance with UL 3202.

A.4.6.1.1

UL 3202 EV Charging Systems Utilizing Energy Storage includes criteria that requires the onboard ESS in EV chargers to comply with applicable UL 9540 construction and performance requirements.

Statement of Problem and Substantiation for Public Input

An increasing number of EV chargers incorporate onboard lithium-ion battery storage. This includes permanently installed, mobile, and autonomous EV chargers. UL 3202 is being developed to be cover these products.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 340-NFPA 855-2023 [Section No. 2.3.7]	

Submitter Information Verification

Submitter Full Name: Howard Hopper
Organization: UL Solutions
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 13:19:55 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-1-NFPA 855-2023

Statement: This new section addresses electric vehicle charging technology that incorporates energy storage.

Public Input No. 334-NFPA 855-2023 [New Section after 4.6.5]

TITLE OF NEW CONTENT

4.6.5.1

Repurposed, remanufactured, and refurbished batteries shall also comply with 9.2.4.

Statement of Problem and Substantiation for Public Input

This provides an informative link to the repurposed, remanufactured, and refurbished battery section, a form of reused equipment.
This public input was developed by an NFPA 855 2nd life battery task group (#16).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 314-NFPA 855-2023 [Section No. 9.2.4]	

Submitter Information Verification

Submitter Full Name: Howard Hopper
Organization: UL Solutions
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City:
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Submittal Date: Thu Jun 01 13:08:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-142-NFPA 855-2023

Statement: This addition is to connect repurposed and refurbished batteries back to the requirements in 9.2.4. The wording in 4.6.5 does not tie the ESS back to the requirements in NFPA 855 for ESS that use new batteries.

Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]

4.6.11* ESS Toxic and Highly Toxic Gas ~~Release~~ Emitted During Normal Use.

ESS shall not ~~release~~ emit toxic or highly toxic gases during normal charging, discharging, and use.

Statement of Problem and Substantiation for Public Input

While many ESS technologies use toxic materials and can produce toxic byproducts (particularly during an abnormal event, such as thermal runaway or fire), there is a difference between generation or released and emission. If the toxic species is generated internal to the battery (or by fire suppression system interaction with the ESS) but is consumed internally or is combusted or reacts to form other non-toxic compounds prior to human exposure it is not considered to be “emitted”.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group

Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
Affiliation: none
Street Address:
City:
State:
Zip:
Submittal Date: Sat Apr 22 12:03:38 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-85-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

While many ESS technologies use toxic materials and can produce toxic byproducts (particularly during an abnormal event, such as thermal runaway or fire), there is a difference between generation or released and emission. If the toxic species is generated internal to the battery (or by fire suppression system interaction with the ESS) but is consumed internally or is combusted or reacts to form other non-toxic compounds prior to human exposure it is not considered to be “emitted”.

Toxic emissions are not adequately addressed in the current addition of 855. Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 291-NFPA 855-2023 [Section No. 4.6.12.2]

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*.

Statement of Problem and Substantiation for Public Input

Indoor enclosures in controlled environments don't need to be weatherproof. It is sufficient to say enclosures are suitable for the type of exposure required by NFPA 70.

Submitter Information Verification

Submitter Full Name: Richard Kluge

Organization: Ericsson

Affiliation: ATIS

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 10:16:38 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-60-NFPA 855-2023

Statement: Indoor enclosures in controlled environments don't need to be weatherproof. It is sufficient to say enclosures are suitable for the type of exposure required by applicable codes and standards. The first part of the sentence was unnecessary, and there are non-electrical components in energy storage systems. NFPA 70 is not the only document specifying suitable enclosure types, especially outside of North America, and thus the reference was made more generic to applicable codes and standards, with examples in the annex.

Public Input No. 289-NFPA 855-2023 [New Section after 4.7]

4.7.1 Mixing of ESS Technologies.

Where advserse interaction between two or more ESS technologies is possible, each shall be installed in a seperate fire area.

Statement of Problem and Substantiation for Public Input

Suggestion is to prohibit mixing potentially adverse interacting ESS in the same fire area. This is safer and more straightforward than addressing this via the HMA.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 288-NFPA 855-2023 [Section No. 4.4.1]	Same topic - take these together

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 08:50:21 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This is currently addressed under Section 4.4.1 (2) in which an HMA is required and covers potentially adverse interactions of different ESS technologies.

Public Input No. 113-NFPA 855-2023 [Section No. 4.7.1.1]

4.7.1.1

~~Lead~~ Installations of 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~~ than 60 V dc that under the exclusive control of communications ~~utilities and located~~ utilities 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.

Statement of Problem and Substantiation for Public Input

Editing the exemption of communications standby battery plants to be more consistent with the exemption provided in the NEC under article 90.2(D). The NEC exempts such communications standby power equipment very broadly. For NFPA 855 to more narrowly exempt equipment and point back to the NEC which has a broader exemption creates confusion.

Submitter Information Verification

Submitter Full Name: Richard Kluge

Organization: Ericsson

Affiliation: ATIS

Street Address:

City:

State:

Zip:

Submittal Date: Mon May 15 21:02:49 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The requirement for NFPA 76 and telecommunications sites should remain in the standard.

Public Input No. 192-NFPA 855-2023 [Section No. 4.7.1.1]

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.

Statement of Problem and Substantiation for Public Input

NFPA 70 does not apply to low voltage, less than 60 V dc power systems in telecommunications facilities. The existing carveout in 4.7.1.1 in NFPA 855 for these lead-acid and nickel-cadmium systems includes a requirement for NFPA 76 for these installations but Article 480 of the NFPA 70 does not require NFPA 76.

Submitter Information Verification

Submitter Full Name: Randy Schubert
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:

Submittal Date: Tue May 30 15:14:15 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The requirement for NFPA 76 should remain in the standard.

Public Input No. 357-NFPA 855-2023 [Section No. 4.7.1.1]

4.7.1.1

Lead-acid ~~and~~ , nickel-cadmium, and zinc-manganese 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.

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name: Umer Anwer
Organization: Urban Electric Power
Street Address:
City:
State:
Zip:

Submittal Date: Thu Jun 01 16:37:45 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft to justify the exception for zinc manganese in this area, including what happens when an over-cycle causes an internal short circuit.

Public Input No. 359-NFPA 855-2023 [Section No. 4.7.1.2]

4.7.1.2

Lead-acid ~~and~~ , nickel-cadmium ~~battery~~ , and zinc-manganese 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.

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name: Umer Anwer

Organization: Urban Electric Power

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 16:40:36 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft to justify the exception for zinc manganese in this area, including what happens when an over-cycle causes an internal short circuit.

Public Input No. 256-NFPA 855-2023 [Section No. 4.7.2]

4.7.2 Seismic Protection.

ESS shall ~~be seismically braced~~ meet seismic requirements in accordance with the local building code.

Statement of Problem and Substantiation for Public Input

This makes the compliance with the seismic requirements more general rather than specifying bracing.

Submitter Information Verification

Submitter Full Name:	Kevin Fok
Organization:	LG Energy Solution Vertech
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed May 31 22:30:14 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution:	FR-61-NFPA 855-2023
Statement:	This makes the compliance with the seismic requirements more general rather than specifying bracing.

Public Input No. 138-NFPA 855-2023 [Section No. 4.7.4.3.1]

4.7.4.3.1

Energy storage located on property that is under the exclusive control of electric 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.

Statement of Problem and Substantiation for Public Input

The section should qualify that the exclusion refers to electric utilities not any utility, and conforms to NFPA 70 90.2 (D) (5).

Submitter Information Verification

Submitter Full Name: Chris Searles

Organization: Ieee Essb Committee

Affiliation: CGS and Assciates

Street Address:

City:

State:

Zip:

Submittal Date: Tue May 23 10:06:39 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-62-NFPA 855-2023

Statement: The section qualifies that the specific NEC 90.2(D)(5) exclusion refers to electric utilities not just any type of utility.

Public Input No. 114-NFPA 855-2023 [Section No. 4.7.4.3.2]

4.7.4.3.2

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

Statement of Problem and Substantiation for Public Input

NFPA 70 does not require disconnects for any lead-acid and nickel-cadmium battery systems less than 60 V dc that are used in standby power applications. Requiring a permanent plaque denoting the location of the disconnect presumes there is a disconnect which is often not the case for low voltage battery plants. Restricting the exemption to certain telecom facilities is not consistent with Article 480 of the NEC.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon May 15 21:19:44 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The suggested modification of applying the carve out to “standby power systems” is not sufficient and not adequately justified.

Public Input No. 193-NFPA 855-2023 [Section No. 4.7.4.3.2]

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~~ for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations and secured from public access shall not be required to comply with 4.7.4.3.

Statement of Problem and Substantiation for Public Input

Disconnect signage requirements should not require NFPA 76 compliance. The existing carveout was reworded to add language consistent with other similar carveouts requiring these installations be in under exclusive control of the communications utility in spaces used exclusively for such installations and secured from the public.

Submitter Information Verification

Submitter Full Name: Randy Schubert
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:

Submittal Date: Tue May 30 15:26:36 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-122-NFPA 855-2023

Statement: The suggested modification of applying the carve out to “standby power systems” is not sufficient and not adequately justified.

Public Input No. 139-NFPA 855-2023 [Section No. 4.7.5.4]

~~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.~~

Statement of Problem and Substantiation for Public Input

This applies to residential garages and should be moved to Chapter 15.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 140-NFPA 855-2023 [Section No. 15.4.1]	

Submitter Information Verification

Submitter Full Name: Chris Searles
Organization: Ieee Essb Committee
Affiliation: CGS and Associates
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 23 10:17:55 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The section as written is appropriate and does not warrant to be stricken out of Chapter 4 and moved solely into Chapter 15. A gap in the residential Chapter 15, Section 15.8 was identified. Section 15.8 is revised by separate revision to mirror what current 4.7.5.4 requires.

Public Input No. 185-NFPA 855-2023 [Section No. 4.7.5.4]

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.~~

Statement of Problem and Substantiation for Public Input

This is redundant with section 15.8.

Submitter Information Verification

Submitter Full Name:	Robert Rallo
Organization:	Solar System Services
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 30 09:28:27 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The section as written is appropriate and does not warrant to be stricken out of Chapter 4 and moved solely into Chapter 15. A gap in the residential Chapter 15, Section 15.8 was identified. Section 15.8 is revised by separate revision to mirror what current 4.7.5.4 requires.

Public Input No. 294-NFPA 855-2023 [Sections 4.7.7.1.2, 4.7.7.1.3]

Sections 4.7.7.1.2, 4.7.7.1.3

4.7.~~7.~~ 1.~~2~~ – _

The ESS shall not be located inside an electrical room.

4.7.~~7.1.3~~ <u>2</u>

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

Statement of Problem and Substantiation for Public Input

For TC discussion: Consider relocating these requirements to a location earlier in 4.7 so they are applied more generally. As currently located, they apply only to below grade ESS installations, which could be the intent, but seems rather limiting.

Submitter Information Verification

Submitter Full Name: Richard Kluge

Organization: Ericsson

Affiliation: ATIS

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 10:25:42 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-63-NFPA 855-2023

Statement: Current requirements only provide location guidance for installations below grade, but it is important that safe access to the installation for emergency responders be available in all locations.

Public Input No. 141-NFPA 855-2023 [Section No. 4.7.7.3]

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 ~~uninterruptable~~ 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) Lead-acid and Ni-cadmium battery systems listed to UL 1973.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

Submitter Full Name:	Chris Searles
Organization:	Ieee Essb Committee
Affiliation:	CGS and Assciates
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 23 10:29:09 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-145-NFPA 855-2023

Statement: The improvements in UL 1973 for fire safety lead-acid and Ni-Cd batteries is recognized by this revision.

Public Input No. 161-NFPA 855-2023 [Section No. 4.7.7.3]

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 ~~uninterruptable~~ 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) Lead-acid and nickel-cadmium battery systems, which the batteries are listed to UL1973.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

Submitter Full Name: Gary Balash

Organization: East Penn Manufacturing Compan

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 24 09:17:07 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-145-NFPA 855-2023

Statement: The improvements in UL 1973 for fire safety lead-acid and Ni-Cd batteries is recognized by this revision.

Public Input No. 360-NFPA 855-2023 [Section No. 4.7.7.3]

4.7.7.3

The requirements in 4.7.7 shall not apply to the following:

(1) * Lead-acid ~~and~~ , nickel-cadmium, and zinc-manganese 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, and zinc-manganese 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 and zinc-manganese battery systems utilized exclusively in uninterruptable 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

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name: Umer Anwer
Organization: Urban Electric Power
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 16:41:24 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft to justify the exception for zinc manganese in this area, including what happens during an over-cycle internal short circuit.

Public Input No. 295-NFPA 855-2023 [Section No. 4.7.10]

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*~~ where provided .

Statement of Problem and Substantiation for Public Input

NFPA 70 does not require disconnects for most ESS below 60Vdc. The current text implies otherwise and could create an impression that a disconnect is obligatory.

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 10:33:28 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-115-NFPA 855-2023
Statement: NFPA 70 does not require disconnects for most ESS below 60 Vdc.

Public Input No. 259-NFPA 855-2023 [Section No. 4.8]

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 ft

2

(139 m ^{2}) 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 fire command center or 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* .

Statement of Problem and Substantiation for Public Input

Relocated language deleted. "fire command center" added. See related PIs.

This was the change. Terra scrambled it.

4.8.1.1 to A.4.8.1.2 deleted.

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] (NO CHANGE)

4.8.2.2 *
Multiple panels shall be aggregated to a master or annunciator panel at a fire command center or location approved by the AHJ. (added "fire command Center".)

4.8.3 *
DELETED

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

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	
Public Input No. 261-NFPA 855-2023 [New Section after 3.1]	

Submitter Information Verification

Submitter Full Name: Robert Davidson
Organization: Davidson Code Concepts, Llc
Street Address:
City:
State:
Zip:

Submittal Date: Wed May 31 22:48:11 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-43-NFPA 855-2023

Statement: This revision ensures that “other” approved locations are permitted as various sites may not have a formal fire command center or may have reporting to multiple locations.

This aligns the requirement with the defined fire command center and ties it in with the colloquial term “first responder station.”

Public Input No. 210-NFPA 855-2023 [Section No. 4.8.1 [Excluding any Sub-Sections]]

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

Statement of Problem and Substantiation for Public Input

This provides an option for thermal imaging to be used for smoke and/or fire detection.

Submitter Information Verification

Submitter Full Name: Kevin Fok
Organization: Lg Energy Solution Vertech
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 11:13:26 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-181-NFPA 855-2023

Statement: NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]

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

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

Submitter Information Verification

Submitter Full Name: Scott Lang
Organization: Honeywell International
Street Address:
City:
State:
Zip:
Submittal Date: Tue Nov 29 13:22:58 EST 2022
Committee: ESS-AAA

Committee Statement

Resolution: FR-181-NFPA 855-2023

Statement: NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Public Input No. 273-NFPA 855-2023 [Section No. 4.8.1.1]

~~**4.8.1.1** * –~~

~~Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft ^{2} (139 m ^{2}) using lead-acid or nickel-cadmium battery technology shall not be required to have the detection required in 4.8.1 .~~

Statement of Problem and Substantiation for Public Input

Submitted on behalf of TG9
Reorganized section and moved to 9.6.1 to align with the technology specific protection requirements.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Moved from 4.8.1 to 9.6.1

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA 855 TG9
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 07:17:04 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 274-NFPA 855-2023 [Section No. 4.8.1.2]

~~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 .~~

Statement of Problem and Substantiation for Public Input

Reorganizes from section 4.8.1 to section 9.6.1 to align with technology specific protections

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Moved to 9.6.1

Submitter Information Verification

Submitter Full Name:	Noah Ryder
Organization:	Fire and Risk Alliance
Affiliation:	Submitted on behalf of NFPA 855 TG9
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 07:23:54 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 275-NFPA 855-2023 [Section No. 4.8.2.2]

4.8.2.2*

Multiple panels shall be aggregated to a master or annunciator panel at a fire command center or location approved by the AHJ.

Statement of Problem and Substantiation for Public Input

The addition of "fire command center" aligns this section with NFPA 72 and the definition provided in 3.3.12 of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 287-NFPA 855-2023 [Section No. A.4.8.2.2]	

Submitter Information Verification

Submitter Full Name: Noah Ryder

Organization: Fire and Risk Alliance

Affiliation: Submitted on behalf of NFPA 855 TG9

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 07:31:55 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-43-NFPA 855-2023

Statement: This revision ensures that “other” approved locations are permitted as various sites may not have a formal fire command center or may have reporting to multiple locations.

This aligns the requirement with the defined fire command center and ties it in with the colloquial term “first responder station.”

Public Input No. 276-NFPA 855-2023 [Section No. 4.8.3]

~~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.~~

Statement of Problem and Substantiation for Public Input

Relocated section to 9.6.1... to realign with the technology specific protection revisions

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA 855 TG9
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 07:35:32 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 281-NFPA 855-2023 [Section No. 4.8.3]

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 of standby power in ~~standby and 2 hours in alarm~~ a non-alarm condition and 2 hours of standby power in an alarm condition .

Statement of Problem and Substantiation for Public Input

This clarifies the standby time and the alarm/non-alarm condition, similar to what is proposed for 9.6.5.6.7.

Submitter Information Verification

Submitter Full Name: Kevin Fok

Organization: LG Energy Solution Vertech

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 08:05:52 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 162-NFPA 855-2023 [New Section after 4.9]

4.9.1.7

Lead-acid and nickel-cadmium battery systems which the batteries are listed to UL1973 shall not be required to have fire suppression system installed.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

Submitter Full Name: Gary Balash

Organization: East Penn Manufacturing Compan

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 24 10:04:12 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-47-NFPA 855-2023

Statement: Lead-acid batteries and nickel-cadmium batteries tested and listed to UL 1973 have shown they are safe technologies, which do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL 1973 are self-extinguishing plastics rated per UL 94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL 1973 environmental test, Section 42 for single cell failure design tolerance.

Public Input No. 142-NFPA 855-2023 [New Section after 4.9.1]

4.9.1.7

Lead-acid and nickel-cadmium batteries that are listed to UL 1973 shall not be required to have a fire suppression system installed.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

Submitter Full Name: Chris Searles
Organization: Ieee Essb Committee
Affiliation: CGS and Associates
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 23 10:52:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-47-NFPA 855-2023

Statement: Lead-acid batteries and nickel-cadmium batteries tested and listed to UL 1973 have shown they are safe technologies, which do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL 1973 are self-extinguishing plastics rated per UL 94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL 1973 environmental test, Section 42 for single cell failure design tolerance.

Public Input No. 361-NFPA 855-2023 [Section No. 4.9.1.1]

4.9.1.1*

Lead-acid ~~and~~ , nickel-cadmium, and zinc-manganese 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.

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name: Umer Anwer

Organization: Urban Electric Power

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 16:42:29 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft for the Chapter 9 exclusions to justify the exception for zinc manganese in this area, including what happens when an over-cycle causes an internal short circuit.

Public Input No. 119-NFPA 855-2023 [Sections 4.9.1.1, 4.9.1.2, 4.9.1.3]

Sections 4.9.1.1, 4.9.1.2, 4.9.1.3

~~**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 uninterruptable 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.~~

Statement of Problem and Substantiation for Public Input

These exemptions are battery specific and are repeated in Chapter 9 section 9.6.2.2. They can be removed from Chapter 4.

If action is taken, the annex note for 4.9.1 can be relocated to an annex for 9.6.2.2.1.

Submitter Information Verification

Submitter Full Name: Richard Kluge
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:

Submittal Date: Tue May 16 10:08:59 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-44-NFPA 855-2023

Statement: These exemptions are battery specific and are repeated in Chapter 9 Section 9.6.2.2. They can be removed from Chapter 4.

Public Input No. 362-NFPA 855-2023 [Section No. 4.9.1.2]

4.9.1.2

Lead-acid and zinc-manganese battery systems in uninterruptable 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.

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name: Umer Anwer
Organization: Urban Electric Power
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 16:42:52 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft for the Chapter 9 exclusions to justify the exception for zinc manganese in this area, including what happens when an over-cycle causes an internal short circuit.

Public Input No. 363-NFPA 855-2023 [Section No. 4.9.1.3]

4.9.1.3*

Lead-acid ~~and~~ , nickel-cadmium, and zinc-manganese 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.

Statement of Problem and Substantiation for Public Input

UEP recommends granting ZnMnO2 exemptions for certain standards pertaining to lower voltage UPS and power backup energy storage systems. UEP's ZnMnO2 battery has been characterized as similar to lead-acid from a fire safety perspective, thus we believe ZnMnO2 batteries should have similar exemptions to lead-acid in these specific applications.

Submitter Information Verification

Submitter Full Name:	Umer Anwer
Organization:	Urban Electric Power
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 16:43:20 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: Additional details should be submitted for the Second Draft for the Chapter 9 exclusions to justify the exception for zinc manganese in this area, including what happens when an over-cycle causes an internal short circuit.

Public Input No. 220-NFPA 855-2023 [Section No. 4.9.3]

4.9.3 Alternate Automatic Fire Control, Suppression, and ~~Suppression~~ Thermal Runaway Mitigation Systems.

4.9.3.1*

Other automatic fire control ~~and suppression~~ , suppression, and thermal runaway mitigation 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~~ , suppression, and thermal runaway mitigation 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

(7) UL 9540

Statement of Problem and Substantiation for Public Input

This attempts to include approaches for thermal runaway mitigation.

Submitter Information Verification

Submitter Full Name: Kevin Fok
Organization: LG Energy Solution Vertech
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 14:26:55 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Insufficient information provided to demonstrate that a thermal runaway mitigation system is similar to control/suppression and should be included here. Insufficient information provided that UL 9540 is sufficient for acceptability of the system. This section is for the protection of the room or space, thus if it is not a fire protection system then it does not belong in this list/section.

Public Input No. 326-NFPA 855-2023 [Section No. 4.9.3.2]

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 18A

(4) NFPA 750

(5) NFPA 770

(6) NFPA 2001

(7) NFPA 2010

Statement of Problem and Substantiation for Public Input

Adding 18A to the alternative suppression systems to all the option of using an Encapsulating Agent (EA)

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
Organization: Hazard Control Technologies
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 12:29:26 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Insufficient information provided that NFPA 18A is sufficient for acceptability of the system.

Public Input No. 126-NFPA 855-2023 [New Section after 4.10]

4.11 Electric Vehicle Charging Stations

4.11.1 The requirements of this chapter shall apply to all Electric Vehicle Supply Equipment (EVSE) stationary charging equipment with an integrated ESS.

4.11.2* ESS integrated with charging equipment shall comply with all applicable requirements in NFPA 855 and the following.

4.11.2.1 The EVSE shall be listed.

4.11.2.2 The installation shall be in accordance with NFPA 70 (NEC).

4.11.2.3 The electric vehicles being charged shall not be considered an exposure.

4.11.2.4 Individual EVSE with integral ESS with maximum stored energy less than 50 kWh shall not require fire barriers in 9.6.4.

4.11.2.5 EVSE electrical disconnects shall be remotely located at an approved location.

Statement of Problem and Substantiation for Public Input

This new section is being added to address new technologies that integrate ESS into EV supply equipment. This public input was developed by the NFPA 855 Task Group 5 EV Charging Equipment.

Submitter Information Verification

Submitter Full Name:	Chris Towski
Organization:	Cambridge Fire Department
Affiliation:	Fire Prevention Association of Massachusetts
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed May 17 13:24:58 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-1-NFPA 855-2023

Statement: This new section addresses electric vehicle charging technology that incorporates energy storage.

Public Input No. 127-NFPA 855-2023 [New Section after 4.10]

4.11* Electric Vehicle Battery Use.

Utilizing electric vehicles to export power to premise wiring shall follow the requirements in section 4.11.

4.11.1

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.

4.11.2

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.

Statement of Problem and Substantiation for Public Input

Moving existing section 15.11 to new section 4.11 for Electric Vehicle Battery Use allows expansion to broadly include batteries used as a source of stored energy regardless of the occupancy. It is expected that V2G applications will see significant growth in both system size and number of locations. Existing 855 definitions for mobile ESS address temporary installations of trailer-mounted ESS brought to specific locations. V2G ESS are intended to operate as ESS on an ongoing, often daily, basis. They may be used similarly to stationary ESS in electricity markets or to manage onsite electricity demand charges.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 128-NFPA 855-2023 [New Section after A.4.9.4.1]	

Submitter Information Verification

Submitter Full Name: Josh Gerber

Organization: 33 North Energy

Affiliation: Nuvve Holding Corporation

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 17 17:05:36 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: CI-22-NFPA 855-2023 Most V2G applications would still be at the residential level, and thus the text in 15.11 kept.

Statement: The technical committee is seeking public comment on this for the Second Draft,

V2G is larger than just residential, and thus should be covered in Chapter 4, in addition to Chapter 15.

Public Input No. 24-NFPA 855-2023 [Section No. 5.2.2]

5.2.2

Lead-acid and nickel-cadmium battery systems that are used for dc power for control of substations and control or ~~safe~~ orderly 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.

Statement of Problem and Substantiation for Public Input

Delete or replace the word “safe.” Section 2.2.2.1 in the Manual of Style for NFPA Technical Committee Documents states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague and Table 2.2.2.3 in the Manual of Style for NFPA Technical Committee Documents lists “safe(ly) (ty).”

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
State:
Zip:
Submittal Date: Thu Mar 30 15:57:18 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-123-NFPA 855-2023

Statement: The NFPA Manual of Style for Technical Committee Documents Table 2.2.2.3 states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague. The use of the word safe is unenforceable and vague, the use of “orderly’ corrects this.

Public Input No. 25-NFPA 855-2023 [Chapter 6]

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~~ orderly 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:

  (9) Commissioning checklist

  (10) Relevant operational testing forms

  (11) Necessary commissioning logs

  (12) Progress reports

(13) Means and methods whereby facility operation and maintenance staff will be trained on the system

(14) Identification of personnel who are qualified to service and maintain the system and respond to incidents involving each system

(15) 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.

6.1.5 Commissioning Report.

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.

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.

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.

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.

6.1.5.3.2

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

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.

Statement of Problem and Substantiation for Public Input

Delete or replace the word “safe.” Section 2.2.2.1 in the Manual of Style for NFPA Technical Committee Documents states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague and Table 2.2.2.3 in the Manual of Style for NFPA Technical Committee Documents lists “safe(ly) (ty).”

Submitter Information Verification

Submitter Full Name: Palmer Hickman
Organization: Electrical Training Alliance
Street Address:
City:
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Submittal Date: Thu Mar 30 15:59:25 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-124-NFPA 855-2023

Statement: The NFPA Manual of Style for Technical Committee Documents Table 2.2.2.3 states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague. The use of the word safe is unenforceable and vague, the use of “orderly’ corrects this.

Public Input No. 143-NFPA 855-2023 [New Section after 6.1.1]

6.1.1.3

Lead-acid and nickel-cadmium battery systems listed to UL 1973 shall be permitted to have a commissioning plan complying with recognized industry practices in lieu of complying with 6.1.5.2 .

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

Submitter Full Name: Chris Searles

Organization: Ieee Essb Committee

Affiliation: CGS and Associates

Street Address:

City:

State:

Zip:

Submittal Date: Tue May 23 11:08:20 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The public input does not identify what the “recognized industry practices” are. The technical committee’s requests that the submitter provide, at the public comment stage, an annex note explaining what the practices are or where to find them and recommends that it be limited to standby power systems.

Public Input No. 194-NFPA 855-2023 [Section No. 6.1.1.1]

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 battery requirements shall be permitted to have a commissioning plan complying with recognized industry practices in lieu of complying with 6.1.5.2.

Statement of Problem and Substantiation for Public Input

The existing wording for the commissioning plan carveout for lead-acid and nickel-cadmium batteries should be clarified for NFPA 76 battery requirements since commissioning plans are required to comply with recognized industry practices. Some installations and industry practices would not be applicable for all of NFPA 76, but NFPA 76 battery requirements should apply.

Submitter Information Verification

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City:	
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Submittal Date:	Tue May 30 15:39:08 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-147-NFPA 855-2023

Statement: Many of the NFPA 76 requirements apply to telecom equipment and spaces unrelated to the safety or operation of the battery plant. When referencing NFPA 76 compliance in this section, it is reasonable to delineate that conformance to the battery requirements is the area of concern.

Public Input No. 102-NFPA 855-2023 [Section No. 6.1.3.2]

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:

(9) Commissioning checklist

(10) Relevant operational testing forms

(11) Necessary commissioning logs

(12) Progress reports

(13) Means and methods whereby facility operation and maintenance staff will be trained on the system

(14) Identification of personnel who are qualified to service and maintain the system and respond to incidents involving each system

(15) ~~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~~

Statement of Problem and Substantiation for Public Input

AHJ/Customers are requiring a decommissioning plan at the start of the projects while in Chapter 8 section 8.1 it states "prior to decommissioning the owner of the ESS or their designated agent(s) shall prepare a written decommissioning plan to comply with 8.1.3."

Submitter Information Verification

Submitter Full Name: Chris Groves
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Submittal Date: Tue May 09 14:25:37 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: A vendor specified decommissioning plan is critical information for the system owner. Having this prepared at the time of commissioning protects against instances where manufacturer of the system exits the business or otherwise can no longer provide information on safe decommissioning at some future date. Having a decommissioning plan formulated at the time of commissioning does not prevent it from being later revised or updated by the owner or designated agent and submitted for AHJ approval as noted in Chapter 8. The text in Section 8.1 is correct as written and need not change.

Public Input No. 91-NFPA 855-2023 [Section No. 6.1.3.2]

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~~ , spill detection and thermal management, ventilation, or exhaust systems associated with the installation and verification of proper operation of the safety controls

(8) The following documentation:

  (9) Commissioning checklist

  (10) Relevant operational testing forms

  (11) Necessary commissioning logs

  (12) Progress reports

(13) Means and methods whereby facility operation and maintenance staff will be trained on the system

(14) Identification of personnel who are qualified to service and maintain the system and respond to incidents involving each system

(15) 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

Statement of Problem and Substantiation for Public Input

Where spill detection systems are provided, they should be tested. In the case of flow batteries, spill detection systems are an integral part of the safety systems. The only change in this proposal is to add "spill detection"

This Public Input was submitted by the Flow Battery Task Group TG20.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 92-NFPA 855-2023 [New Section after A.6.1.1.2]	

Public Input No. 92-NFPA 855-2023 [New Section after A.6.1.1.2]

Submitter Information Verification

Submitter Full Name: Steve Edley
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Street Address:
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Submittal Date: Mon May 08 19:01:50 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-98-NFPA 855-2023

Statement: Where spill detection systems are provided, they should be tested. In the case of flow batteries, spill detection systems are an integral part of the safety systems.

Public Input No. 296-NFPA 855-2023 [Section No. 6.1.4.2]

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~~ shall demonstrate 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~~ confirm the operation, function, and maintenance serviceability ~~for each of the commissioned ESS is confirmed~~ of the ESS .

Statement of Problem and Substantiation for Public Input

Current sentence is confusing. Suggested edits are a slight improvement.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 10:41:29 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-148-NFPA 855-2023

Statement: This clarifies the requirement.

Public Input No. 251-NFPA 855-2023 [Section No. 6.3.1]

6.3.1

~~Operations~~ The ESS owner shall maintain operations and maintenance documentation ~~shall be provided to the ESS owner~~ .

Statement of Problem and Substantiation for Public Input

The proposed revision is intended to clarify that the ESS owner is responsible for the operations and maintenance records. Although the ESS owner can hire contractors to perform the operations and maintenance and to prepare and submit maintenance logs, ultimately, the ESS owner is responsible for them. Over the course of the system lifetime, it is possible that different contractors will be hired to perform maintenance and the ESS owner will need to make sure that all of the records are maintained.

Submitter Information Verification

Submitter Full Name: Kevin Fok

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Submittal Date: Wed May 31 21:21:31 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-149-NFPA 855-2023

Statement: The clarifies that the ESS owner is responsible for the operations and maintenance records. Although the ESS owner can hire contractors to perform the operations and maintenance and to prepare and submit maintenance logs, ultimately, the ESS owner is responsible for them. Over the course of the system lifetime, it is possible that different contractors will be hired to perform maintenance and the ESS owner will need to make sure that all of the records are maintained.

Public Input No. 215-NFPA 855-2023 [Section No. 6.4.4]

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 or by an approved certification organization .

Statement of Problem and Substantiation for Public Input

This provides the option to have an approved certification organization perform the evaluation.

Submitter Information Verification

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Submittal Date:	Wed May 31 11:47:39 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: If a listed ESS that is installed in the field, it can affect the listing of the product and should be investigated by the organization that listed the product originally. It is not clear what an “approved certification organization” is and why it can assess a product that has been listed by another organization.

Public Input No. 23-NFPA 855-2023 [Chapter 7]

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.

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~~ orderly 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~~ the 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:

- (4) Energy storage management systems (ESMS)
- (5) Fire protection equipment and systems
- (6) Spill control and neutralization systems
- (7) Exhaust and ventilation equipment and systems
- (8) Gas detection systems
- (9) Other

~~required safety equipment~~

- (a) required equipment and systems

(10) Response considerations similar to a safety data sheet (SDS) that address ~~response safety concerns~~ response concerns and extinguishment where an SDS is not required

(11)* 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.

Statement of Problem and Substantiation for Public Input

Delete or replace the word “safe.” Section 2.2.2.1 in the Manual of Style for NFPA Technical Committee Documents states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague and Table 2.2.2.3 in the Manual of Style for NFPA Technical Committee Documents lists “safe(ly) (ty).”

Submitter Information Verification

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Submittal Date:	Thu Mar 30 15:48:43 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-18-NFPA 855-2023 The term “safety” in safety equipment in (3)(f) and in safety concerns in (4) is widely used and recognized so there is no need to delete it.

Statement: The term “safe” in 7.1.1.2 and 7.1.2 brings no value to the standard.

The terms “and shut down” brings great value to the standard as the shutdown procedures are key to the safety of BESSs. The safety procedures should include shut down of the ESS. In the case of some technologies, shutting down of the ESS may be more involved than turning off the inverters.

Public Input No. 93-NFPA 855-2023 [Section No. 7.1.2]

7.1.2

The operation and maintenance documentation shall include the following:

(1) Procedures for the safe startup and shut down 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:

 (4) Energy storage management systems (ESMS)

 (5) Fire protection equipment and systems

 (6) Spill control and neutralization systems

 (7) Exhaust and ventilation equipment and systems

 (8) Gas detection systems

 (9) Other required safety equipment and systems

(10) Response considerations similar to a safety data sheet (SDS) that address response safety concerns and extinguishment where an SDS is not required

(11)* An instruction that equipment or system changes to the installation are required to be recorded by updating any engineering documentation

Statement of Problem and Substantiation for Public Input

The safety procedures should include shut down of the ESS. In the case of some technologies, shutting down of the ESS may be more involved than turning off the inverters. This proposal only adds the phrase "and shutdown".

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

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Street Address:
City:
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Submittal Date: Mon May 08 19:08:08 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-18-NFPA 855-2023 The term “safety” in safety equipment in (3)(f) and in safety concerns in (4) is widely used and recognized so there is no need to delete it.

Statement: The term “safe” in 7.1.1.2 and 7.1.2 brings no value to the standard.

The terms “and shut down” brings great value to the standard as the shutdown procedures are key to the safety of BESSs. The safety procedures should include shut down of the ESS. In the case of some technologies, shutting down of the ESS may be more involved than turning off the inverters.

Public Input No. 234-NFPA 855-2023 [Sections 7.1.2, 7.1.3]

Sections 7.1.2, 7.1.3

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:

(4) Energy storage management systems (ESMS)

(5) Fire protection equipment and systems

(6) Spill control and neutralization systems

(7) Exhaust and ventilation equipment and systems

(8) Gas detection systems

(9) Other required safety equipment and systems

(10) ~~Response considerations similar to a safety data sheet (SDS) that address response safety concerns and extinguishment where an SDS is not required~~ Emergency response plan shall be prepared according to *4.3 Emergency Planning and Training*

(11)* 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.~~

Statement of Problem and Substantiation for Public Input

Suggest pointing to 4.3 Emergency Planning and Training for emergency response plans and to remove the Safety Data Sheet (SDS) section since 4.3 Emergency Planning and Training provides the overall emergency response plan, including SDSs as needed.

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Submittal Date: Wed May 31 19:58:17 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Item (4) is important to the standard as it keeps the requirements for information necessary for response consideration even if an SDS is not onsite. Furthermore, there is no justification to remove the SDS requirement as its federally required and required by most fire codes.

Public Input No. 297-NFPA 855-2023 [Section No. 7.2.5.2]

7.2.5.2

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

Statement of Problem and Substantiation for Public Input

Training should cover both procedures and documentation that have been changed as part of a recommissioning.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 10:47:23 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-65-NFPA 855-2023

Statement: Training should cover both procedures and documentation that have been changed as part of a

recommissioning. The new requirement ensures first responders are also trained (not just owner/operators).

Public Input No. 26-NFPA 855-2023 [Chapter 8]

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~~ orderly 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.

8.3.3

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

Statement of Problem and Substantiation for Public Input

Delete or replace the word “safe.” Section 2.2.2.1 in the Manual of Style for NFPA Technical Committee Documents states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague and Table 2.2.2.3 in the Manual of Style for NFPA Technical Committee Documents lists “safe(ly) (ty).”

Submitter Information Verification

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Submittal Date: Thu Mar 30 16:03:40 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-151-NFPA 855-2023

Statement: The NFPA Manual of Style for Technical Committee Documents Table 2.2.2.3 states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague. The use of the word safe is unenforceable and vague,. Orderly is a sufficient description.

Public Input No. 298-NFPA 855-2023 [Section No. 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 original version of 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

Statement of Problem and Substantiation for Public Input

Simplification for clarity. Seems the intent is to provide a copy of the original decommissioning plan.

Submitter Information Verification

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Committee: ESS-AAA

Committee Statement

Resolution: FR-152-NFPA 855-2023

Statement: This simplifies the wording while emphasizing the need to provide a copy of the original decommissioning plan created at the start of the project.

Public Input No. 27-NFPA 855-2023 [Chapter 9]

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.

9.1.2

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

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.

9.1.5 Fire and Explosion Testing.

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.

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.

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.

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.

9.1.5.1.4

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

9.1.5.2* Test Reports.

9.1.5.2.1

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

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.

9.2 Equipment.

9.2.1 Listing.

9.2.1.1

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

9.2.1.2 Lead-Acid and Nickel-Cadmium Battery Systems.

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.

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.

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~~ orderly 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.

9.2.1.2.4

Lead-acid battery systems in uninterruptable 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.

9.2.2 HMA for Existing Lithium-Ion ESS.

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.

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.

9.2.3 Energy Storage Management System (ESMS).

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.

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.

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.

9.2.3.4 Lead-Acid and Nickel-Cadmium Battery Systems.

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.

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~~ orderly 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.

9.2.3.4.3

Lead-acid and nickel-cadmium battery systems in uninterruptable 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.

9.2.4 Repurposed and Refurbished Batteries.

9.2.4.1

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

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.

9.3 Location Classification.

Installation locations shall be classified as specified in 9.3.1 or 9.3.2.

9.3.1 Indoor Installations.

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

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.

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.

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:

  (a) *Rooftop installations*: ESS installations located on the roofs of buildings

  (b) *Open parking garage installations*: ESS installations located in a structure or portion of a structure as defined in 3.3.19

  (c) Mobile ESS installations

9.4 Installation.

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.

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

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

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.

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.

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.

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.

9.4.2* Size and Separation.

9.4.2.1

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

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.

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.

9.4.2.4 Lead-Acid and Nickel-Cadmium Battery Systems.

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.

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 shutdown~~ orderly shutdown of generating stations under the exclusive control of the electric utility and located outdoors or in building spaces used exclusively for such installations.

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.

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.

9.5 Location and Applications.

9.5.1 Indoor Installations.

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

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.

9.5.1.1 ESS Dedicated Use Buildings.

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.

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.

9.5.1.2 Non-Dedicated-Use Buildings.

9.5.1.2.1* Occupied Work Centers.

ESS in occupied work centers shall comply with this section.

9.5.1.2.1.1

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

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.

9.5.1.2.2 Dwelling Units and Sleeping Units.

9.5.1.2.2.1

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

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.

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.

9.5.2 Outdoor Installations.

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

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.

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.

9.5.2.2 Vegetation Control.

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.

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.

9.5.2.3 Walk-in Units.

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.

9.5.2.3.2*

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

9.5.2.3.3

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

9.5.2.4 Maximum Size.

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.

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.

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.

9.5.2.6 Locations Near Exposures.

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

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.

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.

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.

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.

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.

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.

9.5.2.6.1.7 Means of Egress Separation.

(A)

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

(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.

9.5.2.6.1.8 Exterior Wall Installations.

(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).

(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.

9.5.3 Specific Outdoor Locations.

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.

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.

9.5.3.1.1 Rooftop Installations.

9.5.3.1.1.1

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

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.

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.

9.5.3.1.3 Clearance to Exposures.

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

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

9.5.3.1.4 Fire Suppression and Control.

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.

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.

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.

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.

9.5.3.2.1 Charging and Storage.

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.

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~~ <u>or shutdown</u> 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.

9.5.3.2.2 Deployment.

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.

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~~ or 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.

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.

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.

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.

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.

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*.

9.5.3.2.5.3

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

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.

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

[a]In walk-in units, spacing is not required between ESS units and the walls of the enclosure.

[b]Alarm signals are not required to be transmitted to an approved location for mobile ESS deployed 30 days or less.

[c]Only required for walk-in units.

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 overcurrent 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

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.

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.

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.

9.5.3.2.6.5 Duration.

(A)

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

(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.

9.5.3.2.6.6 Clearance to Exposures.

(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

(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.

(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.

9.5.3.2.6.7 Electrical Connections.

Electrical connections shall be made in accordance with the manufacturer’s instructions.

(A)

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

(B)

Fixed electrical wiring shall not be permitted.

9.5.3.2.6.8 Fencing.

(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.

(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).

9.6 Protection and Remediation.

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.

9.6.2 Fire Control and Suppression.

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.

9.6.2.2 Lead-Acid and Nickel-Cadmium Battery Systems.

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.

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.

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.

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.

9.6.3 Water Supply.

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.

9.6.3.2 Lead-Acid and Nickel-Cadmium Systems.

9.6.3.2.1*

Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft^2 (139 m^2) 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.

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~~ or 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.

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.

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.

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~~ or 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.

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

	Battery Technology				-	-			
Compliance Required	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	EDLC Energy Storage		Other Electrochemical ESS and Battery Technologies*	Refe
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.

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.

9.6.5.1.1 Ni-MH Batteries.

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

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.

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.

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.

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 $ft^3/min/ft^2$ (5.1 $L/sec/m^2$) of floor area of the room, walk-in unit, enclosure, container, or cabinet

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.

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.

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.

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.

9.6.5.2 Spill Control.

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.

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.

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.

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.

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.

9.6.5.2.6

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

9.6.5.3 Neutralization.

9.6.5.3.1*

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

9.6.5.3.2

Neutralization shall not be required for ESS with immobilized electrolyte.

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~~ their operating parameters and preclude thermal runaway.

9.6.5.5.1

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

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.

9.6.5.6* Explosion Control.

9.6.5.6.1

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

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.

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~~ or 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 uninterruptable 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

9.6.5.6.2

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

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

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.

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.

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.

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:

  (6) A trouble signal upon failure of the gas detection system

  (7) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

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.

9.6.5.6.9

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

9.6.6 Remediation Measures.

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.

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.

9.6.6.2.1*

Trained hazard support personnel shall be approved by the AHJ.

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.

9.6.6.2.3

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

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.

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

Statement of Problem and Substantiation for Public Input

Delete or replace the word “safe.” Section 2.2.2.1 in the Manual of Style for NFPA Technical Committee Documents states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague and Table 2.2.2.3 in the Manual of Style for NFPA Technical Committee Documents lists “safe(ly) (ty).”

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Committee: ESS-AAA

Committee Statement

Resolution: FR-120-NFPA 855-2023

Statement: The NFPA Manual of Style for Technical Committee Documents Table 2.2.2.3 states that “the main text of codes and standards shall not contain references or requirements that are unenforceable and vague. The use of the word safe is unenforceable and vague.

Public Input No. 263-NFPA 855-2023 [Section No. 9.1.5.1 [Excluding any Sub-Sections]]

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~~ .

Statement of Problem and Substantiation for Public Input

This proposes to delete the reference to UL 9540A. Unfortunately, the manner in which laboratories are conducting the large-scale fire testing under this standard does not create the large-scale fire event the standard requires for assessment of a catastrophic event or any fire at all. When laboratory leadership has been questioned on this the response has been that they always assumed an event would be a spontaneous thermal runaway of a cell or two which is incredulous because that was discussed before UL 9540A existed, rejected and it was identified the expectation was a catastrophic event not associated with a cell failure would be the cause. That the fire occurred. This intent has long been captured by the annex note to this section. Since four separate editions of UL 9540A and how the lab conducts the testing have failed to address this lack of fire data the standard calls for it no longer makes sense to reference this document. An additional reason is that the standard as written does not encompass various battery technology since the standard is lithium-ion technology centric, causing difficulties for other technologies required to comply with the large-scale fire and explsosion testing requirements.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 264-NFPA 855-2023 [Section No. 2.3.7]	

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Committee:	ESS-AAA

Committee Statement

Resolution: FR-139-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 355-NFPA 855-2023 [Section No. 9.1.5.1 [Excluding any Sub-Sections]]

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~~ .

Statement of Problem and Substantiation for Public Input

When the first edition of NFPA 855 was initially drafted UL 9540A was being developed to evaluate ESS fire propagation properties. Since then this standard has been updated under the ANSI consensus process, based on input from a broad range of stakeholders, including many NFPA 855 committee members. The 4th edition of this standard is now the accepted industry norm, and the 5th edition is currently under development with considerable industry input and participation.
This proposal removes “or equivalent standard” because there are no equivalent test standards that provide the fire propagation test data required by the overall NFPA 855 protection concept. In addition, removing “or equivalent standard” closes a loophole where a previous version of UL 9540A might be used to generate required test data.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 356-NFPA 855-2023 [Section No. A.9.1.5.1]	

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Committee Statement

Resolution: FR-139-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 186-NFPA 855-2023 [Section No. 9.1.5.1.1]

9.1.5.1.1

Lead-acid and nickel-cadmium batteries used in standby power systems and listed to UL 1973 Appendix H cell/monobloc shall not require UL 9540A testing when they are installed with a charging system that is listed to UL 1012, UL 1741, UL 60950-1, or UL 62368-1, or a UPS listed to UL 1778.

Statement of Problem and Substantiation for Public Input

There are two levels of testing for lead-acid and Ni-Cad batteries in UL 1973, cell/monobloc and system (per Table H.1 of UL 1973 Appendix H). This would clarify which level of listing and testing would be required and would eliminate any confusion as to the requirements.

Most grid connected systems now use inverter/chargers that are listed to UL 1741. By adding UL 1741 to the list for charger requirements, expands the section to include modern technology.

Submitter Information Verification

Submitter Full Name: Robert Rallo
Organization: Solar System Services
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 30 09:33:24 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution:

Statement: There are two levels of testing for lead-acid and Ni-Cad batteries in UL 1973, cell/monobloc and system (per Table H.1 of UL 1973 Appendix H). This revision clarifies which level of listing and testing i is required and eliminates any confusion as to the requirements.

Most grid connected systems now use inverter/chargers that are listed to UL 1741. Adding UL 1741 to the list for charger requirements, expands the section to include modern technology.

Public Input No. 313-NFPA 855-2023 [New Section after 9.1.5.1.2]

9.1.5.1.2.1*

When cell thermal runaway results in the release of flammable gases during a cell or module level test, a unit level test shall be conducted involving intentional ignition of the vent gases to assess the fire propagation hazard.

A. 9.1.5.1.2.1

Intentional ignition of the vent gases informs the degree of fire hazard presented by the released flammable gases and the development of a fire protection strategy. The ignition source should be of sufficient magnitude such as generated by a spark igniter, glow plug, or pilot flame located in close proximity to the origin of the vented gases, but outside of the module of origin, to cause prompt ignition of the flammable gases. External ignition in this manner is not intended to address deflagration mitigation as required in 9.1.5.1.4.

Statement of Problem and Substantiation for Public Input

Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 315-NFPA 855-2023 [New Section after 9.1.5.1.4]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA 855 TG9
Street Address:
City:
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Submittal Date: Thu Jun 01 12:01:53 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-189-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]

9.1.5.1.2.1*

When cell thermal runaway results in the release of flammable gases during a cell or module level test, a unit level test shall be conducted involving intentional ignition of the vent gases to assess the fire propagation hazard.

A. 9.1.5.1.2.1

Intentional ignition of the vent gases informs the degree of fire hazard presented by the released flammable gases and the development of a fire protection strategy. The ignition source should be of sufficient magnitude such as generated by a spark igniter, glow plug, or pilot flame located in close proximity to the origin of the vented gases, but outside of the module of origin, to cause prompt ignition of the flammable gases. External ignition in this manner is not intended to address deflagration mitigation as required in 9.1.5.1.4.

Statement of Problem and Substantiation for Public Input

NFPA Explosion Task Group recommendation - As 9540A is meant to be a fire test, if not all tests result in a fire. In order to properly evaluate a fire condition if the test doesn't initially result in a fire condition, the vent gasses may have to be ignited by means of an alternate source. This statement requires that ignition.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Paul Hayes
Organization:	The Hiller Companies/American
Affiliation:	None
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Apr 27 13:30:17 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-189-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 315-NFPA 855-2023 [New Section after 9.1.5.1.4]

A9.1.5.1.4

Currently the de-facto large-scale test, UL9540A, lumps the fire hazard and explosion together and assumes that if no deflagration is observed then the ESS system is safe. The provision of an evaluation of deflagration hazard mitigation is important and independent from the fire hazard evaluation and is necessary to ensure that the NFPA 68, NFPA 69, or alternative deflagration protection measure is appropriate for the ESS design.

Statement of Problem and Substantiation for Public Input

Added appendix material to clarify that the intent of the large-scale testing is to evaluate both the fire propagation and explosion mitigation potential

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 313-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 316-NFPA 855-2023 [Section No. 9.1.5.1.4]	

Submitter Information Verification

Submitter Full Name: Noah Ryder

Organization: Fire and Risk Alliance

Affiliation: Submitted on behalf of NFPA 855 TG9

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 12:08:10 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-141-NFPA 855-2023

Statement: This will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not explode. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent /off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite and cause deflagration As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the deflagration hazard is sufficiently evaluated.

Public Input No. 316-NFPA 855-2023 [Section No. 9.1.5.1.4]

9.1.5.1.4*_

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

Statement of Problem and Substantiation for Public Input

Added appendix material

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 315-NFPA 855-2023 [New Section after 9.1.5.1.4]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA 855 TG9
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 12:15:02 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-141-NFPA 855-2023

Statement: This will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not explode. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent /off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite and cause deflagration As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the deflagration hazard is sufficiently evaluated.

Public Input No. 366-NFPA 855-2023 [Section No. 9.1.5.2.1]

9.1.5.2.1*

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

A.9.1.5.2.1

The complete test report should include all required UL 9540A test results. Depending on results obtained, as described in A.9.1.5.1, the report may not include all potential tests in the sequence.

Statement of Problem and Substantiation for Public Input

This proposal clarifies what constitutes a complete test report. It also explains that the test report for individual tests will only include results and not an entire test report. For example, a unit level report would contain the test results for module level and cell level tests and not the entire cell level test report and module level test report. This is to prevent inclusion of proprietary information when the ESS manufacturer obtains cells and modules from different manufacturers.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 356-NFPA 855-2023 [Section No. A.9.1.5.1]	

Submitter Information Verification

Submitter Full Name: Howard Hopper
Organization: UL Solutions
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City:
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Submittal Date: Thu Jun 01 16:46:09 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Each test level is required for engineered evaluation.

Public Input No. 1-NFPA 855-2022 [New Section after 9.1.5.2.2]

9.1.5.2.3* For Chapter 15 ESS installations that do not exceed the individual or aggregate ratings referenced in 15.5.3, the AHJ shall be permitted to require the test report to be accompanied by a supplemental report prepared by an approved independent third party with expertise in the matter that provides an interpretation of the test data in relation to the installation requirements for the ESS.

A.9.1.5.2.3 Section 1.3.2 indicates that ESS in one- and two-family dwellings and townhouses shall only be required to comply with Chapter 15. However, 15.3.1 identifies reduced spacing conditions which require fire and explosion testing to comply with 9.1.5. Since these residential ESS cannot exceed 20 kWh and the total aggregate energy of the installations is limited. This section does not apply to residential ESS that exceed the individual and aggregate ratings specified in 15.5.1 and 15.5.2, since 15.5.3 requires these larger systems to comply with commercial ESS requirements in Chapter 4 through 9.

Statement of Problem and Substantiation for Public Input

This new section would eliminate the requirement for a registered design professional with fire protection engineering expertise and replace that with language similar to what is currently found in NFPA 1, Section 1.16.1 when technical assistance is required by the AHJ (the IFC has similar language in 104.8.2). The current language is onerous for the smaller residential installations. In most cases the installations are simpler with clear cut location requirements contained within Chapter 15 where there is no need for a supplemental report.

As written, an installer could be doing the exact same installation at a number of homes in a jurisdiction, and they would need a registered design professional (e.g., FPE) for each installation. The new Section 9.1.5.2.3 matches how this topic, (technical assistance for supplemental reports), is addressed in NFPA 1 Fire Code. The requirement is only triggered if the AHJ request the supplemental report and the professional preparing the report can be any independent third party with expertise in the matter that is approved by the AHJ.

Submitter Information Verification

Submitter Full Name: Brian Baughman

Organization: Generac Power Systems Inc.

Street Address:

City:

State:

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Submittal Date: Tue Nov 08 11:51:40 EST 2022

Committee: ESS-AAA

Committee Statement

Resolution: This conflicts with recent TIA and subsequent revision which removed the connection between Chapter 15 and Chapter 9 to separate the requirements for testing and registered design professional.

Public Input No. 368-NFPA 855-2023 [New Section after 9.1.5.2.2]

TITLE OF NEW CONTENT

9.1.5.2.2.1*

For ESS installations in one- and two-family dwellings and townhouse units regulated by Chapter 15, the supplemental report in 9.1.5.2.2 shall be provided by an approved qualified person or a registered design professional.

A.9.1.5.2.2.1

The requirements in 9.1.5.2.2 require supplemental reports to be provided for each ESS installation, and the individual reports would be stamped by a registered design professional. However given that many ESS installations in one- and two-family dwellings and townhouse housing developments use smaller, more standardized equipment and designs, there is no need for each supplemental report to be stamped by a registered design professional.

For these installations a supplementary report, provided by an approved qualified person should suffice, and a single report may cover numerous installations in a typical housing development or installation scenario. The AHJ can still determine which persons can provide this report, and whether the report is applicable for a given installation.

Statement of Problem and Substantiation for Public Input

This proposal accomplishes the goal envisioned by TIA 1727, which was still being considered by the NFPA 855 committee after the closing date for NFPA 855 public inputs. If that TIA was successful, modifications to the adopted TIA text, or this public input may be necessary for correlation purposes.

Submitter Information Verification

Submitter Full Name:	Howard Hopper
Organization:	UL Solutions
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 16:57:44 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This conflicts with recent TIA and subsequent revision which removed the connection between Chapter 15 and Chapter 9 to separate the requirements for testing and registered design professional.

Public Input No. 247-NFPA 855-2023 [Section No. 9.2.1.1]

9.2.1.1

ESS shall be evaluated, tested and listed by a recognized laboratory in accordance with the appropriate test standard (UL 9540) , unless specifically exempted elsewhere in this standard.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: American Fire Technologies
Street Address:
City:
State:
Zip:

Submittal Date: Wed May 31 21:03:52 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Proposed changes do not improve the language.

Public Input No. 137-NFPA 855-2023 [Section No. 9.2.1.2.1]

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~~ batteries listed to UL 1973 shall not be required to be listed to ~~UL 1973~~ UL 9540 .

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

UL has done testing with VRLA product and determined that UL 1973 under Appendix H testing is equivalent to UL 9540A large-scale testing and equivalent to a UL 9540 listing at the battery level regardless of the power conversion systems (PCS).

Submitter Information Verification

Submitter Full Name: Chris Searles

Organization: IEEE ESSB Committee

Affiliation: CGS and Associates

Street Address:

City:

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Submittal Date: Tue May 23 09:27:39 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The proposal does not tie in the full listing requirements required for this technology.

Public Input No. 165-NFPA 855-2023 [Section No. 9.2.1.2.1]

9.2.1.2.1*

Lead-acid and nickel-cadmium batteries, ~~where used in a stationary standby service with~~ listed to UL1973, in systems 600 V dc or less, shall not be ~~permitted~~ required to be listed to ~~UL 1973~~ UL9540 ..

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

Submitter Full Name: Gary Balash

Organization: East Penn Manufacturing Compan

Street Address:

City:

State:

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Submittal Date: Wed May 24 11:40:16 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The proposal does not tie in the full listing requirements required for this technology.

Public Input No. 187-NFPA 855-2023 [Section No. 9.2.1.2.1]

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 Appendix H cell/monobloc .

Statement of Problem and Substantiation for Public Input

There are two levels of testing for lead-acid and Ni-Cad batteries in UL 1973, cell/monobloc and system (per Table H.1 of UL 1973 Appendix H). This would clarify which level of listing and testing would be required and would eliminate any confusion as to the requirements.

Submitter Information Verification

Submitter Full Name: Robert Rallo
Organization: Solar System Services
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 30 09:40:45 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The proposal does not tie in the full listing requirements required for this technology.

Public Input No. 195-NFPA 855-2023 [Section No. 9.2.1.2.2]

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~~ .

Statement of Problem and Substantiation for Public Input

The prior edition of NFPA 855 added 9.2.1.2.1 as an option for UL 1973 listing instead of UL 9540 listing for all lead-acid and nickel-cadmium batteries less than 600 V in stationary standby applications. The more stringent criteria for telecommunications low voltage -48 V plant under exclusive control of the utility and NFPA 76 compliant was not required to be listed to UL 9540 or any listing at the time. Many traditional lead-acid telecom products historically did not have a listing. The fire resistance criteria in NFPA 76 are more stringent than UL 1973 (and low voltage compared to the 600 V criteria in 9.2.1.2.1) so these installations should be clarified that they do not require listing and should be distinct from 9.2.1.2.1.

Submitter Information Verification

Submitter Full Name: Randy Schubert
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
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Zip:
Submittal Date: Tue May 30 15:49:24 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-126-NFPA 855-2023

Statement: Modifying Section 9.2.1.2.1 provides for an improved clarification of the carve out and recognition of the improvement with UL 1973 providing for listing of this technology

Public Input No. 112-NFPA 855-2023 [Sections 9.2.1.2.2, 9.2.1.2.3]

Sections 9.2.1.2.2, 9.2.1.2.3

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~~ .

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~~ .

Statement of Problem and Substantiation for Public Input

Issue 1 of NFPA 855 exempted telecom and electric utility batteries from listing. Issue 2 introduced an option to list certain lead-acid batteries to UL 1973. But saying telecom and electric utility batteries don't need to be listed to UL 9540, does not exempt them from UL 1973 listing, as was originally intended. The NEC exempts all lead-acid batteries from all listing requirements and excluding telecom and utility lead-acid batteries from both UL 9540 and UL 1973 is consistent with the NEC and issue 1 of 855.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon May 15 20:54:05 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-126-NFPA 855-2023

Statement: Modifying Section 9.2.1.2.1 provides for an improved clarification of the carve out and recognition of the improvement with UL 1973 providing for listing of this technology

Public Input No. 248-NFPA 855-2023 [Section No. 9.2.2.1]

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.

A.9.2.2.1

Hazard Mitigation Analysis (HMA) for non-listed ESS shall follow the guidelines of Annex G. The HMA shall specifically address the sections of the Appropriate Standard *not evaluated* by the Recognized Laboratory to identify the risks of the omitted sections, evaluate the efficacy of the associated engineering or administrative controls, and effectiveness of the proposed hazard mitigation measures that precludes the likelihood of fire, shock or injury to personnel.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes

Organization: American Fire Technologies

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 31 21:07:27 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: This issue is resolved by the clarification of the HMA requirements in the body of the standard for non-listed and field evaluation systems.

Public Input No. 301-NFPA 855-2023 [Section No. 9.2.3.1]

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~~ .

Statement of Problem and Substantiation for Public Input

If the ESMS or BMS is required by the listing or HMA, it is required. Nothing in chapter 9 through 13 should modify it so it is not required. The ending phrase can be removed.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 11:30:59 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-66-NFPA 855-2023

Statement: There is nothing in Chapters 9-13 presently that would invalidate the need for an ESMS or BMS if the listing of the particular product or HMA requires it. Therefore, the ending clause is unnecessary.

Public Input No. 145-NFPA 855-2023 [New Section after 9.2.3.4]

9.2.3.4.4

Lead-acid and nickel-cadmium battery systems listed to UL 1973 shall not be required to comply with 9.2.3.1 through 9.2.3.3.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

Submitter Full Name:	Chris Searles
Organization:	Ieee Essb Committee
Affiliation:	CGS and Associates
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 23 11:41:47 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-127-NFPA 855-2023

Statement: This revision eliminates multiple carve outs for lead-acid systems by replacing them with a single carve out.

Public Input No. 166-NFPA 855-2023 [New Section after 9.2.3.4]

9.2.3.4.4

Lead-acid and nickel-cadmium batteries listed to UL1973 in systems 600vdc or less, shall not be required to comply with 9.2.3.1 through 9.2.3.3.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

Submitter Full Name:	Gary Balash
Organization:	East Penn Manufacturing Compan
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Wed May 24 11:47:58 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution:	FR-127-NFPA 855-2023
Statement:	This revision eliminates multiple carve outs for lead-acid systems by replacing them with a single carve out.

Public Input No. 180-NFPA 855-2023 [Section No. 9.2.3.4.1]

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.

Statement of Problem and Substantiation for Public Input

Telecom nominal -48V bulk power plant batteries do not require BMS/ESMS and NFPA-76 is not relevant to this criteria.

Submitter Information Verification

Submitter Full Name:	Randy Schubert
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Fri May 26 11:43:21 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-127-NFPA 855-2023

Statement: This revision eliminates multiple carve outs for lead-acid systems by replacing them with a single carve out.

Public Input No. 314-NFPA 855-2023 [Section No. 9.2.4]

9.2.4 Repurposed, Remanufactured, and Refurbished Batteries.

9.2.4.1 *

This section covers batteries that have been repurposed, remanufactured, or refurbished. This includes batteries previously used in other applications, such as electric vehicle propulsion.

A.9.2.4.1

This section covers repurposed, remanufactured, and refurbished batteries used in ESS. “Repurposed” most often refers to batteries and battery modules previously used in electric vehicles.

“Remanufactured” refers to rebuilt or refurbished batteries that have undergone a manufacturing type process to allow them to be used in an ESS application.

“Refurbished” refers to batteries used in an ESS application that are renovated or cleaned up so they can continue to be used in the same ESS application.

Regardless of whether a battery is repurposed, remanufactured, or refurbished, it may no longer be covered by the original battery OEM specifications and should undergo an evaluation to verify that it meets all applicable safety and performance requirements in this standard.

The requirements in this section are not intended to cover normal maintenance and testing operations on batteries conducted in accordance with the original battery OEMs instructions.

The replacement of worn out batteries with new OEM batteries in ESS is covered by the repair and retrofit requirements in 4.6.2 and 4.6.3.

9.2.4.2

ESS containing repurposed, remanufactured, or refurbished batteries shall comply with all applicable requirements in this standard for ESS containing new batteries.

9.2.4.3

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

9.2.4. 2 * –

~~Batteries previously used in other applications, such as electric vehicle propulsion, shall~~

4

Refurbished batteries that are used in an application that (1) differs from the original use, or (2) have internal parts replaced or repaired shall be treated as remanufactured batteries and also comply with 4.2.4.5 and 4.2.4.6.

9.2.4.5*

Repurposed batteries, remanufactured batteries, and the refurbished batteries covered by 9.2.4.4.1 shall not be permitted unless the equipment is repurposed or remanufactured by a ~~UL 1974–compliant battery repurposing company where reused in ESS applications and the system complies with 4.6.1~~ company that is listed in accordance with UL 1974.

Note - (Renumber A.2.4.2 to A.2.4.5 with no text changes)

9.2.4.6*

The repurposed, or remanufactured batteries, modules and cells shall be provided with a nameplate marking that includes the electrical ratings, chemistry; model number; and manufacturer's identification..

A.9.2.4.6

As part of the repurposing process, UL 1974 requires all markings from the original manufacturer (OEM) to be removed and replaced with markings provided as part of the re-purposing or remanufacturing of the batteries. This means there will be no markings that reference the battery OEM after the product has been repurposed .

Statement of Problem and Substantiation for Public Input

This proposal accomplishes the following:

1. Clarifies that repurposed, remanufactured, and refurbished batteries must comply with 9.2.4 and other applicable requirements in the standard.
2. 9.2.4.4 and 9.2.4.4.1 address refurbished batteries, and does not require refurbishing operations that are primarily cosmetic in nature to be performed by a UL 1974 facility.
3. Revised 9.2.4.5 provide clarity that the repurposing or remanufacturing company is listed, and that the listing can be provided by any approved certification organization.
4. 9.2.4.6 identifies the markings to be provided on the repurposed batteries, as required in UL 1974, Section 23. The annex clarifies that UL 1974 does not allow the battery OEM identification to be visible on the repurposed batteries.
5. The proposal assumes the scope of UL 1974 will be expanded to cover remanufactured batteries.

This public input was developed by an NFPA 855 2nd life battery task group (#16).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 334-NFPA 855-2023 [New Section after 4.6.5]	

Submitter Information Verification

Submitter Full Name: Howard Hopper
Organization: UL Solutions

Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 12:05:22 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-144-NFPA 855-2023

Statement: This first revision provides a link to the repurposed, remanufactured, and refurbished battery section, a form of reused equipment. The terms repurposed, remanufactured, and refurbished are used interchangeably but each has a slightly different connotation or meaning based on the audience or context in which it is used. The first revision covers all these kinds of batteries – whether they are repurposed from an OEM, rebuilt (remanufactured) or had minor repairs done to it (refurbished).

UL 1974 evaluates repurposing facilities and those facilities are listed under UL 1974. However, it does not mean that the batteries coming from the repurposer has undergone any safety standard testing. This is why the ESS using repurposed batteries would still have to be listed to UL 9540 as indicated in 4.6.1 of NFPA 855 and it's also why repurposed battereis should still be listed to UL 1973.

Public Input No. 277-NFPA 855-2023 [New Section after 9.3.1]

9.3.1.1

Walk-in units shall be treated as indoor installations.

A.9.3.1.1

Walk-in ESS are units where other than the arms of personnel can enter the enclosure or container housing the system or system components for any reason. This includes ESS enclosed within an outer enclosure similar to an ISO shipping container. It does not include ESS cabinets where personnel can reach into the outer enclosure to perform service or maintenance. Building codes regulate such structures and containers as buildings.

Statement of Problem and Substantiation for Public Input

The addition of this section makes it clear that walk-in units are treated as indoor installations, eliminates confusion between sections 4 and 9.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 278-NFPA 855-2023 [New Section after 9.3.1]	

Submitter Information Verification

Submitter Full Name: Noah Ryder

Organization: Fire and Risk Alliance

Affiliation: Submitted on behalf of NFPA 855 TG9

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jun 01 07:39:16 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-118-NFPA 855-2023

Statement: The revision clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 278-NFPA 855-2023 [New Section after 9.3.1]

9.3.1.2

Outdoor ESS cabinets that exceed 53 ft × 8.5 ft × 9.5 ft (16.2 m × 2.6 m × 2.9 m) in size, not including HVAC and other equipment shall be treated as indoor installations.

Statement of Problem and Substantiation for Public Input

Eliminates the size restriction and makes it clear that units exceeding the previously defined size limitations of 9.5.2.4.1 are to be treated as indoor installations regardless of whether they are walk-in or not.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 277-NFPA 855-2023 [New Section after 9.3.1]	
Public Input No. 280-NFPA 855-2023 [Section No. 9.5.2.3]	
Public Input No. 282-NFPA 855-2023 [Section No. 9.5.2.4]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA 855 TG9
Street Address:
City:
State:
Zip:

Submittal Date: Thu Jun 01 07:44:49 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-118-NFPA 855-2023

Statement: The revision clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]

Sections 9.3.1, 9.3.2

9.3.1 Indoor Installations.

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

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.

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.

9.3. 1.3

Walk-in units shall be treated as indoor installations.

A.9.3.1.3

Walk-in ESS are units where other than the arms of personnel can enter the enclosure or container housing the system or system components for any reason. This includes ESS enclosed within an outer enclosure similar to an ISO shipping container. It does not include ESS cabinets where personnel can reach into the outer enclosure to perform service or maintenance. Building codes regulate such structures and containers as buildings.

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:

  (a) *Rooftop installations*: ESS installations located on the roofs of buildings

  (b) *Open parking garage installations*: ESS installations located in a structure or portion of a structure as defined in 3.3.19

  (c) Mobile ESS installations

9.3.1.2

Outdoor ESS cabinets that exceed 53 ft × 8.5 ft × 9.5 ft (16.2 m × 2.6 m × 2.9 m) in size, not including HVAC and other equipment shall be treated as indoor installations.

Statement of Problem and Substantiation for Public Input

See Public Input 255

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	Connected for complete change
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	
Public Input No. 261-NFPA 855-2023 [New Section after 3.1]	

Submitter Information Verification

Submitter Full Name: Robert Davidson

Organization: Davidson Code Concepts, Llc

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 31 22:37:06 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-118-NFPA 855-2023

Statement: The revision clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 167-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]

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.

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

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr 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.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

Statement of Problem and Substantiation for Public Input

watt per cell battery calculation was not included, along with the existing AH calculation. Reference Table 1.3 footnotes.

Submitter Information Verification

Submitter Full Name: Gary Balash

Organization: East Penn Manufacturing Compan

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 24 14:01:14 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-4-NFPA 855-2023

Statement: The ESS line items added include nickel-hydrogen and zinc manganese dioxide batteries which indicate that through testing had little impact of fire through the various testing processes. The new battery types are added to the table based on criteria in 9.4.1.

Various technologies where added such as zinc-air to be consistent with able 1.3. Footnote b was modified to be consistent with the various technologies in Table 1.3.

The ESS line items are to be modified to include specific line items for lithium metal, and zinc bromide batteries with a maximum of 600 kWH. The batteries perform above the hazards shown with lithium-Ion.

The technical committee is seeking public comment for the possible deletion of this table in its entirety.

Public Input No. 182-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]

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.

Table 9.4.1 Maximum Stored Energy

ESS Type	Maximum Stored Energy[a] (kWh)
Lead-acid batteries, all types	Unlimited
Nickel batteries [b] Nickel-Hydrogen Batteries Zinc manganese dioxide batteries (Zn-MnO2)	Unlimited Unlimited Unlimited
Lithium-ion batteries, all types Lithium metal batteries Zinc Bromide Batteries	600 600 600
Sodium nickel chloride batteries	600
Flow batteries[c]	600
Other battery technologies	200
Storage capacitors	20

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

Additional Proposed Changes

File Name	Description	Approved
9.4.1_upload.pdf	TG8 9.4.1 Table changes	

Statement of Problem and Substantiation for Public Input

This proposal is intended to modify table 9.4.1 and based on the use of Terraview, the attached document is the recommended changes, with terra view the changes shown on existing lines was not intended only add new ESS types..

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized in table 9.4.1 in a new ESS Type besides “other battery technologies.” The task group heard 7 presentations from various manufactures and evaluated the submitted information through the open task group process.

The ESS line items added include Nickel-Hydrogen and Zinc Manganese Dioxide batteries which through submitted presentations indicated that through testing had little impact of fire through the various testing processes.. The task group is recommending that that material be recognized with an unlimited Maximum Stored Energy based on 9.4.1

The ESS line items are further recommended to be modified to include specific line items for Lithium Metal, and Zinc Bromide batteries with a maximum of 600 kWH. Through the presentation the submitted information by the various manufactures appeared the batteries performed above the hazards shown with Lithium-Ion.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 183-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 183-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Michael O`Brian
Organization:	Code Savvy Consultants
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Mon May 29 19:24:13 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-4-NFPA 855-2023

Statement: The ESS line items added include nickel-hydrogen and zinc manganese dioxide batteries which indicate that through testing had little impact of fire through the various testing processes. The new battery types are added to the table based on criteria in 9.4.1.

Various technologies where added such as zinc-air to be consistent with able 1.3. Footnote b was modified to be consistent with the various technologies in Table 1.3.

The ESS line items are to be modified to include specific line items for lithium metal, and zinc bromide batteries with a maximum of 600 kWH. The batteries perform above the hazards shown with lithium-Ion.

The technical committee is seeking public comment for the possible deletion of this table in its entirety.

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.

Table 9.4.1

Table 9.4.1 Maximum Stored Energy	
ESS Type	**Maximum Stored Energy[a] (kWH)**
Lead-acid batteries, all types	Unlimited
Nickel Batteries	Unlimited
Nickel-Hydrogen Batteries	Unlimited
Zinc manganese dioxide batteries ($Zn\text{-}MnO_2$)	Unlimited
Lithium-ion batteries, all types	600
Lithium metal batteries	600
Zinc Bromide Batteries	600
Sodium nickel chloride batteries	600
Flow batteries	600
Other battery technologies	200
Storage capacitors	20

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

Public Input No. 231-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]

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.

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
Iron-air batteries	600
Other battery technologies	200
Storage capacitors	20

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

Additional Proposed Changes

File Name	Description	Approved
Table_9.4.1-_NFPA_855_Public_Input_for_Iron-Air_Updates.pdf	Table 9.4.1 - Form Energy's Proposed Updates	

Statement of Problem and Substantiation for Public Input

Form Energy is proposing that iron-air batteries be added to Table 9.4.1 as an ESS Type with increased maximum stored energy limits from “other battery technologies”.

600 kWh is recommended because iron-air is demonstrated to be equivalent to or safer than other chemistries listed at that same maximum stored energy quantity. Form Energy has test data available to present to the committee to support these safety claims.

It is also recommended that iron-air technology be separately listed (and not covered under "other" technologies) because it has safety benefits that will be seen in other sections of the code (Table 9.6.5).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 229-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	Addition of iron-air chemistry to tables 1.3 and 9.4.1

Submitter Information Verification

Submitter Full Name: Alli Nansel

Organization: Form Energy

Street Address:

City:

State:

Zip:

Submittal Date: Wed May 31 17:30:45 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-4-NFPA 855-2023

Statement: The ESS line items added include nickel-hydrogen and zinc manganese dioxide batteries which indicate that through testing had little impact of fire through the various testing processes. The new battery types are added to the table based on criteria in 9.4.1.

Various technologies where added such as zinc-air to be consistent with able 1.3. Footnote b was modified to be consistent with the various technologies in Table 1.3.

The ESS line items are to be modified to include specific line items for lithium metal, and zinc bromide batteries with a maximum of 600 kWH. The batteries perform above the hazards shown with lithium-Ion.

The technical committee is seeking public comment for the possible deletion of this table in its entirety.

NFPA 855: Public Input Submittal for Iron-Air Updates

The following document outlines Form Energy's submission for the NFPA 855 Public Input Period. Changes to the current edition are outlined in red.

Table 9.4.1 Maximum Stored Energy

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

Rationale: *Form Energy is proposing that iron-air batteries be added to Table 9.4.1 as an ESS Type with increased maximum stored energy limits from "other battery technologies".*

600 kWh is recommended because iron-air is demonstrated to be equivalent to or safer than other chemistries listed at that same maximum stored energy quantity. Form Energy has test data available to present to the committee to support these safety claims.

It is also recommended that iron-air technology be separately listed (and not covered under "other" technologies) because it has safety benefits that will be seen in other sections of the code (Table 9.6.5).

Public Input No. 266-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]

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.

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
Hybrid supercapacitors	Unlimited

[a]For ratings in amp-hrs, kWh should equal maximum rated voltage multiplied by amp-hr rating divided by 1000.

[b]Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

[c]Includes vanadium, zinc-bromine, polysulfide, bromide, and other flowing electrolyte-type technologies.

Statement of Problem and Substantiation for Public Input

See PI 265

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 265-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 265-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 267-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	

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Submittal Date: Wed May 31 23:52:58 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-4-NFPA 855-2023

Statement: The ESS line items added include nickel-hydrogen and zinc manganese dioxide batteries which indicate that through testing had little impact of fire through the various testing processes. The new battery types are added to the table based on criteria in 9.4.1.

Various technologies where added such as zinc-air to be consistent with able 1.3. Footnote b was modified to be consistent with the various technologies in Table 1.3.

The ESS line items are to be modified to include specific line items for lithium metal, and zinc bromide batteries with a maximum of 600 kWH. The batteries perform above the hazards shown with lithium-Ion.

The technical committee is seeking public comment for the possible deletion of this table in its entirety.

Public Input No. 196-NFPA 855-2023 [Section No. 9.4.2.4.1]

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 and listed to UL 1973 or in telecommunications facilities that comply with ~~NFPA 76~~ NFPA 76 .

Statement of Problem and Substantiation for Public Input

9.4.2.4.4 already allows larger battery groupings up to 250 kWh each for UL 1973 lead-acid and ni-cd batteries without voltage limitation. When using low voltage systems of less than 50 V ac or 60 V dc with either UL 1973 listed batteries or NFPA 76 compliance there should be relief for the 3 ft separation criteria since the listing or NFPA 76 fire resistance criteria mitigate propagation risk. NFPA 70 Chapter 480 allows smaller separation distances for lead-acid and ni-cd systems. In smaller telecom applications it is common to have one side of a battery string along a wall with less than 3 feet separation and there is no history of adverse impacts or risks.

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Committee: ESS-AAA

Committee Statement

Resolution: FR-128-NFPA 855-2023

Statement: The revised wording eliminates the need for the multiple carve outs.

Public Input No. 146-NFPA 855-2023 [Section No. 9.4.2.4.4]

9.4.2.4.4

~~Lead~~ Paragraphs 9.4.2.1 and 9.4.2.2 shall not apply to 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~~ battery systems listed to UL 1973 .

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not internally start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover. In addition, lead-acid and nickel-cadmium batteries use a water-based electrolyte that aids in extinguishing any externally caused fire. Table 9.4.1 states that lead-acid and nickel-cadmium battery systems are granted unlimited kWh for MAQ, and restricting maximum group sizing does not appear to be consistent with the logic behind Table 9.4.1. The 250 kWh limitation has been exceeded for decades with lead-acid batteries in certain UPS and telecommunications applications without any incidents.

Submitter Information Verification

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Committee: ESS-AAA

Committee Statement

Resolution: FR-128-NFPA 855-2023
Statement: The revised wording eliminates the need for the multiple carve outs.

Public Input No. 172-NFPA 855-2023 [Section No. 9.4.2.4.4]

9.4.2.4.4

Paragraph 9.4.2.1 and 9.4.2.2 shall not apply to 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. .

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test. Plus, I'm not sure where 250kWh came from but as an example, a 480V UPS system using 2000AH, 2 volts cells, would calculate out to a 960kWh system. These size systems have been used for many years, and currently, are all over the world, without any major fires and or explosions. Adding the UL1973 testing and listing only further proves these size systems are very safe and have been safe for many years.

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Submittal Date: Wed May 24 15:57:39 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-128-NFPA 855-2023

Statement: The revised wording eliminates the need for the multiple carve outs.

Public Input No. 188-NFPA 855-2023 [Section No. 9.4.2.4.4]

9.4.2.4.4

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

Statement of Problem and Substantiation for Public Input

There are two levels of testing for lead-acid and Ni-Cad batteries in UL 1973, cell/monobloc and system (per Table H.1 of UL 1973 Appendix H). This would clarify which level of listing and testing would be required and would eliminate any confusion as to the requirements.

Submitter Information Verification

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Committee: ESS-AAA

Committee Statement

Resolution: FR-128-NFPA 855-2023
Statement: The revised wording eliminates the need for the multiple carve outs.

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

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

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
Toxic and Highly Toxic emissions	Yes	Yes	9.6.7
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group

Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]

Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date: Sat Apr 22 14:17:46 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-104-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. As the technology specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

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

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~~ Exhaust Ventilation During normal operation*	Yes	Yes	9.6.5.1
Spill Control*	Yes	yes	9.6.5.2
Neutralization*	Yes	Yes	9.6.5.3
Safety Caps*	Yes	Yes	9.6.5.4
Thermal Runaway*	Yes	Yes	9.6.5.5
Explosion Control*	Yes	Yes	9.6.5.6

NA: Not applicable.

* Table 9.6.5 shall determine if a sub-category of electrochemical ESS must comply with this requirement. The listed reference section shall determine whether the form-factor of an ESS defined in section 3.3.9 shall comply or is exempt from this requirement.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task Group Recommendations - As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group

Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 64-NFPA 855-2023 [Section No. G.8]

Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

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Committee:	ESS-AAA

Committee Statement

Resolution: CI-104-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. As the technology specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

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

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
Toxic and Highly Toxic Emissions	Yes	No	9.6.7
Occupied work centers	Not allowed	Not allowed	9.5.1.2.1
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	

Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 14:21:44 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-105-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

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

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~~ Exhaust Ventilation during normal operations*	Yes	Yes	9.6.5.1
Spill Control*	Yes	Yes	9.6.5.2
Neutralization*	Yes	Yes	9.6.5.3
Safety Caps*	Yes	Yes	9.6.5.4
Thermal Runaway*	Yes	Yes	9.6.5.5
Explosion Control	Yes	Yes	9.6.5.6

NA: Not applicable.

* * Table 9.6.5 shall determine if a sub-category of electrochemical ESS must comply with this requirement. The listed reference section shall determine whether the form-factor of an ESS defined in 3.3.9 shall comply or is exempt from this requirement.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task Group Recommendations - As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Fri Apr 28 09:35:25 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: CI-105-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Public Input No. 308-NFPA 855-2023 [Section No. 9.5.2.1]

~~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.~~

Statement of Problem and Substantiation for Public Input

It seems this exception to the MAQ based on the HMA is already completely addressed in the MAQ section via 9.4.1 and 9.4.1.2. This section can be removed.

Submitter Information Verification

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Submittal Date: Thu Jun 01 11:45:42 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: This section a trigger for an HMA on larger li-ion installations.

Public Input No. 280-NFPA 855-2023 [Section No. 9.5.2.3]

9.5.2.3 Walk-in Units.

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.

~~**9.5.2.3.2** *~~

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

~~**9.5.2.3.3**~~

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

Statement of Problem and Substantiation for Public Input

Simplified section and aligned with other revisions proposed

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 278-NFPA 855-2023 [New Section after 9.3.1]	Reorganized from 9.5.2.4

Submitter Information Verification

Submitter Full Name: Noah Ryder
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Submittal Date: Thu Jun 01 08:03:39 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-119-NFPA 855-2023

Statement: This clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]

Sections 9.5.2.3, 9.5.2.4

9.5.2.3 Walk-in Units.

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.~~

~~**9.5.2.3.2**~~ ~~*~~ –

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

~~**9.5.2.3.3**~~ –

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

~~**9.5.2.4**~~ – ~~Maximum Size.~~

~~**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.~~

~~**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 .~~ unit installations.

Statement of Problem and Substantiation for Public Input

This proposal is part of the PI 255 proposal which clarifies how walk-in units are treated.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	
Public Input No. 261-NFPA 855-2023 [New Section after 3.1]	

Submitter Information Verification

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Submittal Date: Wed May 31 22:42:20 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-119-NFPA 855-2023

Statement: This clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 279-NFPA 855-2023 [Section No. 9.5.2.3.1]

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

Statement of Problem and Substantiation for Public Input

ITM language removed as unnecessary with other proposed revisions, added clarity that the minimum 3' spacing is not required for outdoor walk-in units. This is predicated on UL9540A unit level test results.

Submitter Information Verification

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Submittal Date: Thu Jun 01 07:58:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-119-NFPA 855-2023

Statement: This clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 103-NFPA 855-2023 [Section No. 9.5.2.4]

9.5.2.4 Maximum Size.

9.5.2.4.1

Outdoor ESS walk-in ~~units or ESS cabinets shall~~ units 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.

9.5.2.4.2

Outdoor ESS walk-in ~~units or ESS cabinets that~~ units 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.

Statement of Problem and Substantiation for Public Input

This appears to be some legacy verbiage based on the largest standard ISO container platform. This should not be applicable to cabinet systems and should not be applicable to an outdoor non-walk in enclosure. I understand there may be a concern with sizing of a system so if there are restrictions still warranted it should be based on total area of length and width. Height does not play a factor unless double stacking systems. There could be roof exhaust vents, lights, deflagration panels, etc. roof mounted.

Submitter Information Verification

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Submittal Date: Tue May 09 15:43:28 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-119-NFPA 855-2023

Statement: This clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 282-NFPA 855-2023 [Section No. 9.5.2.4]

~~**9.5.2.4** Maximum Size.~~

~~**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.~~

~~**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 .~~

Statement of Problem and Substantiation for Public Input

Moved to proposed 9.3.1.1/9.3.1.2 based on chapter realignment

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 278-NFPA 855-2023 [New Section after 9.3.1]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
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City:
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Submittal Date: Thu Jun 01 08:09:37 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-119-NFPA 855-2023

Statement: This clarifies what is treated as a building in Section 9.3.1.2. It eliminates the size restriction for cabinet and walk-in units.

Public Input No. 312-NFPA 855-2023 [Section No. 9.5.2.6.1.3]

9.5.2.6.1.3

~~Clearances~~ Where approved clearances to buildings shall be permitted to be reduced to 3 ft (0.9 m) based ~~on fire~~ on fire and explosion testing complying with 9.1.5.

Statement of Problem and Substantiation for Public Input

The reduction of the clearance to buildings based on test results per section 9.1.5 should still require AHJ approval.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 11:56:07 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The requirements, including permissive requirements, are enforced by the AHJ.

Public Input No. 319-NFPA 855-2023 [Section No. 9.5.2.6.1.8(A)]

(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).

Statement of Problem and Substantiation for Public Input

This item is a duplication of section 4.8. It can be removed if the TC agrees it is redundant.

Submitter Information Verification

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Affiliation: ATIS
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Submittal Date: Thu Jun 01 12:22:58 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Instructions are necessary for proper installation of wall-mounted ESS.

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Rooftop and open parking garage ESS installations shall comply with this section and as detailed in Table 9.5.3.1.

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
Toxic and Highly Toxic Emissions	Yes	Yes	9.6.7
Technology-specific protection	Yes	Yes	9.6.5

NA: Not applicable.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics Task Group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]

Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date:	Sat Apr 22 14:24:08 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-153-NFPA 855-2023

Statement: As the technology specific protection table changes with the changes in technology and battery type, the applicable code requirements for location specific application is not always clear. Specific mitigation measures are added to the tables for guidance per locations.

A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Rooftop and open parking garage ESS installations shall comply with this section and as detailed in Table 9.5.3.1.

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~~
Exhaust Ventilation during normal operations*	Yes	Yes	9.6.5.1
Spill Control*	Yes	Yes	9.6.5.2
Neutralization*	Yes	Yes	9.6.5.3
Safety Caps*	Yes	Yes	9.6.5.4
Thermal Runaway*	Yes	Yes	9.6.5.5
Explosion Control*	Yes	Yes	9.6.5.6

NA: Not applicable.

* Table 9.6.5 shall determine if a sub-category of electrochemical ESS must comply with this requirement. The listed reference section shall determine whether the form-factor of an ESS defined in 3.3.9 shall comply or is exempt from this requirement.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task Group Recommendations - As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
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Submittal Date: Fri Apr 28 09:41:11 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-153-NFPA 855-2023

Statement: As the technology specific protection table changes with the changes in technology and battery type, the applicable code requirements for location specific application is not always clear. Specific mitigation measures are added to the tables for guidance per locations.

A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 321-NFPA 855-2023 [Section No. 9.5.3.1.1.1]

9.5.3.1.1.1

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

Statement of Problem and Substantiation for Public Input

Simplification for emphasis.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
Organization:	Ericsson
Affiliation:	ATIS
Street Address:	
City:	
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Submittal Date:	Thu Jun 01 12:25:13 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The proposed revision does not provide additional clarity and eliminates approval.

Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]

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 thermal image or 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.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	

Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]

Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]

Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]

Submitter Information Verification

Submitter Full Name: Scott Lang
Organization: Honeywell International
Street Address:
City:
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Zip:
Submittal Date: Tue Nov 29 13:31:23 EST 2022
Committee: ESS-AAA

Committee Statement

Resolution: FR-103-NFPA 855-2023

Statement: This provides correlation with the changes in NFPA 72.

Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]

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 thermal image or 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.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	

Submitter Information Verification

Submitter Full Name: Scott Lang

Organization: Honeywell International
Street Address:
City:
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Zip:
Submittal Date: Tue Nov 29 13:34:06 EST 2022
Committee: ESS-AAA

Committee Statement

Resolution: FR-121-NFPA 855-2023

Statement: The addition of thermal image fire detection aligns with other revisions for smoke and fire detection. Fault condition testing is not defined or included in the standard.

Public Input No. 324-NFPA 855-2023 [Section No. 9.5.3.1.2]

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 ~~,~~ and 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.

Statement of Problem and Substantiation for Public Input

Section 9.1.5 does not contain fault condition testing, only fire and explosion testing.

Submitter Information Verification

Submitter Full Name: Richard Kluge

Organization: Ericsson

Affiliation: ATIS

Street Address:

City:

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Submittal Date: Thu Jun 01 12:28:28 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-121-NFPA 855-2023

Statement: The addition of thermal image fire detection aligns with other revisions for smoke and fire detection. Fault condition testing is not defined or included in the standard.

Public Input No. 365-NFPA 855-2023 [Section No. 9.5.3.2 [Excluding any Sub-Sections]]

Mobile ESS operation shall be classified as specified in 9.5.3.2.~~1~~ 2 or 9.5.3.2.3 .

9.5.3. 2 .2 The requirements of this section do not apply to ESS that are 100kWh or less when permanently mounted on a vehicle or trailer to power electrical systms installed on the vehcle or trailer when the ESS is listed in accordance with 4.6.1..

Statement of Problem and Substantiation for Public Input

When mobile the ESS requirements were created the discussion focused on large power supplies transported to a location to provide for temporary power needs at that location whether for a building or temporary equipment at that location. The uses of ESS have expanded to address the cut back of emissions from vehicles whether to power reefers on trailer trucks or heating equipment on food delivery vans. As written the current language is a barrier to these important applications.

Submitter Information Verification

Submitter Full Name: Robert Davidson

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City:

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Submittal Date: Thu Jun 01 16:45:49 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-69-NFPA 855-2023

Statement: Section 9.5.3.2 incorrectly referenced the subsections. Removing the references to the subsections makes it read better.

Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]

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

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~~ Exhaust Ventilation during Normal operations*	Yes	9.6.5.1
Spill Control*	Yes	9.6.5.2
Neutralization*	Yes	9.6.5.3
Safety Caps*	Yes	9.6.5.4
Thermal Runaway*	Yes	9.6.5.5
Explosion Control*	Yes	9.6.5.6

[a]In walk-in units, spacing is not required between ESS units and the walls of the enclosure.

[b]Alarm signals are not required to be transmitted to an approved location for mobile ESS deployed 30 days or less.

[c]Only required for walk-in units.

* Table 9.6.5 shall determine if a sub-category of electrochemical ESS must comply with this requirement. The listed reference section shall determine whether the form-factor of an ESS defined in 3.3.9 shall comply or is exempt from this requirement.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task Group Recommendations - As the technology Specific protection table changes with the changes in technology and batter type, the applicable code requirements for location specific application is not always clear. The specific mitigation measures are added to the tables for guidance per locations.

Related Public Inputs for This Document

Related Input	Relationship

Public Input No. 64-NFPA 855-2023 [Section No. G.8]

Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]

Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]

Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]

Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]

Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]

Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]

Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes

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Affiliation: None

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Submittal Date: Fri Apr 28 09:47:50 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-154-NFPA 855-2023

Statement: As the technology specific protection table changes with the changes in technology and battery type, the applicable code requirements for location specific application is not always clear. Specific mitigation measures are added to the tables for guidance per locations.

Public Input No. 218-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.1

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.

A.9.6.1.1

Paragraph 9.6.1.1 aligns with 90.2(B)(4) of NFPA 70.

This requirement is intended to address small, normally unoccupied structures in remote locations, such as repeater stations, which are not adjacent to other important buildings or structures. It is not intended to apply to structures in an urban or suburban setting. The AHJ determines which structures are considered remote. The hardship of installing and maintaining smoke detection in these small, remote structures, along with heating and cooling to maintain the smoke detectors within listing specifications, is a reason for this exclusion.

See NFPA 76 for more information on fire detection for telecommunications structures.

Statement of Problem and Substantiation for Public Input

PI made on behalf of TG 9
This section is intended to address small, remote, normally unoccupied structures where the hardship of installing and maintaining the FA system outweighs the risk associated with the ESS and the associated chemistries. It is specifically limited to chemistries that are not prone to thermal runaway and is not applicable to locations that are in close proximity to other important structures or exposures.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name:	Noah Ryder
Organization:	Fire and Risk Alliance
Affiliation:	NFPA 855 TG 9
Street Address:	
City:	
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Zip:	
Submittal Date:	Wed May 31 13:55:29 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 219-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.2 *

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.

A.9.6.1.2

Paragraph 4.8.1.2 aligns with the scope of 90.2(D)(5) of NFPA 70.

Statement of Problem and Substantiation for Public Input

PI Submitted on Behalf of TG 9
This PI allows for utility owned structures, with batteries not prone to thermal runaway, to monitor the smoke detectors via the process control system in lieu of NFPA 72 compliance. This brings this section of the code into alignment with NFPA 70 90.2 (D) (5).

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitting on Behalf of TG9
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Submittal Date: Wed May 31 14:05:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 222-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.3*

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]

Statement of Problem and Substantiation for Public Input

Submitted on behalf of TG9
There has been a lack of clarity as to where signals shall be annunciated to ensure that the fire service and other stakeholders can access the necessary information. This section clarifies that the AHJ has input into where and potentially how many annunciation locations are required to support a safe and efficient response at the site. This is also aligned with the current NFPA 72 language.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name:	Noah Ryder
Organization:	Fire and Risk Alliance
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Street Address:	
City:	
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Zip:	
Submittal Date:	Wed May 31 14:51:27 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 223-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.4 *

Multiple panels shall be aggregated to a master or annunciator panel at a fire command center or location approved by the AHJ.

A.9.6.1.4

As part of the smoke detection system's local annunciation, providing a fire alarm annunciation panel for emergency responders in an approved location where it can annunciate the ESS(s) being monitored should be considered. The location and information provided should be covered by the emergency operations plan required by 4.3.2.1 and evaluated as part of the HMA.

Statement of Problem and Substantiation for Public Input

Submitted on behalf of TG9
This addition ensures that if multiple annunciation panels/locations are provided throughout a site that the fire service has a single dedicated location where the entirety of the site information can be displayed/provided. This will prevent the fire service and others from having to negotiate the site to determine which panel may provide the necessary information to inform emergency response. This also will ensure that the placement is aligned with and included in the process of developing the HMA and ERP.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name:	Noah Ryder
Organization:	Fire and Risk Alliance
Affiliation:	Submitted on behalf of NFPA 855 TG9
Street Address:	
City:	
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Zip:	
Submittal Date:	Wed May 31 14:56:24 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 271-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.5 *

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.

A.9.6.1.5

The HMA or deflagration evaluation study in conjunction with UL 9540A or fire and explosion test data will be used to support the requirement for additional power supply backup above and beyond NFPA 72 requirements. This requirement applies to lithium-ion technologies because testing and actual events have shown that events can be multiple hours in duration. The additional backup will allow first responders to monitor situational conditions for longer periods of time.

Statement of Problem and Substantiation for Public Input

Submitted on behalf of TG9
It has been shown that incidents involving lithium ion ESS can last for extended periods of time and as a result the detection/notification systems must be able to operate for an extended period. If the large-scale fire testing or resulting HMA indicate that the incident may last longer than 2 hrs then additional backup may be required.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
Affiliation: Submitted on behalf of NFPA855 TG9
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 06:54:42 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 272-NFPA 855-2023 [New Section after 9.6.1]

9.6.1.6

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

Statement of Problem and Substantiation for Public Input

Submitted on behalf of TG9
This ensures that all alarm signals are transmitted and monitored as required by NFPA 72 as in a number of installations the alarm signals are not being communicated to approved monitoring stations which may result in delayed responses to incidents.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]	Subsection

Submitter Information Verification

Submitter Full Name:	Noah Ryder
Organization:	Fire and Risk Alliance
Affiliation:	Submitted on behalf of NFPA 855 TG9
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 07:06:17 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 116-NFPA 855-2023 [Section No. 9.6.1]

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.

9.6.1.1*

Normally unoccupied, remote standalone telecommunications structures with a gross floor area of less than 1500 ft^2 (139 m^2) using lead-acid or nickel-cadmium battery technology shall not be required to have the detection required in 4.8.1 .

9.6.1.2*

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 .

Statement of Problem and Substantiation for Public Input

Consider that the two sections currently in 4.8.1.1 and 4.8.1.2 and corresponding annex materials might be more suitably located in chapter 9 as they are electrochemical exceptions.

Submitter Information Verification

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Submittal Date:	Mon May 15 21:54:05 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 217-NFPA 855-2023 [Section No. 9.6.1]

9.6.1 Smoke and Fire Detection.

Areas containing ESS systems located within buildings or structures or located outdoors shall be provided with a smoke detection or radiant energy–sensing system in accordance with ~~Section~~ ~~4.8~~ NFPA 72 , unless modified by this chapter.

Statement of Problem and Substantiation for Public Input

Revision submitted on behalf of TG-9.
The existing language provided a loophole/confusion about whether outdoor cabinets and enclosures were required to be provided with smoke/fire detection systems. The consensus of the TG was that the intent of the standard was to have smoke/fire detection provided for all systems regardless of installation location and that the systems should be compliant with NFPA 72.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 218-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 219-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 222-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 223-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 271-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 272-NFPA 855-2023 [New Section after 9.6.1]	
Public Input No. 273-NFPA 855-2023 [Section No. 4.8.1.1]	
Public Input No. 274-NFPA 855-2023 [Section No. 4.8.1.2]	
Public Input No. 276-NFPA 855-2023 [Section No. 4.8.3]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
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Submittal Date: Wed May 31 13:48:33 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-95-NFPA 855-2023
Statement: This revision cleans up the smoke and fire detection requirements.

Public Input No. 255-NFPA 855-2023 [Section No. 9.6.1]

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~~ NFPA 72 , unless modified by this chapter.

9.6.1.1 *

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.

A.9.6.1.1

Paragraph 9.6.1.1 aligns with 90.2(B)(4) of NFPA 70.

This requirement is intended to address small, normally unoccupied structures in remote locations, such as repeater stations, which are not adjacent to other important buildings or structures. It is not intended to apply to structures in an urban or suburban setting. The AHJ determines which structures are considered remote. The hardship of installing and maintaining smoke detection in these small, remote structures, along with heating and cooling to maintain the smoke detectors within listing specifications, is a reason for this exclusion.

See NFPA 76 for more information on fire detection for telecommunications structures.

9.6.1.2 *

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.

A.9.6.1.2

Paragraph 4.8.1.2 aligns with the scope of 90.2(D)(5) of NFPA 70.

9.6.1.3

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]

9.6.1.4 *

Multiple panels shall be aggregated to a master or annunciator panel at a fire command center or location approved by the AHJ.

A.9.6.1.4

As part of the smoke detection system’s local annunciation, providing a fire alarm annunciation panel for emergency responders in an approved location where it can annunciate the ESS(s) being monitored should be considered. The location and information provided should be covered by the emergency operations plan required by 4.3.2.1 and evaluated as part of the HMA.

9.6.1.5 *

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.

A.9.6.1.5

The HMA or deflagration evaluation study in conjunction with UL 9540A or fire and explosion test data will be used to support the requirement for additional power supply backup above and beyond NFPA 72 requirements. This requirement applies to lithium-ion technologies because testing and actual events have shown that events can be several hours in duration. The additional backup will allow first responders to monitor situational conditions for longer periods of time.

9.6.1.6

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

Statement of Problem and Substantiation for Public Input

This proposal coupled with several others cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70; relocates technology specific requirements and clarifies that walk-in units are treated as indoor installations.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	
Public Input No. 257-NFPA 855-2023 [Sections 9.3.1, 9.3.2]	
Public Input No. 258-NFPA 855-2023 [Sections 9.5.2.3, 9.5.2.4]	
Public Input No. 259-NFPA 855-2023 [Section No. 4.8]	
Public Input No. 260-NFPA 855-2023 [Section No. 3.3.9.4]	
Public Input No. 261-NFPA 855-2023 [New Section after 3.1]	

Submitter Information Verification

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Submittal Date: Wed May 31 22:26:56 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-95-NFPA 855-2023
Statement: This revision cleans up the smoke and fire detection requirements.

Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]

9.6.1 Smoke and Fire Detection.

Areas containing ESS systems located within buildings or structures shall be provided with a smoke detection ~~or~~ , thermal image fire detection or radiant energy–sensing system in accordance with Section 4.8, unless modified by this chapter.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

Submitter Information Verification

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Submittal Date: Tue Nov 29 13:27:21 EST 2022

Committee: ESS-AAA

Committee Statement

Resolution: FR-96-NFPA 855-2023

Statement: This revision cleans up the smoke and fire detection requirements; correlates the requirements with NFPA 72 and NFPA 70. The Section 4.8.1 moves are consistent with realignment of Chapter 4 to Chapters 9-13. New Section 9.6.1.5 (former 4.8.3) is revised due to the nature of incidents with ESS, alarm condition is needed in excess of 5 minutes found in NFPA 72. Two hours of alarm time

allows for fire ground operations as opposed to the building evacuation time that NFPA 72 is focused on.

Public Input No. 299-NFPA 855-2023 [New Section after 9.6.2]

9.6.2.x

For pre-engineered systems that are not compliant with NFPA 13, 15, or equivalent, the system piping and appurtenances shall be ASTM B31.2 compliant and shall be listed as such in the UL9540 listing in accordance with 4.6.1.

Statement of Problem and Substantiation for Public Input

This makes it clear that systems are still required to meet a piping/appurtenances standard even if they don't comply with 13, 15, or equivalent. Currently many pre-engineered systems do not have a proper piping listing when seeking the 9540 listing and in some cases the systems are erroneously stated to meet the requirements of 13 or 15 and when they are reviewed prior to installation/commissioning there is a gap as the systems do not comply.

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Submittal Date: Thu Jun 01 11:22:30 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-48-NFPA 855-2023

Statement: This makes it clear that systems are still required to meet a piping/appurtenances standard even if they don't comply with NFPA 13, NFPA 15, or equivalent. Currently many pre-engineered systems do not have a proper piping listing when seeking the UL 9540 listing and in some cases the systems are erroneously stated to meet the requirements of NFPA 13 or NFPA 15 and when they are reviewed prior to installation/commissioning there is a gap as the systems do not comply.

Public Input No. 303-NFPA 855-2023 [New Section after 9.6.2]

9.6.x*

Chemistries capable of thermal runaway based on 9.1.5, shall not include clean agent or aerosol suppression systems except as permitted per 9.6.x.1 or 9.6.x.2.

A.9.6.x

Chemistries capable of thermal runaway and production of flammable gases present a conflicting mitigation challenge when clean agent or aerosol agents are deployed on BESS enclosures. The challenge of mitigating the deflagration risk with a deflagration prevention system are made ineffective by an agent that requires the sealing of the enclosure and may result in an increasing deflagration hazard via activation of the system. Therefore the priority must be reducing deflagration risk rather than suppression of a fire.

Statement of Problem and Substantiation for Public Input

It has been shown in testing that activation of clean agent and aerosol systems can result in smoothering of a fire but does not stop the product of off-gassing, venting, or thermal runaway. As a result the system can activate and result in the continued production of gases in a fuel rich environment. If oxygen is introduced into the enclosure or the gases vent and mix with oxygen then a deflagration may ensue. This ensures that these systems will not be installed unless appropriate testing and certifications are in place.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 307-NFPA 855-2023 [New Section after 9.6.2]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
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Submittal Date: Thu Jun 01 11:38:26 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-97-NFPA 855-2023

Statement: Fire protection systems need to demonstrate that they are capable of addressing all the hazards in the protected space.

Public Input No. 307-NFPA 855-2023 [New Section after 9.6.2]

9.6.x.1

If large-scale fire and explosion installation level testing is performed and demonstrates that the suppression agent does not create a deflagration hazard the suppression system may be installed for the specific tested ESS make and model.

A.9.6.x.1

As of current knowledge, there exists no publicly accessible data that confirms the efficacy of clean agent or aerosol systems in mitigating or suppressing thermal runaway. Nevertheless, empirical evidence has demonstrated that these systems are proficient in suppressing a fire, consequently resulting in the continued generation and accumulation of combustible gases, thereby creating a deflagration hazard. Therefore, it is critical to demonstrate, through large-scale experimentation, that the installation of a clean agent or aerosol suppression system does not produce or result in the accumulation of combustible gases. It also is important to note that the efficacy of any suppression system will be tied to the system design details as well as the specific cell chemistry, module, and unit configuration, thus testing for a specfic configuration may not be generally applicable.

Statement of Problem and Substantiation for Public Input

This addition makes it clear that clean agents, inert gases, and aerosol systems are specifically not allowed to be installed unless they have been tested. It has been frequent practice to install these types of systems to address non-battery fires, however they are typically not able to differentiate the conditions and thus may activate and exacerbate the situation rather than improve it.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 303-NFPA 855-2023 [New Section after 9.6.2]	Subsection
Public Input No. 311-NFPA 855-2023 [New Section after 9.6.2]	

Submitter Information Verification

Submitter Full Name: Noah Ryder

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Submittal Date: Thu Jun 01 11:45:25 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-97-NFPA 855-2023

Statement: Fire protection systems need to demonstrate that they are capable of addressing all the hazards in the protected space.

Public Input No. 311-NFPA 855-2023 [New Section after 9.6.2]

9.6.x.2

A clean agent or aerosol systems may be installed when a compliant NFPA 69 deflagration protection system is present and activated from a NFPA 72 listed and monitored gas detection system.

Statement of Problem and Substantiation for Public Input

This section allows for the installation of aerosol and gaseous systems if a NFPA 69 system is present that will evacuate the suppression agent nullifying its potential negative affects regarding the build up of flammable gases.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 307-NFPA 855-2023 [New Section after 9.6.2]	

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
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Submittal Date: Thu Jun 01 11:54:34 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: No information has been provided on clean agent or aerosol systems impact on gas detection system and response times. The use of the agent or aerosol has been shown to exacerbate the deflagration risk during the battery fire.

Public Input No. 300-NFPA 855-2023 [Section No. 9.6.2.1]

9.6.2.1

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

Statement of Problem and Substantiation for Public Input

Cleans up the language to make it clear that internal protection of containerized ESS is only required when it is a walk-in unit. If the unit is non-walk-in but exceeds the maximum size (53') then it is treated as a building per chapter 9 and would require protection via that mechanism.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 11:28:20 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-46-NFPA 855-2023

Statement: This revision clarifies that internal protection of containerized ESS is only required when it is a walk-in unit. If the unit is non-walk-in but exceeds the maximum size (53') then it is treated as a building per Chapter 9 and would require protection via that mechanism.

Public Input No. 147-NFPA 855-2023 [New Section after 9.6.2.2]

9.6.6.2.4

Lead-acid and nickel-cadmium battery systems listed to UL 1973 shall not be required to have a fire suppression system installed.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

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Submittal Date: Tue May 23 12:09:45 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-47-NFPA 855-2023

Statement: Lead-acid batteries and nickel-cadmium batteries tested and listed to UL 1973 have shown they are safe technologies, which do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL 1973 are self-extinguishing plastics rated per UL 94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL 1973 environmental test, Section 42 for single cell failure design tolerance.

Public Input No. 168-NFPA 855-2023 [New Section after 9.6.2.2]

9.6.2.2.4

Lead-acid and nickel-cadmium batteries listed to UL1973 in systems 600vdc or less, shall not require a fire suppression system.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

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Submittal Date:	Wed May 24 14:26:26 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-47-NFPA 855-2023

Statement: Lead-acid batteries and nickel-cadmium batteries tested and listed to UL 1973 have shown they are safe technologies, which do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL 1973 are self-extinguishing plastics rated per UL 94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL 1973 environmental test, Section 42 for single cell failure design tolerance.

Public Input No. 329-NFPA 855-2023 [Section No. 9.6.3.1]

9.6.3.1

Sites where ~~nonmechanical~~ electrochemical 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.

Statement of Problem and Substantiation for Public Input

Chapter 9 applies to electrochemical ESS, not all non-mechanical ESS in electrochemical. The proposed wording is more consistent with the chapter title.

Submitter Information Verification

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Submittal Date: Thu Jun 01 12:51:07 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: This is already addressed in Chapter 9.

Public Input No. 148-NFPA 855-2023 [New Section after 9.6.3.2]

9.6.3.2.3

Lead-acid and nickel-cadmium batteries listed to UL 1973 shall not be required to have a fire water supply .

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

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Submittal Date: Tue May 23 12:17:53 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-132-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed battery.

Public Input No. 169-NFPA 855-2023 [New Section after 9.6.3.2]

9.6.3.2.3

Lead-acid and nickel-cadmium batteries listed to UL1973 in systems 600vdc or less, shall not be required to have a fire water supply.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

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Submittal Date: Wed May 24 14:39:49 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-132-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed battery.

Public Input No. 197-NFPA 855-2023 [Section No. 9.6.3.2.1]

9.6.3.2.1*

Normally unoccupied, ~~remote~~ standalone telecommunications structures with ~~a gross floor area of less than 1500 ft ^{2} (139 m ^{2}) 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.

Statement of Problem and Substantiation for Public Input

Standalone normally unoccupied telecommunications facilities under exclusive control of the communications utility should have a similar carveout to the electric utility facilities without a 1500 square foot limit. When using lead-acid and ni-cd batteries and requiring compliance to NFPA 76 which has stringent fire resistance criteria along with the safety history of low voltage 48 V plant there is no discernible benefit in limiting the square footage.

Submitter Information Verification

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Submittal Date: Tue May 30 16:28:27 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-130-NFPA 855-2023

Statement: The language better coordinates with the building code carve out for these installations. NFPA 76 does not apply to these buildings.

Public Input No. 149-NFPA 855-2023 [New Section after 9.6.4]

9.6.4.3

Lead-acid and nickel-cadmium batteries listed to UL 1973 shall not be required to have a 2-hour fire resistance separation from the rest of the buildings.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Submitter Information Verification

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Submittal Date:	Tue May 23 12:22:43 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-133-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed lead-acid and Ni-Cd batteries which do not warrant higher rated fire walls..

Public Input No. 115-NFPA 855-2023 [Section No. 9.6.4]

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.

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.

9.6.4. X

Rooms or spaces, containing lead-acid or nickel-cadmium batteries, where used in a stationary standby service with 600 V dc or less, 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.

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.

Statement of Problem and Substantiation for Public Input

Fire codes in the past permitted a 1 hour separation between battery systems and most other occupancies. Lead-acid and nickel-cadmium batteries contain a non-flammable electrolyte present a low risk of fire spread. 9.6.4.1 relaxes the 2 hour separation for ESS listed to UL 9540, but as lead-acid and nickel-cadmium batteries are not typically listed, a separate carve out for them when used in traditional standby applications is justified.

Submitter Information Verification

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Submittal Date: Mon May 15 21:35:57 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-133-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed lead-acid and Ni-Cd batteries which do not warrant higher rated fire walls..

Public Input No. 249-NFPA 855-2023 [Section No. 9.6.4.1]

9.6.4.1 *

Rooms or spaces, containing only ESS listed to UL 9540 ~~and~~ , or an AHJ approved equivalent process, 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.

A.9.6.4.1

Because purpose build structures are usually build on site, UL 9540 manufacturing certification may not be feasible. In this conditions a Limited Production Certification (LPC) may be appropriate. In certain case an AHJ may approve a ESS Field Evaluation if equivalence can be shown.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: American Fire Technologies
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 21:10:46 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: No other approval method exists and the proposed text is an unnecessary burden on the AHJ.

Public Input No. 178-NFPA 855-2023 [New Section after 9.6.4.2]

TITLE OF NEW CONTENT

Lead-acid and nickel-cadmium battery systems less than 50 V ac, 60 V dc in telecommunications facilities for installations of communications equipment under the exclusive control of communications utilities and located outdoors or in building spaces used exclusively for such installations that comply with NFPA 76 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.

Statement of Problem and Substantiation for Public Input

Telecommunications installations routinely have battery rooms adjacent to equipment rooms that they serve that are not constructed for 2-hour fire ratings. Where these spaces are compliant with NFPA-76 they have higher degree of fire safety requiring NEBS level A material that are more fire resistant than UL standards. Utilities have full exemption from the fire barrier requirement but a 1-hour fire barrier requirement would be appropriate for adjacent equipment rooms. NFPA allows UL 1973 listings for lead acid batteries in lieu of UL 9540 so another option would be requirement for UL 1973 Listing and NFPA 76 compliance.

Submitter Information Verification

Submitter Full Name: Randy Schubert
Organization: Ericsson
Affiliation: ATIS
Street Address:
City:
State:
Zip:
Submittal Date: Fri May 26 11:19:08 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-133-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed lead-acid and Ni-Cd batteries which do not warrant higher rated fire walls..

Public Input No. 170-NFPA 855-2023 [Section No. 9.6.4.2]

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~~ batteries listed to UL1973, in systems 600vdc or less shall only require a 1 -hour fire resistance separation from the rest of the building.

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

Submitter Full Name: Gary Balash
Organization: East Penn Manufacturing Compan
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 24 14:46:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-133-NFPA 855-2023

Statement: The revision correlates with improved fire safety of a UL 1973 listed lead-acid and Ni-Cd batteries which do not warrant higher rated fire walls..

Public Input No. 183-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

Compliance Required	Battery Technology							Reference
	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	EDLC Energy Storage	Other Electrochemical ESS and Battery Technologies*	
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.

Additional Proposed Changes

File Name	Description	Approved
9.6.4.pdf	Changes to Table 9.6.4	

Statement of Problem and Substantiation for Public Input

This proposal is intended to modify table 9.6.4 and based on the use of Terraview, the attached document is the recommended changes, add new battery technology as well as change the X and Y access for ease of use and consistency in the document.

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized in table 9.6.4 in a new battery technology besides “Other Electrochemical ESS and Battery Technologies*.” The task group heard 7 presentations from various manufacturers and evaluated the submitted information through the open task group process.

The battery technology added include Zinc Bromide and Zinc Manganese Dioxide batteries which through submitted presentations indicated that compliance would be required in all categories..

The battery technologies line items are further recommended to be modified to include specific line items for Lithium Metal, and Nickel-Hydrogen batteries with additions to meet the requirements of thermal runaway and explosion control.

Change of X and Y access is also recommended to aid in ease of use of the table. The change does not indicate any change to existing requirements

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 182-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 182-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Michael O`Brian
Organization:	Code Savvy Consultants
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 30 04:32:05 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-146-NFPA 855-2023

Statement: The change in the x and y axes adds usability to the table. The revision recognizes other ESS types of iron air, hybrid supercapacitors, zinc manganese dioxide (Zn-MnO2), lithium metal, zinc-bromide and nickel-hydrogen.

DRAFT Changes to Table 9.6.5 in switching X and Y access

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

	Compliance Required					
Battery Technology	**Exhaust Ventilation**	**Spill Control**	**Neutralization**	**Safety Caps**	**Thermal Runaway**	**Explosion Control**
Reference	9.6.5.1	9.6.5.2	9.6.5.3	9.6.5.4	9.6.5.5	9.6.5.6
Lead-Acid	Yes	Yes †	Yes †	Yes	Yes	Yes
Zinc manganese dioxide (Zn-MnO2)	Yes	Yes †	Yes †	Yes	Yes	Yes
Zinc Bromide	Yes	Yes †	Yes †	Yes	Yes	Yes
Ni-Cd, Ni-MH, Ni-Zn	Yes	Yes †	Yes †	Yes	Yes	Yes
Nickel-Hydrogen	No	No	No	No	Yes	Yes
Lithium-Ion	No	No	No	No	Yes	Yes
Lithium Metal	No	No	No	No	Yes	Yes
Flow	Yes	Yes	Yes	No	No	No
Sodium Nickel Chloride	No	No	No	No	Yes	Yes
EDLC Energy Storage	Yes	Yes	Yes	Yes	Yes	Yes
Other Electrochemical ESS and Battery Technologies*	Yes	Yes	Yes	Yes	Yes	Yes

*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.

Public Input No. 267-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

	Battery Technology				-	-			
Compliance Required	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	Hybrid Supercapacitor	EDLC Energy Storage		Elect E I Tec
Exhaust ventilation	Yes	Yes	No	Yes	No	No	Yes	Yes 9.6.5.1	
Spill control	Yes †	Yes †	No	Yes	No	No	Yes	Yes 9.6.5.2	
Neutralization	Yes†	Yes†	No	Yes	No	No	Yes	Yes 9.6.5.3	
Safety caps	Yes	Yes	No	No	No	No	Yes	Yes 9.6.5.4	
Thermal runaway	Yes	Yes	Yes	No	Yes	No	Yes	Yes 9.6.5.5	
Explosion control	Yes	Yes	Yes	No	Yes	No	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.

Statement of Problem and Substantiation for Public Input

See PI 265

Hybrid Supercapacitors are electrostatic — posing no risk of thermal runaway as no chemical reaction/conversion takes place in this breakthrough energy storage technology.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 265-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 266-NFPA 855-2023 [Section No. 9.4.1 [Excluding any Sub-Sections]]	
Public Input No. 265-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Robert Davidson
Organization: Davidson Code Concepts, Llc
Street Address:
City:
State:
Zip:
Submittal Date: Wed May 31 23:55:02 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-146-NFPA 855-2023

Statement: The change in the x and y axes adds usability to the table. The revision recognizes other ESS types of iron air, hybrid supercapacitors, zinc manganese dioxide (Zn-MnO2), lithium metal, zinc-bromide and nickel-hydrogen.

Public Input No. 292-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

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

*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.

Additional Proposed Changes

File Name	Description	Approved
Table_9.6.5_-_NFPA_855_Public_Input_for_Iron-Air_Updates.pdf	Table 9.6.5 - Form Energy's Proposed Updates	

Statement of Problem and Substantiation for Public Input

Form Energy is proposing that iron-air technology be added as a separate column to Table 9.6.5 because it has safety benefits that are not currently reflected by the requirements for “other battery technologies”.

Iron-air chemistry requires an aqueous caustic electrolyte therefore spill control and neutralization shall be required. The aqueous electrolyte in iron-air chemistry results in hydrogen generation as a parasitic side-reaction therefore exhaust ventilation, explosion control, and safety caps shall be required.

Thermal runaway protection for managing charging and discharging within safe operating parameters shall not be required for iron-air batteries. Operating conditions outside of normal ranges (overcharge, overdischarge, high current charge/discharge) do not result in thermal runaway for iron-air chemistry. Form Energy has test data available to present to the committee to support this claim.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 229-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	Addition of iron-air to tables 1.3 and 9.6.5.

Submitter Information Verification

Submitter Full Name: Alli Nansel
Organization: Form Energy
Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 10:19:13 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-146-NFPA 855-2023

Statement: The change in the x and y axes adds usability to the table. The revision recognizes other ESS types of iron air, hybrid supercapacitors, zinc manganese dioxide (Zn-MnO2), lithium metal, zinc-bromide and nickel-hydrogen.

NFPA 855: Public Input Submittal for Iron-Air Updates

The following document outlines Form Energy's submission for the NFPA 855 Public Input Period. Changes to the current edition are outlined in red.

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

Compliance Requirement	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	Iron-Air	EDLC Energy Storage	Other Battery Tech	Reference
Exhaust Ventilation	Yes	Yes	No	Yes	No	Yes	Yes	Yes	9.6.5.1
Spill Control	Yes[1]	Yes[1]	No	Yes	No	Yes	Yes	Yes	9.6.5.2
Neutralization	Yes[1]	Yes[1]	No	Yes	No	Yes	Yes	Yes	9.6.5.3
Safety Caps	Yes	Yes	No	No	No	Yes	Yes	Yes	9.6.5.4
Thermal Runaway	Yes	Yes	Yes	No	Yes	No	Yes	Yes	9.6.5.5
Explosion Control	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	9.6.5.6

Rationale: *Form Energy is proposing that iron-air technology be added as a separate column to Table 9.6.5 because it has safety benefits that are not currently reflected by the requirements for "other battery technologies".*

Iron-air chemistry requires an aqueous caustic electrolyte therefore spill control and neutralization shall be required. The aqueous electrolyte in iron-air chemistry results in hydrogen generation as a parasitic side-reaction therefore exhaust ventilation, explosion control, and safety caps shall be required.

Thermal runaway protection for managing charging and discharging within safe operating parameters shall not be required for iron-air batteries. Operating conditions outside of normal ranges (overcharge, overdischarge, high current charge/discharge) do not result in thermal runaway for iron-air chemistry. Form Energy has test data available to present to the committee to support this claim.

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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

Table 9.6.5 Electrochemical ESS Technology-Specific Requirements

	Battery Technology				-	-		
Compliance Required	Lead-Acid	Ni-Cd, Ni-MH, Ni-Zn	Lithium-Ion	Flow	Sodium Nickel Chloride	EDLC Energy Storage	Other Electrochemical ESS and Battery Technologies*	Refe
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
Toxic and Highly Toxic emmission	Yes†	Yes	Yes	Yes	Yes	No	Yes	9.6.7

*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.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics Task Group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics Task Group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics Task Group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics Task Group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics Task Group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics Task Group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics Task Group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics Task Group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics Task Group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics Task Group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics Task Group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics Task Group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]

Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: The Hiller Companies/American
Affiliation: none
Street Address:
City:
State:
Zip:
Submittal Date: Sat Apr 22 14:26:27 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The Technical Committee reaffirms the acceptance of TIA 23-1.

Public Input No. 336-NFPA 855-2023 [Section No. 9.6.5.1.2]

~~**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 .~~

Statement of Problem and Substantiation for Public Input

Section 9.6.5.1 is Exhaust Ventilation During Normal Operation. This section on Abnormal Conditions should be removed or better yet combined with 9.6.5.6.1 under explosion control.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 337-NFPA 855-2023 [Section No. 9.6.5.6.1 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Richard Kluge
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Affiliation:	ATIS
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City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 13:20:22 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This section is used to point to the section for abnormal conditions to make sure that exhaust ventilation is not used for abnormal conditions. Due to confusion in the industry this section needs to stay for clarity.

Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]

9.6.5.1.2 Abnormal Conditions.

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

9.6.5.1.2.2 Protection against toxic or Highly toxic emissions during abnormal charging or thermal runaway conditions shall be in accordance with 9.6.7

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group

Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics Task Group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics Task Group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics Task Group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes

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Affiliation: none

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Submittal Date: Sat Apr 22 13:06:04 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: CI-155-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. This addition helps direct the user to the new toxic chapter. The technical committee is seeking public comment on this for the Second Draft,

Public Input No. 328-NFPA 855-2023 [Section No. 9.6.5.1.3]

9.6.5.1.3 Indoor ESS Cabinets.

Exhaust ventilation for ESS cabinets installed indoors shall ~~evaluate air movement through the~~ be provided for both the cabinet and ~~exhaust from~~ for the room.

Statement of Problem and Substantiation for Public Input

This wording is a slight improvement over the current sentence which essentially states "exhaust ventilation shall evaluate".

Submitter Information Verification

Submitter Full Name: Richard Kluge

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Affiliation: ATIS

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Submittal Date: Thu Jun 01 12:35:50 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-156-NFPA 855-2023

Statement: This clarifies the purpose of the evaluation of ventilation. Wording is an improvement over the current sentence which essentially states "exhaust ventilation shall evaluate".

Public Input No. 94-NFPA 855-2023 [Section No. 9.6.5.1.4]

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~~ conditions, including simultaneous “boost” charging of all the batteries, in accordance with nationally recognized standards.

Statement of Problem and Substantiation for Public Input

Flow batteries, and potentially other technologies may produce hydrogen during conditions other than charging. This change is intended to make these requirements broader in scope.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

Submitter Full Name: Steve Edley

Organization: NFPA 855 Task Group 20

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City:

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Submittal Date: Mon May 08 19:12:04 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-157-NFPA 855-2023

Statement: Flow batteries, and potentially other technologies may produce hydrogen during conditions other than charging. This revision makes these requirements broader in scope. This requirement is specific to outdoor cabinets and has been noted as such.

Public Input No. 95-NFPA 855-2023 [Section No. 9.6.5.1.5 [Excluding any Sub-Sections]]

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~~ conditions, including 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 $ft^3/min/ft^2$ (5.1 $L/sec/m^2$) of floor area of the room, walk-in unit, enclosure, container, or cabinet

Statement of Problem and Substantiation for Public Input

Flow batteries, and potentially other technologies may produce hydrogen during conditions other than charging. This change is intended to make these requirements broader in scope.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

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Street Address:
City:
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Submittal Date: Mon May 08 19:15:22 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-158-NFPA 855-2023
Statement: Flow batteries, and potentially other technologies may produce hydrogen during conditions other than charging. This change makes these requirements broader in scope.

Public Input No. 332-NFPA 855-2023 [Section No. 9.6.5.1.5.1]

9.6.5.1.5.1 – 3

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

Statement of Problem and Substantiation for Public Input

No technical change, but consider moving this requirement directly before 9.6.5.1.4 as 9.6.5.1.4 addresses how to accommodate one of the options, while 9.6.5.1.2 and 9.6.5.1.3 are more generally applicable to mechanical exhaust.

Submitter Information Verification

Submitter Full Name:	Richard Kluge
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Submittal Date:	Thu Jun 01 13:00:53 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-159-NFPA 855-2023

Statement: This requirement is moved directly before 9.6.5.1.4 as 9.6.5.1.4 addresses how to accommodate one of the options, while 9.6.5.1.2 and 9.6.5.1.3 are more generally applicable to mechanical exhaust.

Public Input No. 333-NFPA 855-2023 [Section No. 9.6.5.1.5.4]

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~~ whenever 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~~

(3) gas

~~detected is less than 25 percent of the LFL of the flammable gas mixture.~~

(4) ~~The gas~~ detection system shall be provided with a minimum of 2 hours of standby power.

(5) 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.

Statement of Problem and Substantiation for Public Input

Suggested simplification. The exhaust runs whenever the 25% of LFL is exceeded.

Submitter Information Verification

Submitter Full Name: Richard Kluge

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Submittal Date: Thu Jun 01 13:04:38 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: CI-160-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

The exhaust runs whenever the 25% of LFL is exceeded. Also revised the backup requirements per the new power Section 4.10 on Emergency power standby systems.

Public Input No. 96-NFPA 855-2023 [Section No. 9.6.5.2]

9.6.5.2* Spill Control.

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.

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.

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.

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.

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.

9.6.5.2.6

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

Statement of Problem and Substantiation for Public Input

Added the asterisk to support the addition of an annex note on spill control

This Public Input was submitted by the Flow Battery Task Group TG20.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 97-NFPA 855-2023 [New Section after A.9.6.5.1.5.4]	

Submitter Information Verification

Submitter Full Name: Steve Edley
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City:
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Submittal Date: Mon May 08 19:17:55 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-74-NFPA 855-2023

Statement: UL 9540 has provisions for secondary containment to be supplied at installation as long as this is included in the instruction manual. Section 9.6.5.2 currently implies that additional containment may be necessary even if it is supplied with the product under the scope of its listing. This change clarifies when additional containment should be provided.

Public Input No. 177-NFPA 855-2023 [Section No. 9.6.5.2.1]

9.6.5.2.1

~~Rooms, buildings, or~~ Rooms 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.

Statement of Problem and Substantiation for Public Input

Spill control is required to prevent electrolyte from flowing into adjoining rooms or areas within a building from a battery area in the event of a breach of a single vessel with capacity greater than 55 gallons or multiple vessels with aggregate capacity of 1000 gallons. The spill control must be installed for the battery area or battery room. In a larger facility with battery rooms or areas on different floors or separated from each other the spill control still must be in place for each area not an overall building. Even in the event of a dedicated battery building there are still likely common areas or utility areas separate from the batteries and the electrolyte needs to be contained in the battery area.

Submitter Information Verification

Submitter Full Name: Randy Schubert

Organization: Ericsson

Affiliation: ATIS

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Submittal Date: Fri May 26 11:04:12 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-75-NFPA 855-2023

Statement: It is best to contain only the area with the batteries so that spills do not spread into non-battery areas. This change clarifies that generally you would not put containment for the entire building

Public Input No. 293-NFPA 855-2023 [Section No. 9.6.5.4]

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._ **Flame-arresting safety caps shall not be required if flame-arresting is achieved through other design mechanisms. Alternative flame-arresting methods to safety caps shall be reviewed and approved by a third-party FPE.**

Statement of Problem and Substantiation for Public Input

As the code is currently written, safety caps are the only allowable mechanism for flame arresting.

Form Energy proposes that the code is updated to allow for flame-arresting to be achieved through methods other than safety caps. The intent of this proposal is to allow for freedom of innovation while still achieving the same level of product safety.

Submitter Information Verification

Submitter Full Name: Alli Nansel
Organization: Form Energy
Street Address:
City:
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Zip:
Submittal Date: Thu Jun 01 10:25:01 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-77-NFPA 855-2023
Statement: Other methods beside flame-arresting caps may become available.

Public Input No. 250-NFPA 855-2023 [Section No. 9.6.5.5.2]

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.~~ , UL 9540 listing or AHJ approved equivalent certification process..

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

Submitter Information Verification

Submitter Full Name: Paul Hayes
Organization: American Fire Technologies
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City:
State:
Zip:
Submittal Date: Wed May 31 21:19:19 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The submitter did not provide any data to support adding an equivalent standard and what that standard may be. Additionally, this would put the responsibility on AHJ who is not a certifying agency.

Public Input No. 144-NFPA 855-2023 [Section No. 9.6.5.6]

9.6.5.6* Explosion Control.

9.6.5.6.1

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

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.

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 uninterruptable 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

9.6.5.6.2

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

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

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.

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.

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.

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

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.

9.6.5.6.9

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

Additional Proposed Changes

File Name	Description	Approved
855_Log1585_20_2.pdf	855_Log1585_20_2	

Statement of Problem and Substantiation for Public Input

NOTE: This public input originates from Tentative Interim Amendment No. 20-2 (Log 1585) issued by the Standards Council on August 26, 2021 and per the NFPA Regs., needs to be reconsidered by the Technical Committee for the next edition of the Document.

Substantiation: NFPA 855 Chapter 4.12 listed only rooms building and walk in units under the requirements for explosion control. At the time of the first addition of NFPA 855 it was not evident that the changes in the industry to smaller containers would require the term “cabinets” be included for this chapter and be explicitly stated. The exclusion of “cabinets” in chapter 4.12 has had unintended consequences. It has led to the perception of some in the industry that ESS cabinets do not require explosion control. Some in the industry have assumed that since ESS cabinets were not include in the description they most be exclude. Use of this “loophole” can lead to what the TC would consider an unsafe installation. This TIA is submitted so that minimum levels of safety are required for all installations and to eliminate the unstated exception. In order to correct this exclusion, we are recommending “cabinets” be explicitly stated in chapter 4.12. It was also determined that language should be added to address pressure waves, shrapnel, and container pieces. Additional guidance is added to the annex for clarification.

Emergency Nature: The proposed TIA intends to correct a previously unknown existing hazard.

During the development of NFPA 855 the potential for a deflagration, nor the severity of the event, involving the gases created by a thermal runaway occurrence within an Energy Storage System Cabinet was not recognized. The potential size of ESS cabinets as they exist today was not envisioned either. Based on thermal runaway events and the results of large-scale fire burn testing the potential for a deflagration and the severe dangers presented to workers and emergency responders is clearly recognized. Though the deflagration hazard is now widely known, there are manufacturers and installers that assert that deflagration protection is not required for cabinets because NFPA 855 and fire codes do not specifically call for the hazard to be addressed. This TIA is intended to address this issue by adding a requirement that the potential deflagration hazard associated with ESS cabinets be analyzed and mitigated for ESS installations regulated by NFPA 855.

Submitter Information Verification

Submitter Full Name:	TC ON ESS-AAA
Organization:	NFPA TC ON ENERGY STORAGE SYSTEMS
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 23 11:26:20 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Tentative Interim Amendment

NFPA® 855

Standard for the Installation of Stationary Energy Storage Systems

2020 Edition

Reference: Section 4.12, A.4.12 and A.4.12.1
TIA 20-2
(SC 21-8-37 / TIA Log #1585)

Pursuant to Section 5 of the NFPA *Regulations Governing the Development of NFPA Standards*, the National Fire Protection Association has issued the following Tentative Interim Amendment to NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*, 2020 edition. The TIA was processed by the Technical Committee on Energy Storage Systems, and was issued by the Standards Council on August 26, 2021, with an effective date of September 15, 2021.

1. *Revise Section 4.12 to read as follows:*

4.12* Explosion Control. Where required elsewhere in this standard, explosion prevention or deflagration venting shall be provided in accordance with this section.

4.12.1* ESS installed within a room, building, ESS cabinet, or ESS walk-in unit 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.

4.12~~.2~~.1.1 Explosion prevention and deflagration venting shall not be required where approved by the AHJ based on large-scale ~~fire~~ testing in accordance with 4.1.5 and a deflagration hazard study that demonstrates that flammable gas concentrations in the room, building, ESS cabinet, or ESS walk-in unit cannot exceed 25 percent of the LFL~~ in locations where the gas is likely to accumulate~~.

4.12.1.2 Where approved, ESS cabinets that have been designed to ensure no hazardous pressure waves, debris, shrapnel, or enclosure pieces are ejected, as validated by installation level large-scale testing and engineering evaluation complying with 4.1.5 that includes the cabinet, shall be permitted in lieu of providing explosion control complying with NFPA 68 or NFPA 69.

2. *Revise Annexes A.4.12 and A.4.12.1 to read as follows:*

A.4.12 During failure conditions such as thermal runaway, fire, and abnormal faults, some ESS, in particular electrochemical batteries and capacitors, begin off-gassing flammable and toxic gases, which can include mixtures of CO, H_2, ethylene, methane, benzene, HF, HCl, and HCN. Among other things, these gases present an explosion hazard that needs to be mitigated. Explosion control is provided to mitigate this hazard.

Both the exhaust ventilation requirements of Section 4.9 and the explosion control requirements of Section 4.12 are designed to mitigate hazards associated with the release of flammable gases in battery rooms, ESS cabinets, and ESS walk-in units. The difference is that exhaust ventilation is intended to provide protection for flammable gases released during normal charging and discharging of battery systems since some electrochemical ESS technologies such as vented lead-acid batteries release hydrogen when charging.

In comparison, the Section 4.12 provisions are designed to provide protection for electrochemical ESS during an abnormal condition, such as thermal runaway, which can be instigated by physical damage, overcharging, short circuiting, and overheating of technologies such as lithium-ion batteries, which ~~incidentally~~ do not release detectable amounts of flammable gas during normal charging and discharging, but which can release significant quantities of flammable gas during a thermal event.

A.4.12.1 ~~This requirement targets rooms, buildings, and walk-in units, not ESS in cabinets installed indoors or outdoors or in open parking garages.~~ This requirement recognizes that some cabinet designs with low internal volume, the application of NFPA 68 or NFPA 69 might not be practical. It is possible that a quantitative explosion analysis is necessary to show there is no threat to life and safety. As an example, the cabinet design might be installed such that any overpressure due to ignition of gases and vapors released from cells in thermal runaway within the enclosure are released to the exterior of the enclosure. There should be no uncontrolled release of overpressure of the enclosure. All debris, shrapnel, or pieces of the enclosure ejected from the system should be controlled. The UL 9540A unit level and installation level test identified in 4.1.5 will provide the test data referenced in this section, which is necessary for verification of the adequacy of the engineered deflagration safety of the cabinet.

NFPA 68 applies to the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure so that structural and mechanical damage is minimized, and provides criteria for design, installation, and maintenance of deflagration vents and associated components. NFPA 68 does not apply to detonations. Hydrogen accumulation in a confined space can lead to a detonation. For that reason, the combustion gases generated during the cell, module and installation level testing under UL 9540A must be utilized in applying a NFPA 68 solution. Where the likelihood for detonation exists, alternative solutions, such as those in NFPA 69.

NFPA 69 applies to the design, installation, operation, maintenance, and testing of systems for the prevention of explosions in enclosures that contain flammable concentrations of flammable gases, vapors, mists, dusts, or hybrid mixtures by means of the following methods:

(1) Control of oxidant concentration
(2) Control of combustible concentration
(3) Pre-deflagration detection and control of ignition sources
(4) Explosion suppression
(5) Active isolation
(6) Passive isolation
(7) Deflagration pressure contaminent
(8) Passive explosion suppression

Due to possible accumulation of flammable gases during abnormal conditions for lithium-ion batteries, combustible gas concentration reduction can be a viable mitigation strategy. Gas detection and appropriate interlocks can be used based on appropriate evaluation under a NFPA 69 deflagration hazard study. NFPA 69 allows concentration to exceed 25 percent LFL, but not more than 60 percent with reliable gas detection and exhaust interlocks as demonstrated by a safety integrity level (SIL 2) instrumented safety system rating.

Data on flammable gas composition and release rates, such as that included in UL 9540A large-scale fire testing, provide the information needed to design effective explosion control systems.

Issue Date: August 26, 2021

Effective Date: September 15, 2021

(Note: For further information on NFPA Codes and Standards, please see www.nfpa.org/docinfo)

Public Input No. 253-NFPA 855-2023 [Section No. 9.6.5.6]

9.6.5.6* Explosion Control.

9.6.5.6.1

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

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~~ accumulate exceeding 25 percent of the ~~LFL.~~ LFL in any area of a cabinet or area of a room the ESS is located within has been submitted to the AHJ for review and approval..

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~~ installations that follow the guidelines of IEEE 1635/ASHRAE 21

(3) Lead-acid battery systems in uninterruptable 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~~
~~Batteries listed in accordance with UL 1973~~

(5) units that follow the guidelines of IEEE 1635/ASHRAE 21

(6) Batteries that do not go into thermal runaway or produce flammable gas in the UL 9540A cell level test or equivalent test

9.6.5.6.2

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

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

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.

9.6.5.6.5

ESS ~~enclosures~~ walk-in units and ESS 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.

9.6.5.6.6*

Where ESS ~~batteries~~ walk-in units or ESS cabinets are installed ~~in~~ within a container outdoors ~~, other than a walk-in unit,~~ or within a room or building space the installation shall comply with ~~one~~ both of the following:

(1) The ~~container~~ ESS walk-in unit or ESS cabinet 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~~ The Room or container they are installed within shall be provided with explosion control complying with 9.6.5.6. ~~1~~ 3 . ~~1.~~

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~~ system shall be installed in accordance with NFPA 72 .

(4) For lithium-ion batteries, the combustible gas ~~detection~~ reduction system shall be provided with ~~a minimum of 24 hours of standby power and 2 hours in alarm or as required~~ emergency power for the duration of time a potential deflagration hazard would exist should an uncontrolled thermal runaway event occur as documented 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:~~

 (6) ~~A trouble signal upon failure of the gas detection system~~

 (7) ~~An alarm signal if flammable gas concentration exceeds 10 percent of the LFL~~

annunciation means shall be located as required by the authority having jurisdiction to facilitate an efficient response to the situation and alarm signals shall be transmitted to a supervising station in accordance with NFPA 72:

9.6.5.6.8

Compartmentalization created by cold and hot aisle arrangements within the ESS ~~enclosure~~ walk-in unit or ESS cabinet 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.

9.6.5.6.9

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

Statement of Problem and Substantiation for Public Input

The proposed change clarifies the exempt report requirements, adds standards as a condition of Section 9.6.5.6.1.2 exemptions #2 and #3; Eliminates the reference to UL 1973 as a qualifier since the it does not prevent the hazard; clarifies the application to ESS walk-in units and ESS cabinets; eliminates a conflict with NFPA 72 regarding back up power supply for gas detection systems; addresses the duration time for emergency power for concentration reduction systems.

Submitter Information Verification

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Submittal Date:	Wed May 31 21:37:32 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause

confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 262-NFPA 855-2023 [New Section after 9.6.5.6.1]

9.6.5.6.1.3

Explosion prevention or deflagration venting analysis and design shall be bases upon the gas composition and volume identified by fire and explosion testing conducted in accordance with 9.1.5.

Statement of Problem and Substantiation for Public Input

The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

Submitter Information Verification

Submitter Full Name: Robert Davidson

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Submittal Date: Wed May 31 23:12:01 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 337-NFPA 855-2023 [Section No. 9.6.5.6.1 [Excluding any Sub-Sections]]

Where required elsewhere in this standard, explosion prevention or deflagration venting shall be provided in accordance with this section to safeguard against the release of flammable gases during abnormal charging or thermal runaway conditions .

Statement of Problem and Substantiation for Public Input

Adds text I suggested to relocate from section 9.6.5.1.2 addressing abnormal conditions.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 336-NFPA 855-2023 [Section No. 9.6.5.1.2]	Relocated text

Submitter Information Verification

Submitter Full Name: Richard Kluge

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Submittal Date: Thu Jun 01 13:24:24 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]

9.6.5.6.1.1

Explosion ~~prevention and deflagration venting shall~~ prevention 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~~ has been submitted to the AHJ for review and approval that demonstrates that flammable gas concentrations cannot ~~exceed~~ accumulate exceeding an average of 25 percent of the LFL.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Task Group recommendation - Clean up requirement for explosion control with out reference to options, and noting "accumulation" of gas as more accurate term than "exceeding" with the clarification added that the limit is on average for the defined space.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date:	Thu Apr 27 13:48:10 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 171-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

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 ~~uninterruptable~~ 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~~ UL1973 used in system 600Vdc or less.

(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

Statement of Problem and Substantiation for Public Input

Lead-acid batteries and nickel-cadmium batteries tested and listed to UL1973 have shown they are safe technologies, which show they do not go into thermal runaway, and do not catch fire. These technologies have electrolyte that is aqueous that will not burn and will hinder any ignition. The plastic material used for the cover and container per UL1973 are self-extinguishing plastics rated per UL94, V2 or higher, in most cases rated the highest at V0. This has been proven as well per UL1973 environmental test, section 41 External Fire Exposure for Projectile Hazards Test.

Submitter Information Verification

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Submittal Date: Wed May 24 15:18:39 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to

any BESS configuration.

Public Input No. 189-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

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 uninterruptable 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~~ UL 1973 Appendix H cell/monobloc

(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

Statement of Problem and Substantiation for Public Input

There are two levels of testing for lead-acid and Ni-Cad batteries in UL 1973, cell/monobloc and system (per Table H.1 of UL 1973 Appendix H). This would clarify which level of listing and testing would be required and would eliminate any confusion as to the requirements.

Submitter Information Verification

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Submittal Date: Tue May 30 09:47:38 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

9.6.5.6.1.2

Explosion control following this standard 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~~ installations that comply with the National Electric Safety Code or follow the guidelines of IEEE 1635/ASHRAE 21.

(3) Lead-acid battery systems in uninterruptable 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~~ in units that follow the guidelines of IEEE 1635/ASHRAE 21.

(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.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task Group Recommendations - Adding clarifying condition that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. Makes the conditions of exception more stringent.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group

Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 64-NFPA 855-2023 [Section No. G.8]
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes
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Submittal Date: Thu Apr 27 14:42:13 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and

inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 338-NFPA 855-2023 [Section No. 9.6.5.6.2]

~~**9.6.5.6.2**~~ –

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

Statement of Problem and Substantiation for Public Input

The statement is not needed. Section 9.6.5.1 is already very clear on this issue.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 13:33:05 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The section provides clarification between normal and abnormal operations and is retained.

Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]

9.6.5.6.3*

~~ESS installed within a room, building, ESS cabinet, ESS walk-in unit, or otherwise nonoccupiable enclosure~~ All ESS shall be provided ~~with one of the following:~~ with Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with NFPA 69

- ~~Deflagration venting installed and maintained in accordance with NFPA 68~~

~~.~~

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Task Group - Recommendations - Remove multiple area designations as they just cauased confusion especially as technologies change. Simplify requirement to all ESS. Additional remove the option for NFPA 68 compliance as for large scale gas deflagrations, they have not show to be effective at mitigating the pressure release.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name: Paul Hayes
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Submittal Date: Thu Apr 27 15:13:10 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and

clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]

9.6.5.6.4*

Where approved, ESS ~~cabinets~~ shall be 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 performed by a Registered Design Professional 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~~ with NFPA 69 .

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion control Task Group Recommendations - Providing the defined term of Registered Designed professional. Also removed NFPA 68 as an option.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 64-NFPA 855-2023 [Section No. G.8]

Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]

Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]

Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]

Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]

Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]

Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Thu Apr 27 15:42:34 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 339-NFPA 855-2023 [Sections 9.6.5.6.4, 9.6.5.6.5]

Sections 9.6.5.6.4, 9.6.5.6.5

9.6.5.6.4 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.

9.6.5.6.5 *

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.

~~**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.~~

Statement of Problem and Substantiation for Public Input

No technical change, but it seems like these requirements should be reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 68 and 69.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 13:35:13 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific

explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]

9.6.5.6.5*

~~ESS enclosures and cabinets~~ Independent ESS cabinets installed in larger BESS configuration such rooms, buildings, or containers 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.~~ cabinets and the space they are installed within.

A.9.5.6.5 This condition effectively creates a "box in a box". A deflagration inside the smaller box can adversely impact the larger box and must be evaluated independently.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion control Task group recommendations - The requirements of the section where not clear on the concept of a explosion of a "Box in a box". edited to clarify and explain this concept.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date:	Thu Apr 27 15:50:23 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 341-NFPA 855-2023 [Section No. 9.6.5.6.6]

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~~ The AHJ has approved fire and explosion test results of the c ombination of the container and cabinets ~~shall be tested together to show compliance with~~ in accordance with 9. 6 1 .5 ~~.6.1.1.~~ and a deflagration hazard study demonstrating that flammable gas concentrations cannot exceed 25 percent of the LFL .

Statement of Problem and Substantiation for Public Input

Restating the expected level of performance might be clearer than referring back to an exception and requesting compliance to it.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 13:44:30 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This section has been deleted because of change in prior sections.

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

~~**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 .~~

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion control Task Group recommendations - With edits in prior sections, this section is no longer needed. Explosion requirements for a box in a box have been updated.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date:	Thu Apr 27 16:11:36 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and

clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]

Reliable Power Requirements

Currently 855 nor NFPA 69 provide definitions or expectations of what can and should be considered to be reliable power to support the functions of the safety systems in a failure situation - Recommend the technical committee or Task Group provide better guidance to industry on expectations of back and reliable power.

Statement of Problem and Substantiation for Public Input

Reliable Power Requirements
Currently 855 nor NFPA 69 provide definitions or expectations of what can and should be considered to be reliable power to support the functions of the safety systems in a failure situation - Recommend the technical committee or Task Group provide better guidance to industry on expectations of back and reliable power. No recommended verbiage provided at this time.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date: Fri Apr 28 09:54:15 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: This is covered in the new Section 4.10.

Public Input No. 104-NFPA 855-2023 [Section No. 9.6.5.6.7]

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 or as required by the HMA .

(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:

  (6) A trouble signal upon failure of the gas detection system

  (7) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

Statement of Problem and Substantiation for Public Input

If a system has both NFPA 68 and NFPA 69 the failure of the fan system should be covered by NFPA 68 so backup power is not required. Additionally adding verbiage for HMA validation allows this time to increase or decrease the requirements based on test results. Some of these sites can be astronomically huge and it is not feasible to connect every fan of every enclosure to a backup generator power providing a RUN time of 2 hrs. It should be sized based on a competent FPE/Risk analysis to consider the maximum number of systems in alarm.

Submitter Information Verification

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Submittal Date: Tue May 09 15:56:15 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to

any BESS configuration.

Public Input No. 129-NFPA 855-2023 [Section No. 9.6.5.6.7]

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 and combustible gas concentration reduction system shall be provided with a minimum of 24 hours of standby power while in a non-alarm condition and 2 hours of standby power in an alarm ~~or~~ condition 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:

   (6) A trouble signal upon failure of the gas detection system

   (7) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

Statement of Problem and Substantiation for Public Input

The proposed changes are intended to clarify the intent of the section.

Submitter Information Verification

Submitter Full Name: Kevin Fok
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Submittal Date: Thu May 18 07:22:10 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to

any BESS configuration.

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

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~~ system shall be installed in accordance with NFPA 72 .

(4) For lithium-ion batteries, the gas detection system and combustible gas concentration reduction systems shall be provided with a minimum of 24 hours of standby power while in a non-alarm condition and 2 hours of power in alarm condition or as required by the HMA.

(5) The gas detection system and combustible gas concentration reduction system status shall annunciate the following at an approved central, proprietary, or remote station as required by the AHJ to provide situational information to the first responder in accordance with *NFPA 72*, or at an approved constantly attended location:

  (6) A trouble signal upon failure of the gas detection system or the combustible Gas concentration reduction system.

  (7) An alarm signal if flammable gas concentration exceeds 10 percent of the LFL

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion control Task Group Recommendations - additional clarity added for standby power and locations that a failed condition must be annunciated for First responder protection.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group

Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 64-NFPA 855-2023 [Section No. G.8]
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name: Paul Hayes
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Affiliation: none
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Submittal Date: Thu Apr 27 16:23:19 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion

requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

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.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Task Group Recommendation - As the group has recommended removing NFPA 68 as an option, it is being deleted from this section.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Paul Hayes
Organization:	The Hiller Companies/American
Affiliation:	none
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State:	
Zip:	
Submittal Date:	Thu Apr 27 17:03:03 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to

any BESS configuration.

Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

9.6.5.6.9

The protection design shall demonstrate that ~~deflagrations are~~ deflagration are not propagated to interconnected or adjacent ~~cabinets, enclosures, or rooms~~ BESS .

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Task Group Recommendations - simplify from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group

Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	

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Submittal Date: Thu Apr 27 16:15:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-

cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7* Abnormal Toxic and highly toxic emission detection

Where required elsewhere in this standard , detection and protection shall be provided for toxic and highly toxic emission during abnormal charging or thermal runaway in accordance with this section.

A.9.6.7

During failure conditions such as thermal runaway, fire, and abnormal faults, some ESS, in particular electrochemical batteries and capacitors, begin producing toxic and highly toxic emissions, which can include mixtures of CO, H_2 , ethylene, methane, benzene, HF, HCl, sulfur dioxide, NO, NO_2 , ammonia, hydrogen sulfide, arsine, stibine, formaldehyde, metal oxides, heavy metals, ~~and~~ HCN, etc. Among other things, these emissions can present a health hazard that needs to be addressed. Toxic emissions almost always necessitate the use of SCBA (and possibly additional PPE) for anyone getting near a battery fire. At a bare minimum, sensing for toxic gases expected from the failure of the particular type of ESS should be done with permanent or portable equipment before entering the area without SCBA. Toxic emissions from the battery failure also necessitate the use of appropriate PPE during cleanup later on after first response. [PH1]

[PH1] Move to separate chapter on toxic abnormal

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
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Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]

Public Input No. 48-NFPA 855-2023 [Section No. 15.10]

Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]

Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]

Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date:	Sat Apr 22 13:13:28 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.1

Protection against the release of toxic and highly toxic gas emission during normal operation shall be in accordance with 4.6.11 .

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
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Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
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Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

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Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
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Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Committee:	ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.2 *

Where toxic gas detection is used to provide evacuation notice and/or first responder alert, the detection system shall comply with the following:

(1) The gas detection system shall be designed to provide a warning when the sensed gas(es) reaches the TWA REL.

(2) The gas detection system shall provide an audible alarm when the sensed gas(es) reaches 25 percent of the IDLH.

(3) The gas detection 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:

(1) A trouble signal upon failure of the gas detection system

(2) An alarm signal if the sensed toxic gas(es) concentration exceeds the TWA REL

A.9.6.7.2

The decision as to whether to install a permanent toxic gas detection system is usually dependent on the technology, its likelihood to go into thermal runaway, and whether the site is remote or occupied (or presents an exposure hazard to those who may work, live, or pass nearby). Which toxic gas(es) to detect is dependent on the ESS technology. All of these decisions can be informed by ensuring that any UL 9540A testing done includes the quantities of expected toxic gases emitted to the environment. In addition, plume studies to determine exposure distances, and indoor air quality studies for those technologies that will be placed indoors can inform the analysis. All of these elements would go into an HMA and need review by a fire protection engineer to guide both the system/site designer(s) and the AHJ.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	
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Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
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Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 13:22:22 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.3*

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

A.9.6.7.3

It is recommended that the effects of toxic emissions are considered where there are significant exposures to nearby populations. Plume models can be used to determine potential consequences for scenarios of interest. Plume models should be selected based on appropriate scenarios derived from experimental data. Model outputs must be presented in a way that they can be used to efficiently address the hazards of concern (i.e., toxicity and flammability).

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group

Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	

Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 13:40:18 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.4*

toxic and highly toxic emission detection shall not be required based on fire and explosion testing in accordance with 9.1.5 and a plume study demonstrating that toxic and highly toxic emission concentrations cannot exceed 25% IDLH.

A.9.6.7.4

About Plume Models:

Plume modeling is performed to determine the dispersion extents of flammable and toxic vent gases or products of combustion. Plume models may be required by a utility, customer or AHJ to provide information about possible consequences of a release of material. Plume models may be used to understand potential first responder exposures, inform emergency response planning and/or provide information about potential environmental consequences. Plume models can inform minimum approach distance (MAD) and safe staging area locations.

Plume Modeling Methodology:

A plume model will provide information on possible events based on possible incidents and weather conditions. Since incidents may have unique failures and occur in varied weather conditions, plume studies do not determine the precise outcome of a specific event.

Modeling should be performed using accepted plume modeling tools or computational fluid dynamics models, and should evaluate the impact of wind and environmental conditions on the results.

Source Term:

The selection of scenarios should be based on the most likely failure conditions as well as the highest consequence failure conditions that are reasonably expected to occur. The model should consider dispersion created by a forced ventilation system that may be installed for NFPA 69 purposes. Source term modeling should take into account the temperature of the gases and the heat release rate of a fire. Depending on expected failure conditions, separate plume models may need to be created to consider fire and non-fire conditions. Plume modeling should include something similar to a probable worst-case scenario, which can be used for emergency planning.

Weather Conditions

Plume model results depend on weather conditions at the time of release. Plume models should use reasonable worst-case weather conditions based on historical weather conditions at the site. Alternatively worst case conditions of wind at 10m at 1.5 m/s and class F stability may be used.

Plume Model Outputs:

The modeling should clearly show the extent of any hazardous exposures under varying wind conditions and identify any potential consequences extending outside project boundaries. For toxicity, the model output should provide the toxic gas components (or an equivalent toxic gas mixture) in ppm as function of distance from the source and time. For flammability, the model output should provide the flammable gas mixture in percent of LFL as function of distance from the source and time. Cloud shapes may be plotted for fixed values of toxic concentration and flammable concentration to identify hazardous areas and areas where ignition source control may be needed, respectively. Appropriate elevations shall be selected for model output given the objective of the analysis. For example, providing gas concentrations at 6-feet elevation may be appropriate when evaluating first responder safety whereas ground level concentrations may be appropriate for environmental assessments.

First responder use of plume studies:

A plume study can be great information for first responders. Similar to structure fire size-up to “read the smoke”, the plume and hazards related to the battery event will help identify the level of hazard

on initial arrival. A worst case most probable scenario provides a starting point for monitoring and consideration for protective action. Ideally, the design basis failure should not require protective actions for the public located beyond the property line of the facility unless with prior approval by the AHJ. When the AHJ approves release levels that may require protective actions based on the design basis plume study, an Annex shall be added to the regional emergency operating plan to address this hazard.

MonitoringThe plume model will help first responders identify starting points for immediate and follow-up monitoring. First responders should monitor for CO, LFL, and HF at a minimum. CO is most common and easier to detect airborne effluents. As battery chemistry changes the toxic material may change but CO and LFL should be monitored in all cases.

Minimum Approach Distance

Plume models may be used to inform the MAD to be used for emergency incidents. The MAD should be at a distance at which the concentrations generated by the plume are not expected to exceed IDLH or AEGL-2 values for 60 minute exposure. If the incident is expected to last a long time, then the concentration could be based on longer time period exposures and the distance may be increased.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 13:49:54 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.5

A plume study shall not be required for outdoor remote locations.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date: Sat Apr 22 13:52:51 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]

9.6.7.6

Toxic and highly toxic emission detection 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 uninterruptable 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

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group

Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date:	Sat Apr 22 13:54:28 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: CI-106-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 213-NFPA 855-2023 [Section No. 11.1]

11.1 Installation and Maintenance.

11.1.1

Stationary fuel cell ESS shall comply with the following requirements of Chapter 4 and Chapter 9 :

(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)*

(13) Spill Control *(see Section 9.6.5.2)*

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.

Statement of Problem and Substantiation for Public Input

This is to account for fuel cells that have free-flowing electrolyte, such as some alkaline fuel cells.

Submitter Information Verification

Submitter Full Name: Kevin Fok
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Submittal Date: Wed May 31 11:31:37 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-80-NFPA 855-2023

Statement: Some fuel cells have a liquid fuel source (e.g., methanol), and thus would need spill containment where minimum quantities found in Chapter 9 are exceeded.The sections are called out in the list items, and thus there is no need to reference the chapters in the header.

Public Input No. 198-NFPA 855-2023 [Section No. 13.1.3]

13.1.3*

FESS shall not be installed in individual one- or two-family dwellings or in townhouse

~~units.~~

units unless the installation is designed by a registered design professional, is approved by the AHJ, and is maintained by a trained service provider when regular maintenance is required.

Substantiation: This clause is very limiting and could unnecessarily stifle technological and commercial development. No other technology in this standard is subject to this limitation. It is not clear why FESS should be disallowed from such installations provided they are designed and operated in a safe manner. It is understood that the existing building codes may not account for ESS installations and that there are concerns about homeowners performing any required regular maintenance. Revise wording to address conditions under which the installation could be allowed.

Statement of Problem and Substantiation for Public Input

Substantiation: This clause is very limiting and could unnecessarily stifle technological and commercial development. No other technology in this standard is subject to this limitation. It is not clear why FESS should be disallowed from such installations provided they are designed and operated in a safe manner. It is understood that the existing building codes may not account for ESS installations and that there are concerns about homeowners performing any required regular maintenance. Revise wording to address conditions under which the installation could be allowed.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
Organization:	Amber Kinetics
Affiliation:	Amber Kinetics. I am a member of the NFPA 855 committee and charged with chairing a Task Group to review/revise Ch. 13 of the 855 2023 edition.
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Submittal Date:	Wed May 31 00:07:03 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-26-NFPA 855-2023

Statement: The original text was limiting and could unnecessarily stifle technological and commercial development. The revised wording addresses conditions under which the installation could be allowed.

Public Input No. 199-NFPA 855-2023 [Section No. 13.2 [Excluding any Sub-Sections]]

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

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 *(see 13.1.2)*
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 *(see 13.1.2)*
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 *(see 13.2.7.2)*
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 *(see 13.2.9)*
		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

Compliance Required	Applicable Chapter Reference	Chapter 13 Modifications
Smoke and fire detection	Section 4.8	N/A *(see 13.2.10)*
Fire control and suppression	Section 4.9	N/A *(see 13.2.11)*
Explosion control	9.6.5.6	N/A *(see 13.2.8)*
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.

Additional Proposed Changes

File Name	Description	Approved
Table_13.2_revision.docx	Proposed revision of Table 13.2 to clarify presentation and remove ambiguity. Substantiation: The table, in its current form, is not clear as to whether the referenced sections apply or not. It is difficult to know without further explanation. The submitted revised table is intended to make the table easier to interpret. New table 16-2 has been used as a template and its format has been applied to table 13.2 to help with clarity. Note: where the original entry in Table 13.2 for the “Chapter 13 Modifications” column indicates “N/A” only, the entry in the “Applicable Chapter Reference” column has interpreted as not applicable.	

Statement of Problem and Substantiation for Public Input

Substantiation: The table, in its current form, is not clear as to whether the referenced sections apply or not. It is difficult to know without further explanation. The submitted revised table is intended to make the table easier to interpret. Table 16-2 has been used as a template and its format has been applied to table 13.2 to help with clarity. Note: where the original entry in Table 13.2 for the “Chapter 13 Modifications” column indicates “N/A” only, the entry in the “Applicable Chapter Reference” column has interpreted as not applicable.

Submitter Information Verification

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Submittal Date: Wed May 31 00:11:56 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-161-NFPA 855-2023

Statement: The table, in its current form, is not clear as to whether the referenced sections apply or not. It is difficult to know without further explanation. The revised table makes the table easier to interpret. The format is chosen to match the format of other tables.

Compliance Required	Applies	Reference
Construction Documents	Yes	4.2.1.1 except as modified by 13.2.1 and 13.2.2
	No	4.2.1.2
	No	4.2.1.3
	No	4.2.1.4
Emergency Planning and Training	Yes	4.3.2.1.4 applies except as noted in 13.2.2
	No	4.3.2.1.5 (see 13.1.2)
HMA	Yes	4.4.1 applies except as noted in 13.2.3
Fire and Explosion Testing	No	9.1.5
Equipment	Yes	4.6 See also 13.2.4 and 13.1.2
Retrofits	Yes	Except 4.6.3.2 and 4.6.3.3 (See 13.1.2)
Environments	Yes	4.6.7 See also 13.2.5
Charge Controllers	No	4.6.8
Energy Storage Management Systems	Yes	4.6.10 See also 13.2.6 and 13.2.6.1
Reused Equipment	No	4.6.5
Seismic Protection	Yes	4.7.2 See also 13.2.7 and 13.2.7.1
Fire Barriers	No	9.6.4
Elevation	No	4.7.7 See 13.2.7.2
Open Rack Installation	No	4.7.9
ESS Dedicated Use Buildings	No	9.3.1.1
Non-Dedicated Use Buildings	No	9.3.1.2
Outdoor Installations	No	9.3.2
Enclosures	Yes	4.6.12 See also 13.2.8
Rooftop and Open Parking Garage Installations	No	9.5.3.1 except as noted in 13.2.7, 13.2.7.1, and 13.2.7.2
Mobile ESS Equipment and Operations	Yes	9.5.3.2 See 13.2.9

	No	9.5.3.2.1.2
	No	9.5.3.2.2.2
	No	9.5.3.2.5.3
	No	9.5.3.2.6
Size and Separation	No	9.4.2
Maximum Stored Energy	No	9.4.1
Exhaust Ventilation	No	9.6.5.1
Smoke and Fire Detection	No	4.8 See 13.2.10
Fire Control and Suppression	No	4.9 See 13.2.11
Explosion Control	No	9.6.5.6 See 13.2.8
Water Supply	No	4.9.4
System Interconnection	Yes	5
	No	5.3
Commissioning	Yes	6 See also Section 13.3
Operation and Maintenance	Yes	7 See also Section 13.4
	No	7.1.3
Decommissioning	Yes	8 See also Section 13.5

Public Input No. 200-NFPA 855-2023 [Section No. 13.2.5]

13.2.5*

FESS shall not be installed in ~~locations that could stress the bearing systems and impact their operation.~~ locations where high levels of ground vibration (not including seismic vibration) are transmitted to the operating flywheel and its bearings unless means are provided to limit the vibrations within acceptable limits for the FESS and the installation is evaluated by a registered design professional.

Substantiation: The original clause is too vague and may be unnecessarily limiting. Add additional wording that is consistent with the intent described in the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Statement of Problem and Substantiation for Public Input

Substantiation: The original clause is too vague and may be unnecessarily limiting. Add additional wording that is consistent with the intent described in the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 206-NFPA 855-2023 [Section No. A.13.2.5]	

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Submittal Date:	Wed May 31 00:22:36 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-27-NFPA 855-2023

Statement: The original requirement was too vague and may be unnecessarily limiting. This revision adds wording that is consistent with the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Public Input No. 201-NFPA 855-2023 [Section No. 13.2.6]

13.2.6*

The energy storage management system (ESMS) of a FESS shall ~~include bearing monitoring for magnetic bearings.~~ monitor bearing condition to detect signs of an impending bearing failure and act to bring the flywheel to a safe state before failure occurs.
Substantiation: Monitoring should be required for all bearings, regardless of technology. UL 9540 indirectly refers to monitoring with a requirement that a system shall detect signs of bearing failure before a catastrophic failure occurs.

.

13.2.6.1

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

Substantiation: Change this to cover the more general case where the bearing may be a different technology other than mechanical.

13.2.6.2*

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

Statement of Problem and Substantiation for Public Input

Substantiation (13.2.6): Monitoring should be required for all bearings, regardless of technology. UL 9540 indirectly refers to monitoring with a requirement that a system shall detect signs of bearing failure before a catastrophic failure occurs.

Substantiation (13.2.6.1): Change this to cover the more general case where the bearing may be a different technology other than mechanical.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Affiliation:	Amber Kinetics. Member of NFPA 855 Committee, and chair of Task Group charged with reviewing/revising Ch. 13 of the 2023 edition of 855.
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Submittal Date:	Wed May 31 00:26:58 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: This requirement should be covered by the product standard, not the installation standard.

Public Input No. 346-NFPA 855-2023 [Section No. 13.2.6]

~~**13.2.6** * –~~

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

~~**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.~~

~~**13.2.6.2** * –~~

~~The ESMS shall monitor and record temperature and vibration of the FESS.~~

Statement of Problem and Substantiation for Public Input

These are design features of the ESS and if essential, they should be covered by the listing standard. Suggest UL include these in 9540 if not currently addressed and once included the TC consider removal from 855.

Submitter Information Verification

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Submittal Date: Thu Jun 01 14:38:11 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-28-NFPA 855-2023

Statement: These are design features of the ESS and if essential, they should be covered by the listing standard. Clause 15.3 of UL 9540, Ed 3 covers this requirement.

Public Input No. 202-NFPA 855-2023 [Section No. 13.2.7.1]

13.2.7.1

The seismic ratings of the FESS and suitability ~~of mounting means shall be verified~~ of the seismic mounting means shall be determined by a registered design professional prior to installation and verified during installation.

Substantiation: Seismic ratings and anchoring are usually determined by a qualified structural engineer before the installation occurs.

Statement of Problem and Substantiation for Public Input

Substantiation: Seismic ratings and anchoring are usually determined by a qualified structural engineer before the installation occurs.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Submittal Date:	Wed May 31 00:31:18 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution:	FR-29-NFPA 855-2023
Statement:	Seismic ratings and anchoring are usually determined by a qualified structural engineer before the installation occurs.

Public Input No. 203-NFPA 855-2023 [Section No. 13.2.12]

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.~~ area unless the flywheel design and its production quality controls mitigate the risk of sudden flywheel rupture or if a rupture can be contained completely within the primary flywheel housing.

Substantiation : The size and separation requirements of 9.4.2 are shown as N/A in table 13.2. Also, UL 9540 deals with design, securement, and containment of flywheels in the event of a fault. Such barriers should not be necessary with proper design, securement, and containment.

Statement of Problem and Substantiation for Public Input

Substantiation: The size and separation requirements of 9.4.2 are shown as N/A in table 13.2. Also, UL 9540 deals with design, securement, and containment of flywheels in the event of a fault. Such barriers should not be necessary with proper design, securement, and containment.

Also, see new language added to the Annex notes on Section 13.2.12.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 212-NFPA 855-2023 [Section No. A.13.2.12]	

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Submittal Date:	Wed May 31 00:34:28 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The size and separation requirements of 9.4.2 do not apply as shown in Table 13.2. Also, UL 9540 deals with design, securement, and containment of flywheels in the event of a fault. Such barriers should not be necessary with proper design, securement, and containment.

Public Input No. 204-NFPA 855-2023 [Section No. 13.3]

13.3* Commissioning.

Prior to commissioning, correct ~~installation for mechanical~~ installation per manufacturer's specifications shall be confirmed.

Substantiation: The manufacturer's specifications should account for proper securement and containment

~~shall be confirmed~~

.

Statement of Problem and Substantiation for Public Input

Substantiation: The manufacturer's specifications should account for proper securement and containment.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Affiliation:	Amber Kinetics. Member NFPA 855 Committee, chairing Task Group on review/revision of Ch 13 of the 2023 edition of the 855 standard
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Submittal Date:	Wed May 31 00:37:22 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-32-NFPA 855-2023

Statement: The manufacturer's published instructions should account for proper securement and containment.

Public Input No. 205-NFPA 855-2023 [Section No. 13.4]

13.4* Operation and Maintenance.

~~As part of routine maintenance there shall be~~
The FESS operator shall provide systems and/or procedures for monitoring

~~/checking for bearing wear.~~
bearing condition information provided by the ESMS.

Substantiation: It is often not practical to monitor or check bearing wear. Condition monitoring in this case means that there is a system or procedure in place for routine surveillance of bearing related FESS measurements and messages. Also, the wording should be more general based on the fact that bearings may be made from other than mechanical technologies such as magnetic or air bearings.

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.~~

operator shall confirm that there is a process or system for determining bearing condition and that there is a process for determining when the bearings must be repaired or replaced.

Substantiation: The AHJ may not be qualified for these activities, so it is recommended to change "AHJ" to "operator". Also revise the wording to be consistent with clause 13.4.

13.4. 2*

The ~~AHJ shall~~ operator shall confirm that the maintenance procedures include a check of the status of the ~~vacuum on a periodic basis.~~ flywheel vacuum system status ~~of the vacuum~~ on a periodic basis when a vacuum system is employed and where loss of vacuum presents a safety hazard.

Substantiation: The AHJ may not be qualified for these activities, so it is recommended to change "AHJ" to "operator". Also, revise the wording to make the confirmation conditional because not all flywheels run in a vacuum.

13.4.3 Spin Down.

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.

13.4.3.2

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

Statement of Problem and Substantiation for Public Input

Substantiation (13.4): It is often not practical to monitor or check bearing wear. Condition monitoring in this case means that there is a system or procedure in place for routine surveillance of bearing related FESS measurements and messages. Also, the wording should be more general based on the fact that bearings may be made from other than mechanical technologies such as magnetic or air bearings.

Substantiation (13.4.1): The AHJ may not be qualified for these activities, so it is recommended to change "AHJ" to "operator". Also revise the wording to be consistent with clause 13.4.

Substantiation (13.4.2): The AHJ may not be qualified for these activities, so it is recommended to change “AHJ” to “operator”. Also, revise the wording to make the confirmation conditional because not all flywheels run in a vacuum.

Submitter Information Verification

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Submittal Date:	Wed May 31 00:40:30 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-33-NFPA 855-2023

Statement: For 13.4.1, it is often not practical to monitor or check bearing wear. Condition monitoring in this case means that there is a system or procedure in place for routine surveillance of bearing related FESS measurements and messages. Also, the wording was revised to be more general because bearings may be made from other than mechanical technologies such as magnetic or air bearings.

For 13.4.1, the AHJ may not be qualified for these activities, so “AHJ” was changed to “operator”.

Existing A.13.4 was moved to match the corresponding Section 13.4.1.

Public Input No. 367-NFPA 855-2023 [Chapter 14]

~~Areas~~

Revise Chapter 14 ~~– Storage of Lithium Metal or Lithium-ion Batteries~~

~~**14.1** – Batteries.~~

in its entirety to read as follows:

Collection and Storage of Lithium-ion Batteries

Types, SOC, structure, battery pack, li metal separate from li-ion? Definition that they are different!

14.1 General.

The requirements of this chapter shall apply to areas associated with the collection or storage [AB1] of lithium

metal or lithium-ion batteries shall comply with this chapter.Areas where

-ion batteries.

(Add annex material about Lithium metal vs Lithium ion differences?)

14.1.

1

1

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

- 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
- 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

[AB2] [AB3] *(1) [AB4] Areas where new or refurbished batteries are installed in or packed for use

in the

with devices, equipment, or vehicles they are designed to power

Areas where new or refurbished batteries are packed for use with the

A.14.1.1(1). Such areas include portions of retail establishments and other similar operations where a limited number of batteries are packaged and displayed for installation in devices, equipment,

or vehicles they are designed to power

and vehicles e.g., an individually packaged battery sold for use in a circular saw. Such areas could also include batteries that are contained within the retail packaging of a particular device, equipment or vehicle, e.g. a battery included in the packaging of the circular saw. The areas are not intended to include the large-scale bulk storage of batteries such as would be found in warehouses.

(2) 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

- 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.

[AB5]

14.2 ~~14.4~~ Prevention and Mitigation.

A fire safety plan that provides for the prevention of fire incidents and includes emergency response actions to be taken upon detection of a fire or possible fire involving lithium-ion or lithium metal battery storage ~~early detection mitigation measures~~ shall be provided to the AHJ for review and approval.

A 14.2 ~~14.4~~ Prevention and Mitigation.

The fire safety plan should be comprehensive and provide details on the following: locations of the battery storage including a map of each location within the facility; the types of batteries being stored in each location; the maximum quantity (Wh and mass) that may be stored in each location; the building or supplemental fire protection measures in place; the maximum permitted battery State of Charge for the location based on the intended usage; as well as information on fire department access and emergency response procedures. The plan should also include appropriate emergency contact information for the owners/operators of the storage facility as well as subject matter experts that the fire service can get in contact with. Prevention and mitigation of incidents is primarily accomplished by limiting the quantity of LIB stored (fuel load), proximity to ignition sources, and provision of appropriate fire detection and suppression systems.

14.2.1

Battery storage areas shall be at least 5 ft (1.5 m) from the structure, other combustibles, exits and exit pathways, and fire areas or separated by a listed fire rated separation unless otherwise modified by this chapter.

14.2.1.1

Spacing may be reduced based on large-scale fire testing accompanied by an engineering report that has demonstrated that these requirements may be reduced.

14.2.2

Batteries shall be stored at a state of charge below 30% [nr6] unless otherwise modified by this chapter.

14.3 Collection.

All areas located indoors in any occupancy where

~~used lithium~~

used lithium metal or lithium-

~~ion batteries~~

ion batteries are collected from employees or the public

~~shall comply with~~

shall comply with 14.

~~2~~

3 .1

~~through~~

through 14.

~~2~~

3 .3 .

14.

~~2~~
3 .1 *

Individual

~~containers shall~~

containers shall not

~~exceed 7~~

exceed 7 .5 ft 3 (0.21 m 3) in

~~size each~~

size each , with an aggregate limit of 15 ft 3 (0.42 m 3).

A. 14.

~~2~~
3 .

~~2~~

~~Containers shall comply~~

1

Batteries have been safely collected in one or two 55 gal (208 L) drums (or similarly sized bins or containers) for decades without any significant fire or life safety events.

14.3.2

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~~

~~(4) Where c ombustible~~ - ~~[AB7]~~ - ~~materials are located within the space between collection containers, the containers shall be spaced a minimum 10 ft (3 m) apart~~

~~.Batteries stored indoors shall be stored in accordance with one or more of the methods provided for in~~

~~[AB8]~~ -

~~14.~~

~~3 Indoor Storage Locations~~
~~4 Indoor Storage .~~

~~14.~~

3

4 .

~~1~~ ~~General.~~

~~14.3.1.1~~ –

~~2.1 Manufacturing – Electrode and Cell Fabrication~~

~~Batteries shall be permitted to be stored in rooms or spaces complying with~~ ~~14.3.2.1~~

~~through~~

~~.1~~ ~~and~~ ~~14.3.2.~~ ~~1.3~~ .

~~14. 4 . 2.1.1~~ .

~~Limit storage areas to no greater than 200 sq.ft.~~

~~14. 4.2.2.2~~

~~Limit storage height to no greater than 6 ft.~~

~~14.4.2.2. 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.~~

~~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.~~

~~14.3.2.1.2~~ –

~~The rooms~~

Separate multiple storage areas be aisles not less than 10 ft wide.

14.4.2.2.4

Limit state of charge to less than or equal to 60% (based on max use voltage).

14.4.2.2.5

The rooms or spaces shall be provided with a fire alarm system activated by detection devices installed in accordance with *NFPA 72* .

14.4.2.2.6

The basis of design for an automatic sprinkler system or other listed suppression system shall be based on full-scale fire testing.

14.4.2.2 Manufacturing – Formation/Cell Finishing

A.14.4.2.2

The primary stages of lithium ion battery manufacturing are electrode manufacturing, cell production, and cell finishing. Each stage of manufacturing consists of numerous sub-processes. Of the primary stages of lithium ion battery manufacturing, the greatest risk of fire and explosion is present in cell finishing (e.g., charge/discharge, formation, and aging). During this final stage cell electrochemistry activation occurs. During cell finishing the batteries are stored uncartoned in large rooms with racking for days and weeks at a time. This racking requires specialized fire protection to prevent thermal runaway events from spreading to adjacent materials and spaces. The specific details of the storage configuration, packaging, and battery all impact the fire hazard and protection strategies should be evaluated independently. Battery details to consider include chemistry, format, electrical capacity and state-of-charge).

14.4.2.2.1

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~~ approved detection devices installed in accordance with *NFPA 72* .

14.4.2.2.2

~~The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.~~ The basis of design for an automatic sprinkler system or other approved suppression system shall be based on full-scale fire testing.

14.4.2.2.3

Sprinklers used for protection of lithium ion batteries shall be listed for storage.

14.4.2.2.4 (*NFPA 13 2022 extract from 24.1.6*)

A series of large-scale fire tests involving challenging test scenarios that address the range of variables associated with the intended application of the sprinkler shall be conducted to evaluate the ability of the sprinkler to protect storage fire risks that are representative of those described in the manufacturer's installation and design parameter instructions and referenced in the listing.

14.4.2.2.5 (*NFPA 13 2022 extract 24.1.7*)

The manufacturer's installation and design parameter instructions for these sprinklers shall specify in a standardized manner the end-use limitations and sprinkler system design criteria including at least the following:

- (1) Commodity or commodities to be protected
- (2) Storage arrangements allowed
- (3) Installation guidelines including obstruction and ceiling construction limitations
- (4) Maximum ceiling and storage heights with associated minimum operating pressures and number of sprinklers required to be included in the hydraulic calculation
- (5) Hose stream allowance and duration

14.4.2.2.6 (*NFPA 13 2022 extract 24.1.8*)

The number of sprinklers to be used in the sprinkler system design shall be based on the worst-case result obtained from the full-scale fire test series increased by a minimum 50 percent.

14.4.2.3 Storage - General

A14.4.2.3

Batteries in bulk warehouse storage, whether or not integrated into battery containing devices, will typically be packaged according the transportation requirements. Very few large scale fire tests have been conducted to evaluate storage of lithium-ion batteries in bulk storage. The specific details of the storage configuration, packaging, and battery all impact the fire hazard and protection strategies should be evaluated independently. Battery details to consider include chemistry, format, electrical capacity and state-of-charge).

14.4.2.3.1

The rooms or spaces shall be provided with a fire alarm system activated by ~~an air-aspirating smoke detector system~~

~~or a~~

~~or a radiant-energy detection~~

~~system with occupant notification~~

~~system with occupant notification~~ approved detection devices installed in accordance

~~with~~

with *NFPA 72* .

14.

~~3~~
4 .2.
~~1~~
3 .
~~3~~
2

~~The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.~~ The basis of design for an automatic sprinkler system or other approved suppression system shall be based on full-scale fire testing.

14. 4.2. 3. 3

Sprinklers used for protection of lithium ion batteries shall be listed for storage.

14.4. 2.

~~**2 Prefabricated**~~
3.4 (*NFPA 13 2022 extract from 24.1.6*)

A series of large-scale fire tests involving challenging test scenarios that address the range of variables associated with the intended application of the sprinkler shall be conducted to evaluate the ability of the sprinkler to protect storage fire risks that are representative of those described in the manufacturer's installation and design parameter instructions and referenced in the listing.

14.4.2.3.5 (*NFPA 13 2022 extract 24.1.7*)

The manufacturer's installation and design parameter instructions for these sprinklers shall specify in a standardized manner the end-use limitations and sprinkler system design criteria including at least the following:

- (1) Commodity or commodities to be protected
- (2) Storage arrangements allowed
- (3) Installation guidelines including obstruction and ceiling construction limitations
- (4) Maximum ceiling and storage heights with associated minimum operating pressures and number of sprinklers required to be included in the hydraulic calculation
- (5) Hose stream allowance and duration

14.4.2.3.6 (*NFPA 13 2022 extract 24.1.8*)

The number of sprinklers to be used in the sprinkler system design shall be based on the worst-case result obtained from the full-scale fire test series increased by a minimum 50 percent.

14.3.2.2 Prefabricated Portable Structure.

Batteries shall be permitted to be stored

~~**in prefabricated**~~

in prefabricated portable buildings or

~~**containers complying with**~~

containers complying with 14.3.2.2.1

~~and~~

and 14.3.2.2.3 .

14.3.2.2.

~~1~~

1

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

14.3.2.2.

~~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~~

with *NFPA 72* .

14.3.2.2.

~~3~~

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~~

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~~

activities complying with 14.3.2.3.1

~~and~~

and 14.3.2.3.3 .

14.3.2.3.

~~1~~

1

Each area containing such metal drums or approved containers

~~shall be~~

shall be both of the following:

- (1)

  Not exceeding 900 ft^2 (61 m^2) in area

- (2)

  Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.3.

~~2~~

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~~

or a radiant-energy detection

~~system with~~

system with occupant

~~notification installed~~

notification installed in accordance

~~with~~

with *NFPA 72* .

14.3.2.3.

~~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~~

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~~

container complying with 14.3.2.4.1

~~and~~

and 14.3.2.4.3 .

14.3.2.4.

~~1~~

1

Each area containing the approved transportation containers

~~shall be~~

shall be both of the following:

(1). Not exceeding 900 ft^2 (61 m^2) in area

(2). Separated from other battery storage areas by a minimum of 10 ft (3 m)

14.3.2.4.

~~2~~

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~~

or a radiant-energy detection

~~system with~~

system with occupant

~~notification installed~~

notification installed in accordance

~~with~~

~~14.6.1~~ –

~~Outdoor storage locations for~~

with *NFPA 72* .

14.3.2.4.

~~3~~

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~~

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.

14.

~~5 Explosion Protection.~~

5 Outdoor Storage. [AB9]

14.5.

~~1 Deflagration Potential.~~

~~**14.5.1.1**~~ –

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

~~**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.**~~

~~**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.~~

1 Outdoor storage locations for lithium metal or lithium-ion

~~batteries shall~~

batteries shall comply with the following:

(1. Individual pile sizes shall be limited

~~to 900 ft~~

to 900 ft^2 (83.6 m^2) 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~~

5.2 Clearances shall be permitted to be reduced to 3 ft (0.9 m)

~~where a~~

where a 3-hour freestanding fire barrier, suitable for exterior use, and

~~extending 5 ft~~

extending 5 ft (1.5 m) above and

~~extending 5 ft~~

extending 5 ft (1.5 m) beyond the physical boundary of the pile is provided to protect the exposure.

14.

~~6~~

5 .

~~3 Weather~~

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~~

by 14.6.1

~~for~~

for outdoor storage of batteries without weather protection.

(3) The structure shall be of approved noncombustible construction and not exceed 3,600 ft ^{2} (334.5 m ^{2}) in area.

14.

~~6.4~~

5.4 Outdoor storage areas with an aggregate area greater than 400 ft ^{2} (37.1 m ^{2}) shall be provided with a fire alarm system activated by a radiant-energy detection system with occupant notification installed in accordance

~~with~~

with *NFPA 72* .

14.6 Explosion Protection.

14.6.1 Deflagration Potential.

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

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

14.6.2 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.

Additional Proposed Changes

File Name	Description	Approved
PI_for_Chapter_14_for_26_ed.docx	PI to revise chapter 14	

Statement of Problem and Substantiation for Public Input

This PI is submitted by the Chapter 14 task group consisting of Andrew Blum, Ben Ditch, Christina Francis, Philip Friday, Milosh Puchovsky and Noah Ryder. The task group will continue its work with more detailed language presented to the TC for its First Draft Meeting. Changes address renumbering of sceionts, scope, and more detailed protection criteria for various types of battery storage and manufacturing operations.

Submitter Information Verification

Submitter Full Name: Milosh Puchovsky
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Street Address:
City:
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Submittal Date: Thu Jun 01 16:48:52 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The inclusion of the manufacturing process exceeded the current scope of storage. The issue involving fire suppression design is not specific to the protection of lithium-ion or lithium metal storage, it involves ESS indoor installations as well so a more general proposal to provide guidance should target Chapter 4. Excluding lithium metal batteries from the chapter is a problem since small format lithium metal batteries are currently part of the battery stream both new and as waste. There is also a new solid state lithium metal producer of ESS. To properly assess the impacts of the exemptions the proposed text needs to be modified and refined then submitted as a Public Comment.

Collection and Storage of Lithium-ion Batteries

Types, SOC, structure, battery pack, li metal separate from li-ion? Definition that they are different!

14.1 General.

The requirements of this chapter shall apply to areas associated with the collection or storage of lithium-ion batteries.

Commented [AB1]: Do we want to include manufacturing/assembling areas?

(Add annex material about Lithium metal vs Lithium ion differences?)

14.1.1

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

Commented [AB2]: Will move this down to provide an exemption in 14.4 for indoor storage

*(1) Areas where new or refurbished batteries are installed in or packed for use with devices, equipment, or vehicles they are designed to power

Commented [AB3]: Plan is to remove this and perhaps add an NFPA 13 type "equivalency" section in chapter 1 (or here) as appropriate - AB to look into

Commented [AB4]: MP to work on an annex to better explain what we mean

A.14.1.1(1). Such areas include portions of retail establishments and other similar operations where a limited number of batteries are packaged and displayed for installation in devices, equipment, and vehicles e.g., an individually packaged battery sold for use in a circular saw. Such areas could also include batteries that are contained within the retail packaging of a particular device, equipment or vehicle, e.g. a battery included in the packaging of the circular saw. The areas are not intended to include the large-scale bulk storage of batteries such as would be found in warehouses.

(2) 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

Commented [AB5]: Similar to #1, this will get moved down to 14.4 to provide exemptions for indoor storage

14.2~~14.4~~ Prevention and Mitigation.

A fire safety plan that provides for the prevention of fire incidents and includes emergency response actions to be taken upon detection of a fire or possible fire involving lithium-ion or lithium metal battery storage~~early detection mitigation measures~~ shall be provided to the AHJ for review and approval.

A14.2~~14.4~~ Prevention and Mitigation.

The fire safety plan should be comprehensive and provide details on the following: locations of the battery storage including a map of each location within the facility; the types of batteries being stored in each location; the maximum quantity (Wh and mass) that may be stored in each location; the building or supplemental fire protection measures in place; the maximum permitted battery State of Charge for the location based on the intended usage; as well as information on fire department access and emergency response procedures. The plan should also include appropriate emergency contact information for the owners/operators of the storage facility as well as subject matter experts that the fire service can get in contact with. Prevention and mitigation of incidents is primarily accomplished by limiting the quantity of LIB stored (fuel load), proximity to ignition sources, and provision of appropriate fire detection and suppression systems.

14.2.1

Battery storage areas shall be at least 5 ft (1.5 m) from the structure, other combustibles, exits and exit pathways, and fire areas or separated by a listed fire rated separation unless otherwise modified by this chapter.

14.2.1.1

Spacing may be reduced based on large-scale fire testing accompanied by an engineering report that has demonstrated that these requirements may be reduced.

14.2.2

Batteries shall be stored at a state of charge below 30% unless otherwise modified by this chapter.

Commented [nr6]: This could be increased potentially to 60%, however I think this would need to be verified by publicly released test data across a range of chemistries, technologies, form factors, and battery "condition".

14.3 Collection.

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 **14.3.1** through **14.3.3**.

14.3.1*

Individual containers shall not exceed 7.5 ft^3 (0.21 m^3) in size each, with an aggregate limit of 15 ft^3 (0.42 m^3).

A.14.3.1

Batteries have been safely collected in one or two 55 gal (208 L) drums (or similarly sized bins or containers) for decades without any significant fire or life safety events.

14.3.2

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

14.4 Indoor Storage.

14.4.2.1 Manufacturing – Electrode and Cell Fabrication
Batteries shall be permitted to be stored in rooms or spaces complying with **14.3.2.1.1** and **14.3.2.1.3**.

14.4.2.1.1

Limit storage areas to no greater than 200 sq.ft.

14.4.2.2.2

Limit storage height to no greater than 6 ft.

14.4.2.2.3

Separate multiple storage areas be aisles not less than 10 ft wide.

14.4.2.2.4

Limit state of charge to less than or equal to 60% (based on max use voltage).

14.4.2.2.5

The rooms or spaces shall be provided with a fire alarm system activated by detection devices installed in accordance with *NFPA 72*.

14.4.2.2.6

The basis of design for an automatic sprinkler system or other listed suppression system shall be based on full-scale fire testing.

14.4.2.2 Manufacturing – Formation/Cell Finishing

Commented [AB7]: This is really an extension of the list above.

Commented [AB8]: During our reorganization, we will likely want to move some of our current language about drums, containers, etc. into this section. To be discussed at a later meeting.

A.14.4.2.2

The primary stages of lithium ion battery manufacturing are electrode manufacturing, cell production, and cell finishing. Each stage of manufacturing consists of numerous sub-processes. Of the primary stages of lithium ion battery manufacturing, the greatest risk of fire and explosion is present in cell finishing (e.g., charge/discharge, formation, and aging). During this final stage cell electrochemistry activation occurs. During cell finishing the batteries are stored uncartoned in large rooms with racking for days and weeks at a time. This racking requires specialized fire protection to prevent thermal runaway events from spreading to adjacent materials and spaces. The specific details of the storage configuration, packaging, and battery all impact the fire hazard and protection strategies should be evaluated independently. Battery details to consider include chemistry, format, electrical capacity and state-of-charge).

14.4.2.2.1

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~~ approved detection devices installed in accordance with *NFPA 72*.

14.4.2.2.2

~~The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.~~The basis of design for an automatic sprinkler system or other approved suppression system shall be based on full-scale fire testing.

14.4.2.2.3

Sprinklers used for protection of lithium ion batteries shall be listed for storage.

14.4.2.2.4 (*NFPA 13 2022 extract from 24.1.6*)

A series of large-scale fire tests involving challenging test scenarios that address the range of variables associated with the intended application of the sprinkler shall be conducted to evaluate the ability of the sprinkler to protect storage fire risks that are representative of those described in the manufacturer's installation and design parameter instructions and referenced in the listing.

14.4.2.2.5 (*NFPA 13 2022 extract 24.1.7*)

The manufacturer's installation and design parameter instructions for these sprinklers shall specify in a standardized manner the end-use limitations and sprinkler system design criteria including at least the following:

- (1) Commodity or commodities to be protected
- (2) Storage arrangements allowed
- (3) Installation guidelines including obstruction and ceiling construction limitations
- (4) Maximum ceiling and storage heights with associated minimum operating pressures and number of sprinklers required to be included in the hydraulic calculation
- (5) Hose stream allowance and duration

14.4.2.2.6 (*NFPA 13 2022 extract 24.1.8***)**

The number of sprinklers to be used in the sprinkler system design shall be based on the worst-case result obtained from the full-scale fire test series increased by a minimum 50 percent.

14.4.2.3 Storage - General

A14.4.2.3

Batteries in bulk warehouse storage, whether or not integrated into battery containing devices, will typically be packaged according the transportation requirements. Very few large scale fire tests have been conducted to evaluate storage of lithium-ion batteries in bulk storage. The specific details of the storage configuration, packaging, and battery all impact the fire hazard and protection strategies should be evaluated independently. Battery details to consider include chemistry, format, electrical capacity and state-of-charge).

14.4.2.3.1

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~~ approved detection devices installed in accordance with *NFPA 72*.

14.4.2.3.2

~~The rooms or spaces shall be provided with an automatic sprinkler system designed and installed in accordance with NFPA 13.~~The basis of design for an automatic sprinkler system or other approved suppression system shall be based on full-scale fire testing.

14.4.2.3.3

Sprinklers used for protection of lithium ion batteries shall be listed for storage.

14.4.2.3.4 (*NFPA 13 2022 extract from 24.1.6*)

A series of large-scale fire tests involving challenging test scenarios that address the range of variables associated with the intended application of the sprinkler shall be conducted to evaluate the ability of the sprinkler to protect storage fire risks that are representative of those described in the manufacturer's installation and design parameter instructions and referenced in the listing.

14.4.2.3.5 (*NFPA 13 2022 extract 24.1.7*)

The manufacturer's installation and design parameter instructions for these sprinklers shall specify in a standardized manner the end-use limitations and sprinkler system design criteria including at least the following:

- (1) Commodity or commodities to be protected
- (2) Storage arrangements allowed
- (3) Installation guidelines including obstruction and ceiling construction limitations
- (4) Maximum ceiling and storage heights with associated minimum operating pressures and number of sprinklers required to be included in the hydraulic calculation
- (5) Hose stream allowance and duration

14.4.2.3.6 (*NFPA 13 2022 extract 24.1.8***)**
The number of sprinklers to be used in the sprinkler system design shall be based on the worst-case result obtained from the full-scale fire test series increased by a minimum 50 percent.

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

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**.

14.3.2.3.1

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

- (1)

  Not exceeding 900 ft^2 (61 m^2) 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*.

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**.

14.3.2.4.1

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

(1). Not exceeding 900 ft^2 (61 m^2) 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*.

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.

14.5 Outdoor Storage.

Commented [AB9]: Stopped here. I recommend we reorganize the chapter to flow better. Have a section for collection (14.3), indoor storage (14.4) and outdoor storage (14.5). We can work on moving the sections around at a later time.

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

(1. Individual pile sizes shall be limited to 900 ft^2 (83.6 m^2) 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

14.5.2 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.

14.5.3 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 ft^2 (334.5 m^2) in area.

14.5.4 Outdoor storage areas with an aggregate area greater than 400 ft^2 (37.1 m^2) shall be provided with a fire alarm system activated by a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

14.6 Explosion Protection.

14.6.1 Deflagration Potential.

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

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

14.6.2 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.

Public Input No. 246-NFPA 855-2023 [New Section after 14.1]

14.1.3 Batteries, modules, and ESS temporarily staged or stored at an energy storage system installation site shall not be required to comply with this chapter provided:

(1) W ritten documentation from the supplier attesting to the state of charge prior to delivery to the site is provided to the AHJ

(2) The batteries, modules, and ESS are maintained at a state of charge of 50% or less of rated capacity.

(3) The method of storage addresses battery storage environmental exposure potentials

(4) The AHJ approves the temporary storage arrangement, and duration of the storage or staging.

A.14.1.3 Once ESS units, batteries or modules are delivered to an installation site they are no longer in transit and are being temporarily stored. Requirements found within codes and standards apply to materials whether temporarily or permanently located at a site. It would present practical difficulties to apply this chapter to battery components of an ESS awaiting installation at a site. The hazards for this type of staging or storage is balanced by requiring the state of charge (SOC) to be 50 percent or less, reducing the potential for a spontaneous thermal runaway. This section requires the SOC to be attested to in writing by the ESS supplier. Other considerations for staging of battery components awaiting installation would include the impact of the local environment upon the health of the battery, the status of the SOC, security of the batteries and the site fire protection waters supplies being installed and commissioned.

Statement of Problem and Substantiation for Public Input

Chapter 14 was not intended to apply to batteries associated with ESS properly and safely staged at an installation site awaiting permanent installation. Attempting to apply Chapter 14 can present practical difficulties. This added section identifies that Chapter 14 does not apply as long as the stipulated conditions are met.

This proposal is the product of NFPA 855 Technical Committee Task Group 3 Shipping/Stored batteries.

Submitter Information Verification

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Submittal Date: Wed May 31 21:02:25 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-162-NFPA 855-2023

Statement: Chapter 14 does not apply to batteries associated with ESS properly and safely staged at an installation site awaiting permanent installation. Attempting to apply Chapter 14 can present practical difficulties. This new section identifies that Chapter 14 does not apply as long as the stipulated conditions are met.

Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]

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~~ , thermal image, or radiant -energy detection system with occupant notification installed in accordance with *NFPA 72*.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

Submitter Information Verification

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Submittal Date: Tue Nov 29 12:48:12 EST 2022
Committee: ESS-AAA

Committee Statement

Resolution: FR-163-NFPA 855-2023

Statement: There is a need to correlate the detection technologies with NFPA 72. Specifying “air-aspirating” as the method of smoke detection was inappropriate, other forms of smoke detection can be utilized based upon the conditions present at the location.

Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]

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~~ , thermal image, or radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

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Committee: ESS-AAA

Committee Statement

Resolution: FR-188-NFPA 855-2023

Statement: There is a need to correlate the detection technologies with NFPA 72. Specifying “air-aspirating” as the method of smoke detection was inappropriate, other forms of smoke detection can be utilized based upon the conditions present at the location.

Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]

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~~ , thermal image or a radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

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Committee: ESS-AAA

Committee Statement

Resolution: FR-164-NFPA 855-2023

Statement: There is a need to correlate the detection technologies with NFPA 72. Specifying “air-aspirating” as the method of smoke detection was inappropriate, other forms of smoke detection can be utilized based upon the conditions present at the location.

Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]

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~~ , thermal image, or radiant-energy detection system with occupant notification installed in accordance with *NFPA 72*.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]	
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

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Committee: ESS-AAA

Committee Statement

Resolution: FR-165-NFPA 855-2023

Statement: There is a need to correlate the detection technologies with NFPA 72. Specifying “air-aspirating” as the method of smoke detection was inappropriate, other forms of smoke detection can be utilized based upon the conditions present at the location

Public Input No. 268-NFPA 855-2023 [Section No. 14.4]

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.

14.4.1 The mitigation plan shall include and AHJ approved method to control rocketing of cells involved in thermal runaway.

Statement of Problem and Substantiation for Public Input

The rocketing of cells with the ability to spread an event to other portions of a facility is a documented potential and must be addressed by mitigation measiures.

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Committee:	ESS-AAA

Committee Statement

Resolution: FR-166-NFPA 855-2023

Statement: This hazard needs to be addressed. It has been a regular occurrence involving some battery storage locations.

Public Input No. 2-NFPA 855-2022 [Section No. 14.6.4]

14.6.4

Outdoor storage areas with an aggregate area greater than 400 ft^2 (37.1 m^2) shall be provided with a fire alarm system activated by a radiant-energy or thermal image fire detection system with occupant notification installed in accordance with *NFPA 72*.

Statement of Problem and Substantiation for Public Input

NFPA 72 2025 edition First Draft incorporated a new definition and requirements for "thermal image fire detectors." While thermal image detectors are technically radiant energy sensing detectors, NFPA 72 has previously limited radiant energy detectors to non-imaging flame or spark detectors (UV-IR, triple IR). The SIG-IDS TC decided to add thermal image fire detector requirements into their own section rather than rewrite the existing radiant energy detector section. In any case, as the term radiant energy detectors is used within NFPA 855, thermal imaging is the appropriate term and technology for detecting overheating energy storage systems at an early stage. There is currently a new UL STP working on a new standard for video and thermal imaging fire detectors (UL/ULC 2684) and this is scheduled to be completed prior to the next edition of NFPA 855.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 3-NFPA 855-2022 [Section No. 14.3.2.1.2]	
Public Input No. 4-NFPA 855-2022 [Section No. 14.3.2.2.2]	
Public Input No. 5-NFPA 855-2022 [Section No. 14.3.2.4.2]	
Public Input No. 6-NFPA 855-2022 [Section No. 14.3.2.3.2]	
Public Input No. 7-NFPA 855-2022 [Section No. 4.8.1 [Excluding any Sub-Sections]]	
Public Input No. 8-NFPA 855-2022 [Section No. 9.6.1]	
Public Input No. 9-NFPA 855-2022 [Section No. 9.5.3.1.1.2]	
Public Input No. 10-NFPA 855-2022 [Section No. 9.5.3.1.2]	

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Committee: ESS-AAA

Committee Statement

Resolution: FR-167-NFPA 855-2023

Statement: There is a need to correlate the detection technologies with NFPA 72.

Public Input No. 152-NFPA 855-2023 [New Section after 15.2.1]

15.2.1.1

. Lead-acid and nickel-cadmium batteries used in residential energy storage 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, an inverter listed to UL 1741 or a UPS listed to UL 1778.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

When UL 1973 listed lead-acid/nickel-cadmium battery paired with an appropriate UL charger or inverter, the results are equivalent to UL 9540 certification/listing.

Submitter Information Verification

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Submittal Date: Tue May 23 14:09:04 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-129-NFPA 855-2023

Statement: The new section provides correlation with how lead-acid and nickel-cadmium batteries are treated in Chapter 9 with how they should be treated in one- and two-family dwellings

Public Input No. 29-NFPA 855-2023 [New Section after 15.3.1]

15.12* Test Reports

ESS installed in accordance with Chapter 15 shall be provided with a product-level evaluation by an approved qualified person with expertise in energy storage as a supplemental safety document to be used by the AHJ and the installing contractors.

A.15.12

The test report will provide information that, among other things, describes the size and energy capacity rating of the unit being tested, model numbers of the modules and ESS units, the orientation of ESS in the test facility, and the proximity of the ESS unit under test to adjacent ESS, walls, and monitoring sensors. The test report also includes a complete set of test results and measurements. For example, a complete UL 9540A test report that includes a unit-level test should also include the UL 9540A cell and module-level test.

Statement of Problem and Substantiation for Public Input

Under the direction of the NFPA 855 Committee, a task group was formed to address issues with the current NFPA 855 Chapter 15.3.1. Spacing and engineering requirements for fire and explosion reference to chapter 9 requirements. This proposed input intends to correct a previously unknown existing issue.

This change would eliminate the requirement for a registered design professional with fire protection engineering expertise and replace that with language similar to what is currently found in NFPA 1, Section 1.16.1 when technical assistance is required by the AHJ (the IFC has similar language in 104.8.2). This allows the current language to be onerous for the smaller residential installations. It allows an approved third party with expertise in energy storage to review the documents and provide the supplemental report. As written, an installer could do the same installation at several homes in a jurisdiction, and they would need a registered design professional (e.g., FPE) for each installation. The new Section matches how this topic (technical assistance for supplemental reports) is addressed in NFPA 1 Fire Code. provides direction specific to chapter 15.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 28-NFPA 855-2023 [Section No. 15.3.1]	Coordination of evaluation requirments
Public Input No. 30-NFPA 855-2023 [New Section after 15.3.1]	Coordination of evaluation requirments
Public Input No. 28-NFPA 855-2023 [Section No. 15.3.1]	
Public Input No. 30-NFPA 855-2023 [New Section after 15.3.1]	

Submitter Information Verification

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Submittal Date: Sat Apr 22 11:25:09 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The Technical Committee reaffirms the acceptance of TIA 23-1.

Public Input No. 30-NFPA 855-2023 [New Section after 15.3.1]

15.13 Fire and Explosion Testing .

15.13.1*

Where required by 15.3.1, fire and explosion testing shall be conducted on a representative ESS in accordance with UL 9540A or equivalent test standards.

A.15.13.1

A UL 9540A test or equivalent test should evaluate the fire characteristics of the composition of gases generated at the cell, module, and unit and installation levels for ESS undergoing thermal runaways, such as what might occur due to a fault, physical damage, or exposure hazard. The evaluation of the fire characteristics during fire vent testing at the unit level installation level testing should document whether the fire event propagates to the neighboring ESS units and include radiant heat flux measurements at enclosing wall surfaces and at various distances from the ESS being tested at the unit level. The fire and explosion testing data is intended to be used by manufacturers, system designers, and AHJs to determine if the required separation distance for an ESS installation can be reduced.

15.13.1.1

The complete UL 9540A or equivalent test report shall be provided to the Authority Having Jurisdiction, including the cell, module, and unit level.

15.13.1.2

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

15.13.1.3

The testing shall be conducted, 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.

15.13.1.4*

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.

A.15.13.1.4

changes in an installation configuration, including the internal architecture of modules and units that don't match the parameters tested, such as size and separation, cell type, or energy density, should only be accepted if it can be shown that the configuration provides equivalent results. For example, scaling such as height, depth, and spacing need to conform to the configuration of the test. Changes also might include multiple levels of units on top of each other, located on a mezzanine floor above, or back-to-back units. These configurations might have yet to be evaluated in the test.

15.13.1.5

The testing shall include evaluating deflagration mitigation measures when designed into ESS cabinets.

Statement of Problem and Substantiation for Public Input

Under the direction of the NFPA 855 Committee, a task group was formed to address issues with the current NFPA 855 Chapter 15.3.1. Spacing and engineering requirements for fire and explosion reference to chapter 9 requirements. This proposed input intends to correct a previously unknown existing issue.

This input would eliminate the requirement for a registered design professional with fire protection engineering expertise and replace that with language similar to what is currently found in NFPA 1, Section 1.16.1 when technical assistance is required by the AHJ (the IFC has similar language in 104.8.2). This allows the current language to be onerous for the smaller residential installations. It allows an approved third party with expertise in energy storage to review the documents and provide the supplemental report. As written, an installer could do the same installation at several homes in a jurisdiction, and they would need a registered design professional (e.g., FPE) for each installation. The new Section matches how this topic (technical assistance for supplemental reports) is addressed in NFPA 1 Fire Code. The input keeps the evaluation requirements specific to Chapter 15

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 28-NFPA 855-2023 [Section No. 15.3.1]	Coordination of evaluation requirments
Public Input No. 29-NFPA 855-2023 [New Section after 15.3.1]	Coordination of evaluation requirments
Public Input No. 28-NFPA 855-2023 [Section No. 15.3.1]	
Public Input No. 29-NFPA 855-2023 [New Section after 15.3.1]	

Submitter Information Verification

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Submittal Date: Sat Apr 22 11:30:54 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-102-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 23-1.

Additional information is added for the acceptable listing requirements for standby power exception. Most residential systems use a UL 1741 listed inverter/charger and needs to be references in the exception. The Canadian standard is also added.

Public Input No. 28-NFPA 855-2023 [Section No. 15.3.1]

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~~ ~~.~~ 15.13

Statement of Problem and Substantiation for Public Input

Under the direction of the NFPA 855 Committee, a task group was formed to address issues with the current NFPA 855 Chapter 15.3.1. Spacing and engineering requirements for fire and explosion reference to chapter 9 requirements. This change would eliminate the requirement for a registered design professional with fire protection engineering expertise and replace that with language similar to what is currently found in NFPA 1, Section 1.16.1 when technical assistance is required by the AHJ (the IFC has similar language in 104.8.2). This allows the current language to be onerous for the smaller residential installations. It allows an approved third party with expertise in energy storage to review the documents and provide the supplemental report. As written, an installer could do the same installation at several homes in a jurisdiction, and they would need a registered design professional (e.g., FPE) for each installation. The new Section matches how this topic (technical assistance for supplemental reports) is addressed in NFPA 1 Fire Code. It will point to a new section 15.3 with requirements specific to chapter 15.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 29-NFPA 855-2023 [New Section after 15.3.1]	Coordination of evaluation requirments
Public Input No. 30-NFPA 855-2023 [New Section after 15.3.1]	Coordination of evaluation requirments
Public Input No. 29-NFPA 855-2023 [New Section after 15.3.1]	
Public Input No. 30-NFPA 855-2023 [New Section after 15.3.1]	

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Street Address:
City:
State:
Zip:
Submittal Date: Sat Apr 22 11:11:15 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-101-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 23-1.

Public Input No. 140-NFPA 855-2023 [Section No. 15.4.1]

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

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

Statement of Problem and Substantiation for Public Input

This is currently stated as 4.7.5.4 but actually pertains to 1 and 2 family dwellings. Should be included as a part of Chapter 15.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 139-NFPA 855-2023 [Section No. 4.7.5.4]	

Submitter Information Verification

Submitter Full Name: Chris Searles
Organization: Ieee Essb Committee
Affiliation: CGS and Associates
Street Address:
City:
State:
Zip:
Submittal Date: Tue May 23 10:23:03 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-168-NFPA 855-2023

Statement: A gap in the residential Chapter 15, Section 15.8 was identified. Section 15.8 is revised to mirror what the current 4.7.5.4 requires.

Public Input No. 157-NFPA 855-2023 [Section No. 15.4.1]

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

Statement of Problem and Substantiation for Public Input

As outdoor installations represent the safest location for technologies capable of thermal runaway, removing the exterior opening setback requirements will support more outdoor installations. The reality is a utility or storage room is acceptable for locating an ESS, but outside it must be 3' from a window opening into that same space. This corrects that limitation while encouraging more acceptable installations in the safest locations.

Submitter Information Verification

Submitter Full Name: Matthew Paiss

Organization: Pacific Northwest National Lab

Street Address:

City:

State:

Zip:

Submittal Date: Tue May 23 16:51:02 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: Li-ion batteries specifically have 3’ spacing rules elsewhere in this document, and sometimes even further separation from doors, walkways, etc. A better way to address the concern is to specifically encourage outdoor placement vs indoor, and away from the primary residential structure(s) if possible in the case of Li-ion.

Public Input No. 175-NFPA 855-2023 [Section No. 15.4.2]

15.4.2

If the room or space where the ESS is to be installed is not finished or ~~noncombustible~~ has combustible walls or ceilings , the unfinished or combustible walls and ceilings of the room or space shall be protected with not less than ⅝ in. Type X gypsum board.

Statement of Problem and Substantiation for Public Input

The existing language in the 2023 version of NFPA855 in this section is a clear mistake or typographical error. As this language was brought in from the 2021 International Residential Code (IRC), which is also in the 2024 IRC, is intended to address "combustible" wood framing that his exposed. Additionally, wood paneling and other readily combustible wall coverings are the hazard that is intended to be addressed with the addition of Type X gypsum. The way the 2023 version is written, all rooms would somehow require Type X, which is absolutely what the gypsum industry wants, but it is not what the IRC language ever intended. Please fix this clear mistake.

Submitter Information Verification

Submitter Full Name: William Brooks

Organization: Brooks Engineering

Street Address:

City:

State:

Zip:

Submittal Date: Thu May 25 16:06:51 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-21-NFPA 855-2023

Statement: The existing text required Type X for all rooms. The section was revised to address "combustible" wood framing that is exposed. Additionally, wood paneling and other readily combustible wall coverings are the hazard to be addressed with the addition of Type X gypsum.

Public Input No. 154-NFPA 855-2023 [New Section after 15.5.1]

15.5.1.1

Unit sizing for lead-acid and nickel-cadmium batteries listed to UL 1973 shall not be restricted.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.
Table 9.4.1 states that lead-acid and nickel-cadmium battery systems are granted unlimited kWh for MAQ, and restricting maximum group sizing does not appear to be consistent with the logic behind Table 9.4.1.

Submitter Information Verification

Submitter Full Name:	Chris Searles
Organization:	Ieee Essb Committee
Affiliation:	CGS and Associates
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Tue May 23 14:21:26 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-6-NFPA 855-2023

Statement: The protection levels found within Chapter 15 for this chemistry type allows for the change to be supported. This allows an aggregate amount for the total of the system.

Public Input No. 106-NFPA 855-2023 [Section No. 15.5.1]

15.5.1

Individual ESS units ~~shall~~ using technologies other than lead-acid, Ni-Cd, Ni-Zn, Ni-MH, and NaNiCl shall have a maximum stored energy of 20 kWh.

Statement of Problem and Substantiation for Public Input

Artificially limiting relatively safer technologies (like lead-acid, Ni-Cd, etc.) has no basis in science or the rest of the document. Table 1.3 already allows much higher quantities of these relatively safer technologies without the standard even covering them at all.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 117-NFPA 855-2023 [Section No. 15.5.2]	
Public Input No. 118-NFPA 855-2023 [Section No. 15.5.3]	

Submitter Information Verification

Submitter Full Name: Curtis Ashton
Organization: American Power Systems/ East P
Street Address:
City:
State:
Zip:

Submittal Date: Mon May 15 16:01:02 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-5-NFPA 855-2023

Statement: The specified battery chemistries have a lower fire and explosion risk than other batteries.

Public Input No. 343-NFPA 855-2023 [Section No. 15.5.1]

15.5.1

Individual ESS units shall have a maximum

~~stored energy of 20 kWh.~~

rating based on its listing.

Statement of Problem and Substantiation for Public Input

Reason statement: Changes to UL 9540 in Edition 3 will allow larger unit sizes based on 9540A results. The standard should provide alternatives and options for products demonstrating a higher level of safety evidenced and documented in testing.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 342-NFPA 855-2023 [Sections 15.5.1, 15.5.2, 15.5.3, 15.5.4]	15.5.1

Submitter Information Verification

Submitter Full Name:	Mark Rodriguez
Organization:	Sunrun
Affiliation:	Mark Rodriguez-Sunrun, CALSSA, Jeff Spies-Planet Plansets
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 14:22:30 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The technical committee is looking for additional information for the Second Draft on how the listing data would provide sufficient information. Insufficient technical data submitted based on listing alone in the residential setting.

Public Input No. 342-NFPA 855-2023 [Sections 15.5.1, 15.5.2, 15.5.3, 15.5.4]

Sections 15.5.1, 15.5.2, 15.5.3, 15.5.4

15.5.1 –

~~Individual~~

Individual ESS units shall have a maximum

~~stored energy~~

rating of 20 kWh.

15.5.2 ~~**The**~~

~~aggregate rating~~

ratings of the ESS in each location 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~~

ratings in Table 15.5.2.

15.5.3 The total aggregate ratings of ESS on the property shall not exceed 600 kWh.

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

15.5.

4 * –

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

Additional Proposed Changes

File Name	Description	Approved
NFPA_855_PI_Increased_Aggregate_ratings_for_ESS_15.5.docx	NFPA 855 PI: Increased Aggregate ratings for ESS 15.5	

Statement of Problem and Substantiation for Public Input

Reason: The proposed changes to section 15.5 clarify the original intent for this section, which was to provide a maximum threshold for each location. It was not the intent to limit installations to one location on the property, or to limit to only 80 kWh for all ESS installed on the property. Providing the various maximum thresholds in tabular form provides an easier method for the code user to determine the limits for each location.

Within utility closets, basements and storage or utility spaces
The 40 kWh limit is unchanged from the current version of NFPA 855. That language clarifies that the 40 kWh limit does not apply to spaces or closets located within garages or accessory structures. It only applies to "within the dwelling."

In attached garages
As the ESS industry has gained more experience with the needs of their customers and the grid, and the building safety community has gained more experience with ESS, it is becoming clear that the arbitrary capacity restrictions in the residential code are a hindrance to the deployment of clean energy technologies and are unneeded for safety. Hundreds of thousands of residential batteries have been installed and constructed to product standards leading to greater levels of safety. Taken together, these facts support a reasonable increase in kWh capacity to align with other anticipated hazards and fuel loads that may be present in a residential garage.

A modest increase in the allowable aggregate ESS capacity from 80 kWh to 100 kWh does not pose a significant elevated fire risk in the garage. Manufacturers design ESS to well-established safety standards. They have demonstrated proven track records of operating without igniting in homes, and are built in a way to resist adding fuel to fires from other sources. In the rare event of an ESS fire, a fire from 100 kWh of energy storage does not pose a significantly greater threat to occupant safety and is not significantly more difficult to extinguish than a fire from 80 kWh of energy storage.

The fuel energy density and heat release rate potential presented by a 100-kWh energy storage system are comparable to that of vehicles parked in garages. 100 kWh is a typical capacity of currently available electric vehicles (EVs), which use lithium-ion chemistries as do many stationary ESS. EVs also present significant additional fuel load through materials like upholstered seating and plastic trim. Internal combustion engine (ICE) vehicles have fuel, engine lubricants, and other components with the potential for very significant heat release rates. While the fuel load in a vehicle fueled by a gaseous fuel such as CNG or hydrogen can be less than that of a 100-kWh ESS in total energy output, the dynamics of a designed quick release of a gaseous fuel due to fire exposure in an attached garage can pose a significant concentrated fire exposure, or potentially a deflagration hazard risk to occupants and emergency responders.

This proposal allows homes to add an aggregate of 100 kWh of energy storage to an attached garage, while keeping the content fuel loads at safe levels. While actual fuel loads in garages can vary widely, this can be demonstrated using typical and conservative figures:

A reasonable fuel load for a garage is approximately 22,300 MJ. This assumes the garage is 20' x 20' and that a reasonable fuel load density is 600 MJ/m . Parking two gasoline powered cars in the garage makes up approximately 10,600 MJ of fuel load. Other garage items can make up approximately 3,300 MJ of fuel load. The remaining fuel load available to an ESS (22,300 MJ minus 10,600 MJ minus 3,300 MJ) is 8,400 MJ. 8,400 MJ is equivalent to an ESS with an aggregate capacity of 100 kWh, assuming the ESS has a fuel load of 84 MJ/kWh.

On or within 3 feet (914 mm) of exterior walls of dwellings and attached garages
ESS on the exterior side of exterior walls pose less of a safety risk than ESS inside attached garages. Typical exterior home construction provides sufficient protection from a thermal event. The product safety standard has specific requirements when ESS is intended for wall mounting, near exposures, where surface temperature measurements on wall surfaces do not exceed 97°C (175°F) of temperature rise above ambient per 9.2.15.

In detached garages and detached accessory structures
This scenario poses minimal risk to occupant safety, considering the distance from the dwelling and testing required of ESS. ESS in detached structures pose less of a safety risk than ESS on the exterior side of the dwelling. If an ESS with an aggregate rating of 200 kWh on the exterior side of the dwelling is considered reasonable, then an ESS with an aggregate rating of 200 kWh should be reasonable for ESS in detached structures. 600 kWh matches Table 1207.5 of the IFC. ESS in structures separated from the dwelling by 10 feet do not pose demonstrable risk to occupants.

Outdoors on the ground
This scenario poses minimal risk to occupant safety, considering the distance from the dwelling and the testing required of ESS. Ground mount ESS pose less of a safety risk than ESS on the exterior

side of the dwelling. If an ESS with an aggregate rating of 200 kWh on the exterior side of the dwelling is considered reasonable, then an ESS with an aggregate rating of 200 kWh should be reasonable for ESS mounted on the ground.

Additionally, 200 kWh is equivalent to two typical EVs that can be parked anywhere on the property.

600 kWh matches Table 1207.5 of the IFC. ESS separated from property lines and
the dwelling by 10 feet does not pose a demonstrable risk to occupants.

Endnotes

1. Tesla Model X has a capacity of 100 kWh. Tesla Model S has a capacity of 70-85 kWh. Chevy Bolt has a capacity of 66 kWh. The electric Ford F150 has a capacity of 110-130 kWh or 150-180 kWh with extended range. Sources: ttps://www.forbes.com/wheels/cars/tesla/model-x/, https://www.tesla.com/sites/default/files/tesla-model-s.pdf, https://media.chevrolet.com/media/us/en /chevrolet/vehicles/bolt-ev/2021.tab1.html, https://www.forbes.com/wheels/news/2022-ford-f-150-lightning-ev-pickup-debuts-300-mile-range-priced-at-40k.

2. Builders' websites show the typical two-garage is around 20' x 20'. For example, HWS Garages' website states that "The average 2-car garage size is anywhere from 18' x 20' to 22′ x 22'." While some garages are one-car and some are three-car, a poll conducted by Garage Living shows that 61 percent of garages are two-car. Sources: www.hwsgarage.com/average-garage-sizes/ and www.garageliving.com/blog/home-garage-stats.

3. The average fuel load of a living room is 600 MJ/m . 600 MJ/m^2 is also the business standard in NFPA 557. Sources: Alex Bwalya et al., "A Pilot Survey of Fire Loads in Canadian Homes," National Research Council Canada, March 9, 2004; National Fire Protection Association, "NFPA 557: Standard for Determination of Fire Loads for Use in Structural Fire Protection Design," 2020 Edition, Section 6.1.3.

4. 10,577 MJ (rounded to 10,600 MJ) assumes a small car (2,909 MJ) and large car (7,648 MJ). Sources: Mohd Tohir and Michael Spearpoint, "Distribution analysis of the fire severity characteristics of single passenger road vehicles using heat release rate data," Fire Science Reviews, 2013. Also see M.J. Spearpoint, et. al., "Fire load energy densities for risk-based design of car parking buildings," Case Studies in Fire Safety, 29 April 2015.

5. 3,341 MJ (rounded to 3,300 MJ) is equivalent to half the fuel load items in a typical basement living room. Source: Bwalya, A.C., et. al., "Survey Results of Combustible Contents and Floor Areas in Multi-Family Dwellings," National Research Council Canada, 24 October 2008.

6. 84 MJ/kWh is derived from the estimated fuel load of the gases released by an ESS in thermal runaway (44 MJ/kWh) and the estimated fuel load of the burnable contents inside the ESS (40 MJ/kWh). 44 MJ/kWh was derived from reviewing several studies referenced below. 40 MJ/kWh was derived from multiplying 2 kg/kWh (a conservative figure for burnable contents inside the ESS – the weight of internal contents for some ESS is 1.0-1.5 kg/kWh) by 20 MJ/kg (the typical fuel load of a computer). Sources for fuel load of gases: Frederik Larsson, "Toxic fluoride gas emissions from lithium-ion battery fires," Scientific Reports, 30 August 2017; David Sturk et. al., "Fire Tests on E-vehicle Battery Cells and Packs," Traffic Injury Prevention, 25 February 2015. Sources for kg/kWh weight of internal burnable contents: Tesla, SimpliPhi, and Solaredge. Source for fuel load of a computer: Alex Bwalya et al., "A Pilot Survey of Fire Loads in Canadian Homes," National Research Council Canada, March 9, 2004.

Cost Impact: The code change proposal will not increase or decrease the cost of construction
It clarifies how the maximum thresholds are applied. Allows for more ESS while maintaining a level of safety.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 343-NFPA 855-2023 [Section No. 15.5.1]	

Submitter Information Verification

Submitter Full Name:	Mark Rodriguez
Organization:	Sunrun
Affiliation:	Mark Rodriguez-Sunrun, CALSSA, Joe Cain-SEIA, Jeff Spies-Planet Plansets
Street Address:	
City:	
State:	
Zip:	
Submittal Date:	Thu Jun 01 14:14:14 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The proposal covered a fundamental change to the various spaces, based on adoption in California. There was much discussion on the aggregate amount allowed in the various areas. There was concern over the total of 600 kwh in certain applications as well as application of the basement and dwelling spaces.

NFPA 855, 2026 Edition

Public Input # ___

Proponents:

Mark Rodriguez, SunRun

Jeff Spies, Planet Plansets

Joseph H. Cain, P.E., Solar Energy Industries Association

15.5 Energy Ratings.

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

15.5.2 ~~The aggregate rating *of the ESS shall not exceed the following for each location listed:*~~ The ratings of the ESS in each location shall not exceed the ratings in Table 15.5.2.

~~1. 40 kWh within utility closets and storage or utility spaces.~~

~~2. 80 kWh in attached or detached garages and detached accessory structures.~~

~~3. 80 kWh on exterior walls.~~

~~4. 80 kWh outdoors on the ground.~~

Table 15.5.2 Maximum Ratings of ESS

Location	Maximum Ratings (kWh)	Installation Requirements
Within utility closets, basements, and storage or utility spaces located within dwellings	40	
In attached garages	100	
On or within 3 feet of exterior walls of dwellings and attached garages, or Outdoors on the ground	200	

Commented [1]: FYI - Change to 9540 will allow larger unit sizes based on 9540A results.

Commented [2]: will submit in a separate proposal: "Individual ESS units shall have a maximum rating based on its listing."

Commented [3]: Could maybe merge the outdoor ground (3ft from property line) with this?

In detached garages and detached accessory structures	200	
In detached garages and detached accessory structures	600	Detached garage or detached accessory structure is a minimum 10 feet away from property lines and dwellings.
Outdoors on the ground	600	ESS is a minimum 10 feet away from property lines and dwellings.

For SI: 1 foot = 304.8 mm

15.5.3 The total aggregate ratings of ESS on the property shall not exceed 600 kWh.

~~**15.5.3**~~ **15.5.4** ESS installations exceeding the individual or aggregate ratings allowed by 15.5.1 ~~or 15.5.2~~ through 15.5.3 shall comply with Chapters 4 through 9.

~~**15.5.4**~~**15.5.5** The use of an electric-powered vehicle to power the dwelling while parked shall comply with section 15.11.

Reason: The proposed changes to section 15.5 clarify the original intent for this section, which was to provide a maximum threshold for each location. It was not the intent to limit installations to one location on the property, or to limit to only 80 kWh for all ESS installed on the property. Providing the various maximum thresholds in tabular form provides an easier method for the code user to determine the limits for each location.

Within utility closets, basements and storage or utility spaces
The 40 kWh limit is unchanged from the current version of NFPA 855. That language clarifies that the 40 kWh limit does not apply to spaces or closets located within garages or accessory structures. It only applies to “within the dwelling.”

In attached garages
As the ESS industry has gained more experience with the needs of their customers and the grid, and the building safety community has gained more experience with ESS, it is becoming clear that the arbitrary capacity restrictions in the residential code are a hindrance to the deployment of clean energy technologies and are unneeded for safety. Hundreds of thousands of residential batteries have been installed and constructed to product standards leading to greater levels of safety. Taken together, these facts support a reasonable increase in kWh

capacity to align with other anticipated hazards and fuel loads that may be present in a residential garage.

A modest increase in the allowable aggregate ESS capacity from 80 kWh to 100 kWh does not pose a significant elevated fire risk in the garage. Manufacturers design ESS to well-established safety standards. They have demonstrated proven track records of operating without igniting in homes, and are built in a way to resist adding fuel to fires from other sources. In the rare event of an ESS fire, a fire from 100 kWh of energy storage does not pose a significantly greater threat to occupant safety and is not significantly more difficult to extinguish than a fire from 80 kWh of energy storage.

The fuel energy density and heat release rate potential presented by a 100-kWh energy storage system are comparable to that of vehicles parked in garages. 100 kWh is a typical capacity of currently available electric vehicles (EVs), which use lithium-ion chemistries as do many stationary ESS. EVs also present significant additional fuel load through materials like upholstered seating and plastic trim. Internal combustion engine (ICE) vehicles have fuel, engine lubricants, and other components with the potential for very significant heat release rates. While the fuel load in a vehicle fueled by a gaseous fuel such as CNG or hydrogen can be less than that of a 100-kWh ESS in total energy output, the dynamics of a designed quick release of a gaseous fuel due to fire exposure in an attached garage can pose a significant concentrated fire exposure, or potentially a deflagration hazard risk to occupants and emergency responders.

This proposal allows homes to add an aggregate of 100 kWh of energy storage to an attached garage, while keeping the content fuel loads at safe levels. While actual fuel loads in garages can vary widely, this can be demonstrated using typical and conservative figures:

A reasonable fuel load for a garage is approximately 22,300 MJ. This assumes the garage is 20' x 20' and that a reasonable fuel load density is 600 MJ/m . Parking two gasoline powered cars in the garage makes up approximately 10,600 MJ of fuel load. Other garage items can make up approximately 3,300 MJ of fuel load. The remaining fuel load available to an ESS (22,300 MJ minus 10,600 MJ minus 3,300 MJ) is 8,400 MJ. 8,400 MJ is equivalent to an ESS with an aggregate capacity of 100 kWh, assuming the ESS has a fuel load of 84 MJ/kWh.

On or within 3 feet (914 mm) of exterior walls of dwellings and attached garages
ESS on the exterior side of exterior walls pose less of a safety risk than ESS inside attached garages. Typical exterior home construction provides sufficient protection from a thermal event. The product safety standard has specific requirements when ESS is intended for wall mounting, near exposures, where surface temperature measurements on wall surfaces do not exceed 97°C (175°F) of temperature rise above ambient per 9.2.15.

In detached garages and detached accessory structures
This scenario poses minimal risk to occupant safety, considering the distance from the dwelling and testing required of ESS. ESS in detached structures pose less of a safety risk than ESS on

the exterior side of the dwelling. If an ESS with an aggregate rating of 200 kWh on the exterior side of the dwelling is considered reasonable, then an ESS with an aggregate rating of 200 kWh should be reasonable for ESS in detached structures. 600 kWh matches Table 1207.5 of the IFC. ESS in structures separated from the dwelling by 10 feet do not pose demonstrable risk to occupants.

Outdoors on the ground
This scenario poses minimal risk to occupant safety, considering the distance from the dwelling and the testing required of ESS. Ground mount ESS pose less of a safety risk than ESS on the exterior side of the dwelling. If an ESS with an aggregate rating of 200 kWh on the exterior side of the dwelling is considered reasonable, then an ESS with an aggregate rating of 200 kWh should be reasonable for ESS mounted on the ground.

Additionally, 200 kWh is equivalent to two typical EVs that can be parked anywhere on the property.

600 kWh matches Table 1207.5 of the IFC. ESS separated from property lines and the dwelling by 10 feet does not pose a demonstrable risk to occupants.

Endnotes
1. Tesla Model X has a capacity of 100 kWh. Tesla Model S has a capacity of 70-85 kWh. Chevy Bolt has a capacity of 66 kWh. The electric Ford F150 has a capacity of 110-130 kWh or 150-180 kWh with extended range. Sources: ttps://www.forbes.com/wheels/cars/tesla/model-x/, https://www.tesla.com/sites/default/files/tesla-model-s.pdf, https://media.chevrolet.com/media/us/en/chevrolet/vehicles/bolt-ev/2021.tab1.html, https://www.forbes.com/wheels/news/2022-ford-f-150-lightning-ev-pickup-debuts-300-mile-range-priced-at-40k.

2. Builders' websites show the typical two-garage is around 20' x 20'. For example, HWS Garages' website states that "The average 2-car garage size is anywhere from 18' x 20' to 22′ x 22'." While some garages are one-car and some are three-car, a poll conducted by Garage Living shows that 61 percent of garages are two-car. Sources: www.hwsgarage.com/average-garage-sizes/ and www.garageliving.com/blog/home-garage-stats.

3. The average fuel load of a living room is 600 MJ/m . 600 MJ/m^2 is also the business standard in NFPA 557. Sources: Alex Bwalya et al., "A Pilot Survey of Fire Loads in Canadian Homes," National Research Council Canada, March 9, 2004; National Fire Protection Association, "NFPA 557: Standard for Determination of Fire Loads for Use in Structural Fire Protection Design," 2020 Edition, Section 6.1.3.

4. 10,577 MJ (rounded to 10,600 MJ) assumes a small car (2,909 MJ) and large car (7,648 MJ). Sources: Mohd Tohir and Michael Spearpoint, "Distribution analysis of the fire severity characteristics of single passenger road vehicles using heat release rate data," Fire Science

Reviews, 2013. Also see M.J. Spearpoint, et. al., "Fire load energy densities for risk-based design of car parking buildings," Case Studies in Fire Safety, 29 April 2015.

5. 3,341 MJ (rounded to 3,300 MJ) is equivalent to half the fuel load items in a typical basement living room. Source: Bwalya, A.C., et. al., "Survey Results of Combustible Contents and Floor Areas in Multi-Family Dwellings," National Research Council Canada, 24 October 2008.

6. 84 MJ/kWh is derived from the estimated fuel load of the gases released by an ESS in thermal runaway (44 MJ/kWh) and the estimated fuel load of the burnable contents inside the ESS (40 MJ/kWh). 44 MJ/kWh was derived from reviewing several studies referenced below. 40 MJ/kWh was derived from multiplying 2 kg/kWh (a conservative figure for burnable contents inside the ESS – the weight of internal contents for some ESS is 1.0-1.5 kg/kWh) by 20 MJ/kg (the typical fuel load of a computer). Sources for fuel load of gases: Frederik Larsson, "Toxic fluoride gas emissions from lithium-ion battery fires," Scientific Reports, 30 August 2017; David Sturk et. al., “Fire Tests on E-vehicle Battery Cells and Packs,” Traffic Injury Prevention, 25 February 2015. Sources for kg/kWh weight of internal burnable contents: Tesla, SimpliPhi, and Solaredge. Source for fuel load of a computer: Alex Bwalya et al., "A Pilot Survey of Fire Loads in Canadian Homes," National Research Council Canada, March 9, 2004.

Cost Impact: The code change proposal will not increase or decrease the cost of construction It clarifies how the maximum thresholds are applied. Allows for more ESS while maintaining a level of safety.

Public Input No. 117-NFPA 855-2023 [Section No. 15.5.2]

15.5.2

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

(1) 40 kWh ~~within~~ for Li-based batteries, flow batteries, electric double-layer capacitors (EDLC), or battery types not listed in this requirement within utility closets, basements, and storage or utility spaces

(2) 80 kWh for Li-based or flow batteries, EDLC, or battery types not listed in this requirement in attached ~~or detached garages and detached accessory structures~~

~~80 kWh~~

(3) garages, or where outdoor wall - mounted

(4) ~~80 kWh where outdoor ground mounted~~

(5) ~~to the primary residential structure, or when on or in accessory structures (such as detached garages, sheds) or ground-mounted within 10 feet of the primary residential structure~~

(6) ~~250 kWh for Li-based or flow batteries or EDLC or battery types not linted in this requirement when where outdoor ground-mounted or on or in accessory structures 10 feet or more away from the primary residential structure~~

(7) ~~250 kWh regardless of location on the residential property when using lead-acid, Ni-Cd, Ni-MH, Ni-Zn, NaNiCl, or rechargeable zinc manganese dioxide technologies~~

Additional Proposed Changes

File Name	Description	Approved
15-5-2_PI.docx	Corrected legislative text for 15.5.2 PI 117 because TerraView wouldn't show changes correctly	

Statement of Problem and Substantiation for Public Input

While the limits imposed by this section are relatively reasonable for safety for Li-ion batteries, they do not take into account the use of other relatively safer technologies such as lead-acid, Ni-Cd, etc. Nor do they take into account the higher backup times needed by off-grid residences. These proposed changes still address safety, but allow off-grid residential applications to meet the Code and still have adequate backup times. The lower and higher limits for differing technologies are in keeping with the ideas in existing Tables 1.3 and 9.4.1.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 106-NFPA 855-2023 [Section No. 15.5.1]	
Public Input No. 118-NFPA 855-2023 [Section No. 15.5.3]	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

Organization: American Power Systems/ East P

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Zip:
Submittal Date: Tue May 16 09:08:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-6-NFPA 855-2023

Statement: The protection levels found within Chapter 15 for this chemistry type allows for the change to be supported. This allows an aggregate amount for the total of the system.

15.5.2

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

1. 40 kWh for Li-based batteries, flow batteries, electric double-layer capacitors (EDLC), or battery types not otherwise listed in this requirement within utility closets, basements, and storage or utility spaces
2. 80 kWh for Li-based or flow batteries, EDLC, or battery types not otherwise listed in this requirement in attached or detached garages, or where outdoor wall-mounted to the primary residential structure, or when on or in and detached accessory structures (such as detached garages, sheds, etc.) or ground-mounted within 10 feet of the primary residential structure
3. 250 80 kWh for Li-based or flow batteries or EDLC or battery types not listed in this requirement where outdoor wall ground-mounted or on or in accessory structures 10 feet or more away from the primary residential structure
4. 250 80 kWh regardless of location on the residential property when using lead-acid, Ni-Cd, Ni-MH, Ni-Zn, NaNiCl, or rechargeable zinc manganese dioxide technologies where outdoor ground mounted

Public Input No. 155-NFPA 855-2023 [Section No. 15.5.2]

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.

(5) 250 kWh for lead-acid and nickel cadmium installations regardless of placements.

Statement of Problem and Substantiation for Public Input

Testing to the current UL 1973 proves that lead-acid and nickel-cadmium batteries will not start a fire. UL 1973 requires a self-extinguishing flame-retardant material (UL V2 or greater) for the container and container (jar) cover; thus, the lead-acid and nickel-cadmium batteries will not internally generate a fire.

Table 9.4.1 states that lead-acid and nickel-cadmium battery systems are granted unlimited kWh for MAQ, and restricting maximum sizing does not appear to be consistent with the logic behind Table 9.4.1. However, placing a limit on 1 and 2 family dwellings is not objectionable.

Submitter Information Verification

Submitter Full Name: Chris Searles

Organization: Ieee Essb Committee

Affiliation: CGS and Associates

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Submittal Date: Tue May 23 14:39:27 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-6-NFPA 855-2023

Statement: The protection levels found within Chapter 15 for this chemistry type allows for the change to be supported. This allows an aggregate amount for the total of the system.

Public Input No. 118-NFPA 855-2023 [Section No. 15.5.3]

15.5.3

ESS installations of Li-based batteries, flow batteries or electric double-layer capacitors (EDLC) exceeding the individual or aggregate ratings allowed by 15.5.1 or 15.5.2 shall ~~comply with Chapters~~ 4 ~~through~~ ~~9~~ be provided with a product-level evaluation by an approved qualified person with expertised in energy storage as a supplemental safety document to be used by the AHJ and the installing contractors .

Statement of Problem and Substantiation for Public Input

Lumping all battery chemistries under the exact same restrictive requirements is not the intent of NFPA 855 (see Table 1.3 and 9.4.1 as just two of many examples). Thus, it is prudent to limit the more restrictive requirements to the technologies that are not as safe. The ending text is taken directly from proposed TIA 1727, since it has been felt that requiring residences to meet the full requirements of Chapter 4 is overkill, and economically unjustifiable. The TIA language allows another way to help improve safety without raising costs astronomically of small residential projects.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 106-NFPA 855-2023 [Section No. 15.5.1]	
Public Input No. 117-NFPA 855-2023 [Section No. 15.5.2]	

Submitter Information Verification

Submitter Full Name: Curtis Ashton

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Submittal Date: Tue May 16 09:56:29 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: The proposed text is duplicative of the chapter as a whole and could layer in confusion by the user.

Public Input No. 345-NFPA 855-2023 [Section No. 15.7]

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.

15.7.3 A fire detection system complying with NFPA 72 shall be installed in locations within dwelling units and attached garages where the interconnection to existing systems in 15.7.2 is not feasible or where invasive techniques would be required to install new fire detection devices in existing finished construction. Battery-powered and wirelessly-interconnected devices shall be permitted.

Statement of Problem and Substantiation for Public Input

Reason statement: The reality of interconnected fire detection devices is that devices from varying manufacturers cannot be interconnected per their listings. Residential structures may have specific brands of fire detection devices with no compatible heat alarms or detectors. The listing requires interconnection to compatible devices to ensure that communication protocol functions properly. Contractors need the flexibility to comply with the intent of the code using various approved solutions, including the use of battery-powered, wirelessly interconnected devices with remote annunciators.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 14:27:53 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: Noninvasive techniques are available for fire detection systems complying with NFPA 72 in dwelling units.

Public Input No. 156-NFPA 855-2023 [Section No. 15.10]

15.10 ESS ~~Toxic and Highly Toxic Gas~~ 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.

Statement of Problem and Substantiation for Public Input

The use of the words highly toxic is redundant.

Submitter Information Verification

Submitter Full Name: Chris Searles
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Submittal Date: Tue May 23 14:54:20 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: As the requirements and definition for toxic and highly toxic are different it is appropriate to define both. Retaining both terms provides consistency with the rest of the document.

Public Input No. 48-NFPA 855-2023 [Section No. 15.10]

15.10 ESS Toxic and Highly Toxic Gas ~~Release~~ Emissions During Normal Use.

ESS that have the potential to release toxic or highly toxic ~~gas~~ emissions during charging, discharging, and normal use conditions shall be installed outdoors.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group

Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name:	Paul Hayes
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Zip:	
Submittal Date:	Sat Apr 22 14:04:25 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: CI-107-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 107-NFPA 855-2023 [New Section after 15.11.2]

Chapter 16 Flow Batteries

See attached word document for this section

Additional Proposed Changes

File Name	Description	Approved
TG_20_-_Ch_16_Flow_Batteries_FINAL.docx		

Statement of Problem and Substantiation for Public Input

Chapter 16: Everything in this proposed chapter is new content. The task group felt that it is important to create a dedicated flow battery chapter rather than integrating this content into Chapter 9 to avoid confusion. There is enough unique content associated with flow batteries, such as pumps, stacks and large volume of electrolyte, that gets addressed by this chapter.

Table 16.1
Size and Separation - Not applicable
The primary driver for this separation requirement is propagation of a thermal runaway event from one battery group to another. The prescriptive size imposes a barrier to technical innovation in the design of high energy capacity flow batteries. Flow batteries come in various configurations, as the energy capacity is separated from the power capacity in the form of electrolyte tanks and stacks. Many flow batteries have electrolyte tanks with an energy capacity far exceeding 50kWh.

Remediation Measures - Not applicable
The remediation measures provided in 9.6.6 were written for the fire risks and long duration events present in other technologies. These risks are not posed by flow battery failure modes. See 16.6 for additional requirements.

16.1.1 and A 16.1.1: Flow batteries have large volumes of electrolyte that need to be considered in the HMA in more detail than other technologies.

16.2 and A16.2: For the safety of service personnel, flow batteries require different safety measures to protect against chemical exposure.

16.3.1: 8.1.3 applies, however it is important to ensure that the unique aspects associated with flow batteries are addressed.

16.3.2: It was noted that several flow batteries have been decommissioned where there was not clear ownership of electrolyte removal. This language is intended to address this issue.

16.4.1: Some flow batteries have electrolytes that are not compatible with common fire suppression agents. This is to ensure that compatibility in fire suppression systems is addressed.

16.5.1 and 16.5.2: With flow batteries having large volumes of electrolyte, annunciation for electrolyte in the spill containment system is essential because remediation measures are usually necessary.

16.6.1: The remediation measures for flow batteries in the event of a major incident includes risks associated with managing large volumes of spilled electrolyte. This section is intended to address this risk and any others identified by the HMA. This addition is to address concerns identified by the committee with making Section 9.6.6 not applicable.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

Submitter Full Name: Steve Edley
Organization: NFPA 855 Task Group 20
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City:
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Submittal Date: Mon May 15 16:39:25 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-100-NFPA 855-2023

Statement: This new chapter addresses flow batteries rather than integrating this content into Chapter 9 to avoid confusion. There is enough unique content associated with flow batteries, such as pumps, stacks and large volume of electrolyte, that gets addressed by this chapter.

TG 20 PI

Chapter 16 Flow Batteries

16.0 The requirements of this chapter shall apply to the installation of Flow batteries.

16.1 Flow battery installations shall comply with the requirements in chapters 4-9 and 16 as specified in Table 16.1

Compliance Required	Applies	Reference
Construction Documents	Yes	4.2
Emergency Planning and Training	Yes	4.3
HMA	Yes	4.4 and 16.1
Combustible Storage	Yes	4.5
Equipment	Yes	4.6
Installation	Yes	4.7
Smoke and Fire Detection	Yes	4.8
Fire Control and Suppression	Yes	4.9
Mobile ESS Equipment and Operations	Yes	4.10
System Interconnections	Yes	Chapter 5
Commissioning	Yes	Chapter 6
Operation and Maintenance	Yes	Chapter 7 and 16.2
Decommissioning	Yes	Chapter 8 and 16.3
General	Yes	9.1
Equipment	Yes	9.2
Location Classification	Yes	9.3
Maximum Stored Energy	Yes	9.4.1
Size and Separation	No	9.4.2
Location and Applications	Yes	9.5
Protection and Remediation	Yes, except as noted below	9.6, 16.4, 16.5, 16.6
Protection and Remediation	No	9.6.5.6, 9.6.6

Table 16.1 Flow Battery Installations

Commented [CC1]: Is this going to be a standard alone chapter?
It sounds like stand alone so there may be a need to add something to Chapter 1 like dwellings; Flow batteries shall only be required to comply with Chapter 16.

Or will it be something like the following since table has Chapter 5, 6, 7 and 8 apply in entirety;
Unless modified by this chapter, the requirements of Chapters 4 through 9 shall also apply.

Not sure how Chapters 1-3 would be used. Other chapters don't have it and it might not be necessary but. Chapter 9 has row for:
admin Yes Chapter 1-3.

Commented [MOU2R1]: Done.

Commented [CC3]: Need some kind of scope.
16.1 Flow batteries shall comply with the requirements of this chapter.

Or maybe something to also tie in table.
16.1 Flow batteries shall comply with the requirements in Table 16.1.

Either way it can't just have a table without a reference in a section.

Commented [MOU4R3]: Done

Commented [CC5]: Edits to match other chapters.

Commented [MOU6R5]: Done

16.1 Hazard Mitigation Analysis.

16.1.1* In addition to the failure modes in 4.4.2 the hazard mitigation analysis shall evaluate the consequences of the following failures:

~~6~~ .%Assessment of electrolyte containment system failure.

A.16.1.1 Sensitive site concerns may warrant additional containment provisions in addition to secondary containment systems that are part of the listed system. Examples could include environmental sensitivity or the risk associated with some elevated or rooftop installations.

16.2 Operation & Maintenance

16.2* The owner/operator shall confirm there are procedures in place for maintaining safety during servicing of stacks, pumps, fluid delivery systems, tanks and other serviceable components of a flow battery.

A.16.2 Flow batteries containing hazardous chemicals may need drainage or isolation of certain parts of the system in order to prevent unintentional release of chemicals during disassembly.

16.3 Decommissioning

16.3.1 Procedures for decommissioning of flow batteries shall follow manufacturer's instructions.

16.3.2 If the decommissioning requires removal of electrolyte then the owner or their authorized agent shall ensure an entity has been assigned to be responsible for electrolyte removal and disposition upon decommissioning.

16.4 Fire Control and Suppression

16.4.1 Fire suppression agents used in rooms or areas that contain flow batteries shall be compatible with the flow battery materials and electrolytes.

16.5 Spill Control

16.5.1 Where spill control is provided as part of the installation an alarm system shall be provided to signal an electrolyte leak from the system.

16.5.2 Where required, alarm signals shall be transmitted to an approved location.

Commented [CC7]: Is the enforceable as worded? It is necessary to determine what happens when the designed fails including secondary? I take it that is complete failure of containment. Also what happens with the assessment?

Commented [MOU8R7]: Modified to match style of 4.4.2

16.6 **Hazard Support Personnel.**

16.6.1 Where required by the AHJ for public safety, the owner or their authorized agent shall provide hazard support personnel at the owner's expense.

Substantiation

Chapter 16: Everything in this proposed chapter is new content. The task group felt that it is important to create a dedicated flow battery chapter rather than integrating this content into Chapter 9 to avoid confusion. There is enough unique content associated with flow batteries, such as pumps, stacks and large volume of electrolyte, that gets addressed by this chapter.

Table 16.1

Size and Separation - Not applicable

The primary driver for this separation requirement is propagation of a thermal runaway event from one battery group to another. The prescriptive size imposes a barrier to technical innovation in the design of high energy capacity flow batteries. Flow batteries come in various configurations, as the energy capacity is separated from the power capacity in the form of electrolyte tanks and stacks. Many flow batteries have electrolyte tanks with an energy capacity far exceeding 50kWh.

Remediation Measures - Not applicable

The remediation measures provided in 9.6.6 were written for the fire risks and long duration events present in other technologies. These risks are not posed by flow battery failure modes. See 16.6 for additional requirements.

16.1.1 and A 16.1.1: Flow batteries have large volumes of electrolyte that need to be considered in the HMA in more detail than other technologies.

16.2 and A16.2: For the safety of service personnel, flow batteries require different safety measures to protect against chemical exposure.

16.3.1: 8.1.3 applies, however it is important to ensure that the unique aspects associated with flow batteries are addressed.

16.3.2: It was noted that several flow batteries have been decommissioned where there was not clear ownership of electrolyte removal. This language is intended to address this issue.

16.4.1: Some flow batteries have electrolytes that are not compatible with common fire suppression agents. This is to ensure that compatibility in fire suppression systems is addressed.

16.5.1 and 16.5.2: With flow batteries having large volumes of electrolyte, annunciation for electrolyte in the spill containment system is essential because remediation measures are usually necessary.

16.6.1: The remediation measures for flow batteries in the event of a major incident includes risks associated with managing large volumes of spilled electrolyte. This section is intended to address this risk and any others identified by the HMA. This addition is to address concerns identified by the committee with making Section 9.6.6 not applicable.

Public Input No. 228-NFPA 855-2023 [New Section after 15.11.2]

TITLE OF NEW CONTENT

Type your content here .

Chapter 16 Energy Storage Systems on Barges and Vessels

16.1 Application.

16.1.1* The requirements of this chapter shall apply to installations of ESS on marine barges, vessels, and ships that are used to provide power to electrical loads that are external to the barge, vessel or ship.

A.16.1.1 The intent of this section is to provide minimum safety requirements for ESS on marine vessels that may become mobile to provide power to electrical loads on adjacent land based facilities, other moored vessels, or off-shore structures such as oil drilling platforms. In the event that the provisions of chapter 16 do not adequately cover the installation and operation requirements for these systems, the Design Guidance for Lithium-ion Battery Installations Onboard Commercial Vehicles CG-ENG-Policy Letter Dated 02-19 may be utilized as a reference. In the event of conflicting requirements between the provisions of this standard and the reference, the more stringent requirements shall be implemented. This shall include the ASTM F3353-19: Standard Guide for Shipboard Use of Lithium-Ion (Li-ion) Batteries

16.1.2. Unless modified by this chapter, the requirements of Chapters 1 through 14 shall also apply.

Table 16.1 Barge ESS Installations

Compliance Required	**Barge**	**Ref**
Administrative	Yes	Chapters 1–3
General	Yes	Sections 4.1–4.7
Maximum size	Yes	9.5.2.4
Means of egress separation	Yes	9.5.2.6.1.7
Dedicated Use Buildings	Yes	9.5.1.1
Enclosures	Yes	4.6.12
Clearance to exposures	Yes	9.5.3.1.3
Fire suppression and control	Yes	9.5.3.1.4
Size and separation	Yes	9.4.2
Maximum stored energy	Yes	9.4.1
Elevation	Yes	4.7.7
Smoke and fire detection	Yes	9.6.1
Signage	Yes	4.7.4
Occupied work centers	Yes*	9.5.1.2.1
Open rack installations	Yes	4.7.9
Technology-specific protection	Yes	9.6.5
Other Technology	Yes	Chapter 10-13
Storage (off-spec)	Yes	Chapter 14

Table 16.1 Barge ESS Installations

Compliance Required	**Barge**	**Ref**
Stacking N	Yes	Chapter 16
Commissioning, Decommissioning	Yes	Chapters 6 and 8
Maintenance and operation	Yes	Chapter 7

NA: Not applicable.

16.2 Declared disasters

16.2.1* Where the ESS covered by this chapter are deployed to provide power in areas where disasters have been declared by governmental authorities, the AHJ is authorized to temporarily suspend the application of requirements in this standard for an approved time duration.

A.16.2.1 In situations where natural or other disasters occur in communities, these ESS may be required to provide power that is critical to the health and safety of the local population. In these emergency situations the AHJ may choose to get power restored as soon as possible. A plan and timetable can then be developed to apply additional requirements of this standard on a staged basis.

16.3 Commissioning, recommissioning and decommissioning

16.3.1* ESS commissioning, recommissioning, and decommissioning shall comply with this standard.

A.16.3.1 Since the ESS covered by this section can be deployed on a temporary basis, the AHJ may determine compliance with these requirements based on documentation approved by AHJs in other jurisdictions during a previous deployment.

16.4 Operations and maintenance

16.4.1 Operations and maintenance manuals shall be provided and available as required in 6.3. Consideration of the impact of salt water and corrosive environments shall be taken into account when developing testing, maintenance, and inspection procedures.

16.5 Emergency Planning and Training.

16.5.1 Emergency planning and training shall be provided in accordance with 4.3.

16.5.2* Emergency planning and training shall take into consideration:

1) All safety considerations associated with potential ESS events of land based ESS installations

2) * Alternate protection means provided for the installation, and

3) * Response considerations and practical difficulties associated with the marine environment at the deployment site and during transit.

4) * Evacuation of personnel from the vessel during emergency situations.

A.16.5.2(2) The emergency response training and pre-planning should include the unique hazards of floating ESS including but not limited to:

1. Water supply that may be associated with fire protection systems.

2. Locations of E-Stops and accessibility, including while vessel is in transit.

3. Operation of E-stops and functionality, including interconnection to distributed generation

sources, and potential impact to back-up power of fire protection systems.

4. Operation of Critical radio communications and location tracking systems, with redundant back-up power.

5. Corrosion protection – Corrosive environment protection.

6. Shore connections for Fire Protection systems, including potential flex connections for barge movement with stationary hard piping for the Fire Department Connections.

7. Water application of varying salinity (Salt water, fresh water, brackish) and potential negative effects of saltwater application to equipment.

8. Transformers and transformer related hazards.

9. Thermal management of systems and safety components (temperature control).

10. Impact of stray current from batteries on to marina or responding emergency vessels.

11. Impacts from the full extent of tidal surges on Fire Department response and capabilities.

12. Ship in distress and designation of Captain of Port to take charge during an emergency situation.

A.16.5.2(3) Guidelines and standards are available that cover emergency response considerations and tactics related to these ESS deployments. These include the following:

The NFPA 1405 Guide for Land-Based Fire Departments That Respond to Marine Vessel Fires identifies the elements of a comprehensive marine fire-fighting response program including, but not limited to, vessel familiarization, training considerations, pre-fire planning, and special hazards that enable land-based fire fighters to extinguish vessel fires safely and efficiently. In general, the practices recommended in this publication apply to vessels that are covered by the Safety of Life at Sea (SOLAS) agreement or that call at United States ports. It does not consider offshore terminals or vessels on the high sea.

The NFPA 1005 Standard for Professional Qualifications for Marine Fire Fighting for Land-Based Fire Fighters specifies the minimum job performance requirements for Land-Based Fire Fighters operating at marine fire-fighting incidents. It does not address organization/ management responsibility.

The NFPA 1660 Standard for Emergency, Continuity, and Crisis Management: Preparedness, Response, and Recovery provide fundamental criteria for all-hazards preparedness, response, and resiliency program management; the fundamental criteria for mass evacuation, sheltering, and re-entry program management; and a process for the development of pre-incident plans to assist personnel with safe and effective incident management.

A.16.5.2(4) The NFPA 301 Code for Safety to Life from Fire on Merchant Vessels addresses construction, arrangement, protection, and space utilization factors that are necessary to minimize danger to life from fire, smoke, fumes, or panic. It also provides for reasonable protection against property damage and avoidance of environmental damage consistent with the normal operation of vessels. It also identifies the minimum criteria for the design of egress facilities so as to permit prompt escape of passengers and crew to safe areas aboard vessels and, where necessary, to survival craft embarkation stations.

16.6 Locations, anchoring, and securement

16.6.1* The locations in which ESS covered by this section are deployed or staged shall be approved by the AHJ.

A.16.6.1 Consideration should be given to the location in which the ESS is to be deployed, or staged prior to deployment so that adequate distance is provided between the ESS and exposures. In marine deployments nearby marine traffic may represent an exposure or potential risk and should be taken into consideration.

16.6.2 The methods used to anchor or moor the vessel containing the ESS in place shall be approved and provided in accordance with recognized practices, and take into consideration wave action and tidal surges. When vessels/barges are transported and maintained at a Dry-dock facility for maintenance and inspection, the State of Charge shall be reduced and limited to a minimum of 30%, or lower as per manufacturer's specifications.

16.6.3 An approved fence with a locked gate or other approved barrier shall be provided to keep the general public at least 10 ft (1.5 m) from the outer enclosure of the ESS.

16.7 Electrical connections

16.7.1 Approved temporary or fixed electrical connections shall be permitted to provide power to the electrical loads.

16.7.2* Temporary or fixed wiring for electrical power connections shall comply with NFPA 70 or equivalent codes or regulations.

A.16.7.2 If power is provided to marine related structures or vessels, marine related electrical regulations may take precedence.

16.7.3 A readily accessible disconnecting means for the ESS shall be provided in accordance with 5.2. Where required by the AHJ, disconnecting means shall be provided that are accessible both on the vessel, and on the shore or structure being supplied.

16.8 Marine environment

16.8.1* Equipment, wiring, and enclosures shall be suitable for use in the marine environment

A.16.8.1 This requirement is intended to ensure that equipment has sufficient seals, construction, and corrosion resistance to survive the marine environment in which it is used, which may include fresh water or salt water exposures, and potential immersion due to large waves or water spray. Paint protection should follow ISO 12944:2018 "Corrosion protection of steel structures by protective paint systems".

16.8.2 Equipment, wiring and enclosures that have degraded due to exposure to the marine environment shall be repaired or replaced to provide the required protection.

16.9 Smoke and Fire Detection.

16.9.1 Systems used in required smoke and fire detection applications shall be suitable for use in the marine environment in which the vessel is deployed.

16.9.2 Where approved the smoke and fire detection systems that comply with maritime regulations shall be considered equivalent to the protection required by 4.8.

16.10 Fire Control and Suppression.

16.10.1 Systems used in required fire control and suppression applications shall be suitable for use in the marine environment in which the vessel is deployed.

16.10.2 Where approved fire control and suppression systems that comply with maritime regulations shall be considered equivalent to the protection required by 4.8.

16.11 Fire Protection and Construction for Marinas and Boatyards.

The design of Fire Protection systems for Marinas and Boatyards shall be governed by NFPA 303 and NFPA 307. Adequate setbacks and separation distances (or a passive means of protection) shall be provided between the barge/vessel and other barges/vessels or marina buildings and construction when moored.

16.12* Multi-leveled and Stacked Barges.

A Hazard Mitigation Analysis shall be conducted for Battery Barges utilizing multiple levels, stacked systems, or dedicated use structures of BESS. The HMA shall specifically address the unique impacts of these installation orientations

A.16.12 The Hazard Mitigation Analysis should include the unique hazards of floating ESS utilizing stacked equipment, tiered structures, and dedicated use buildings including but not limited to:

1. Full-scale fire and fault testing (UL 9540A) to represent installation arrangement, with stacked systems.

2. For containers that are directly stacked without an interstitial structure, additional Full-scale fire testing (that shows visible external flaming and propagation) to address a fire event that will directly affect the stacked container above it or adjacent to it, including impacts from Radiant heat and deflagration pressures. Hourly passive fire ratings (minimum 2-hr rating) resulting of full-scale failure testing or computer-based modeling that shows visible external flaming.

3. Passive fire protection (ratings) to protect structure from impact resulting from a BESS fire.

4. For stacked rooms or structures that are multiple levels; the impact and feasibility of explosion protection systems (deflagration venting and location of vents) and effectiveness of supporting structure.

5. The potential impact from wind driven events for systems utilizing Open sides (similar to open parking garages) or exposed BESS.

6. The location of Barge and exposures – Remote vs near exposures and impacts.

7. New Technologies if battery technologies not listed in Table 1.3.

8. An analysis of the impact to equipment inside Control House, including but not limited to protection systems and redundancy (backup power). Critical equipment may include Fire protection, Temperature Control (HVAC) and Battery management/Energy Management systems associated with Energy Storage Systems.

9. Minimum fire separations from Occupied or Occupiable spaces and BESS equipment. Adequate protection with rated assemblies for corridors and means of egress.

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Statement of Problem and Substantiation for Public Input

This will address the unique installations on sea worthy barges that is not currently addressed in the standard.This new chapter will give guidance for ESS on barges.

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Submittal Date: Wed May 31 15:49:29 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-108-NFPA 855-2023

Statement: This new chapter addresses the unique installations on sea worthy barges that is not currently addressed in the standard.

Public Input No. 124-NFPA 855-2023 [Section No. A.1.3.1]

A.1.3.~~1~~ 5

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

In some instances, such as for testing and research laboratories, Department of Energy National Laboratories, research universities and manufacturers engaged in product development, it is not possible to meet all prescriptive requirements of NFPA 855. The very nature of research, development, and testing typically precedes required listings such as UL 9540. Product research, development and testing activities still must comply with applicable codes, standards and safety protocols in relation to potential hazards presented by the laboratory activities.

Statement of Problem and Substantiation for Public Input

This proposal moves the topic covered by existing text from A1.3.1 into the normative text, 1.3.5. The intention is to provide a path to compliance for institutions and manufacturers engaged in research, development, and testing. These institutions are involved in pre-product development and required installation requirements and listings such as UL 9540 are not typically present. For example, products need to be tested, complete and functioning in order to obtain listings. Products routinely are set up and tested by third party laboratory occupancies.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 123-NFPA 855-2023 [New Section after 1.3.4]	

Submitter Information Verification

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Submittal Date: Tue May 16 14:00:29 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-20-NFPA 855-2023 The proposed language was too wide open in allowing anything to go into a lab or even pilot plant, without any fire safety professional or AHJ reviewing the possible hazards.

Statement: Labs doing testing need a way to test newer products not yet covered adequately by existing codes and standards.

Public Input No. 88-NFPA 855-2023 [Section No. A.1.4.2]

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~~ <u>If an AHJ becomes aware of additional information regarding hazards due to an inpection, the AHJ shall be permitted to request that</u> a hazard mitigation analysis be submitted by the owner in accordance with Section 4.4.

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

Statement of Problem and Substantiation for Public Input

Based on input from the 855 committee task group (19) on retroactivity, plus feedback from the NFPA standards liaison, and the overall 855 committee, the first sentence was changed to describe how the potentially unsafe installations would be identified (typically via inspection), and informal (can) language was changed to more formal standards language (shall be permitted)

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 17-NFPA 855-2023 [Section No. 4.4.1]	provides a direct link to the HMA requirements

Submitter Information Verification

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Submittal Date: Fri Apr 28 16:28:52 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-23-NFPA 855-2023 Requirements, including permissive requirements, cannot be in annex material.

Statement: The first sentence was changed to describe how the potentially unsafe installations would be identified (typically via inspection).

Public Input No. 135-NFPA 855-2023 [Section No. A.4.4.1]

A.4.4.1

One form of hazard mitigation analysis (HMA) is a failure mode and effects analysis (FMEA), which is a systematic technique for failure analysis. An FMEA is often the first step of a system reliability study and involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded. Other formal methodologies for conducting the analysis can also be used depending on the complexity and type of the system being assessed. Guidance for analysis can be found in the following standards:

(1) IEC 60812

(2) IEC 61025

(3) MIL-STD-1629A

The mixing of lead-acid batteries with nickel-cadmium batteries should not present a risk of adverse interaction. An HMA might not be necessary for these installations.

Many ESS will be provided with safety equipment to meet the requirements of UL 9540, but in some circumstances additional safety equipment might need to be provided over and above what is included with the ESS. For example, an ESS installed indoors might depend upon exhaust ventilation provided with the installation in accordance with 9.6.5.1 to remove gases from the building. In this case, the HMA would need to address possible failures of such a system. It is not the intent of the HMA to evaluate the safety equipment provided as part of a listed ESS unless that equipment is installation dependent as determined by the testing to UL 9540 and UL 9540A.

To clarification of "adverse" see Section 9.4.1.3 and Section 9.6.2.3.

Statement of Problem and Substantiation for Public Input

The two references provide information that clarifies the meaning of adverse.

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Committee:	ESS-AAA

Committee Statement

Resolution: FR-25-NFPA 855-2023 The proposed references to 9.4.1.3 and 9.6.2.3 do not describe adverse interactions, but simply give design parameters when technologies are mixed in the same fire area.

Statement: There is a need to differentiate between adverse interactions that increase safety risks and those that do not (such as those that may affect only reliability), and thus examples were provided.

Public Input No. 136-NFPA 855-2023 [Section No. A.4.4.1]

A.4.4.1

One form of hazard mitigation analysis (HMA) is a failure mode and effects analysis (FMEA), which is a systematic technique for failure analysis. An FMEA is often the first step of a system reliability study and involves reviewing as many components, assemblies, and subsystems as possible to identify failure modes and their causes and effects. For each component, the failure modes and their resulting effects on the rest of the system are recorded. Other formal methodologies for conducting the analysis can also be used depending on the complexity and type of the system being assessed. Guidance for analysis can be found in the following standards:

(1) IEC 60812

(2) IEC 61025

(3) MIL-STD-1629A

The mixing of lead-acid batteries with nickel-cadmium batteries ~~should~~ will not present a risk of adverse interaction. An HMA ~~might~~ is not be necessary for these installations.

Many ESS will be provided with safety equipment to meet the requirements of UL 9540, but in some circumstances additional safety equipment might need to be provided over and above what is included with the ESS. For example, an ESS installed indoors might depend upon exhaust ventilation provided with the installation in accordance with 9.6.5.1 to remove gases from the building. In this case, the HMA would need to address possible failures of such a system. It is not the intent of the HMA to evaluate the safety equipment provided as part of a listed ESS unless that equipment is installation dependent as determined by the testing to UL 9540 and UL 9540A.

Statement of Problem and Substantiation for Public Input

There are no possible safety interactions by mixing these two chemistries. There are life considerations if the float voltage is not compatible with both chemistries, but there will be no safety issues.

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Committee:	ESS-AAA

Committee Statement

Resolution: FR-25-NFPA 855-2023 The proposed references to 9.4.1.3 and 9.6.2.3 do not describe adverse interactions, but simply give design parameters when technologies are mixed in the same fire area.

Statement: There is a need to differentiate between adverse interactions that increase safety risks and those that do not (such as those that may affect only reliability), and thus examples were provided.

Public Input No. 90-NFPA 855-2023 [New Section after A.4.6.1]

A.4.6.3.1 Some flow batteries can be retrofitted with additional energy storage, discharge or recharge capacity without having to replace the entire battery. For example, additional energy storage could be added by replacing or adding more electrolyte tanks to an existing battery. The flow battery must remain in scope of the product listing in order to comply with 4.6.3.1

Statement of Problem and Substantiation for Public Input

The existing language in 4.6.3 is adequate for flow battery retrofits, however clarification is necessary to ensure that retrofits remain in compliance with their product listing after modification. This appendix note is intended to draw attention to how retrofits may be applied to flow batteries.

This Public Input was submitted by the Flow Battery Task Group TG20.

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Submittal Date: Mon May 08 16:16:47 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-99-NFPA 855-2023

Statement: The existing language in 4.6.3 is adequate for flow battery retrofits, however clarification is necessary to ensure that retrofits remain in compliance with their product listing after modification. This appendix note draws attention to how retrofits may be applied to flow batteries.

Public Input No. 163-NFPA 855-2023 [Section No. A.4.6.1]

A.4.6.1

It is envisioned that equipment provided will be listed in accordance with UL 9540. ESS that are not listed in accordance with UL 9540 should be documented and ~~verified~~ verified by an approved third-party certification organization as meeting the provisions of this standard using the equivalency requirements in Section 1.5, where technical documentation provided shows the ESS that is proposed results in a system that is no less safe than a system meeting the construction and performance requirements of UL 9540. ~~If nonlisted equipment is to be evaluated for compliance with UL 9540, the evaluation and documentation should be provided as part of a field evaluation conducted by an approved third-party certification organization.~~

In specific instances, this standard will not require equipment such as lead-acid batteries to be listed or they can be listed to UL 1973 instead of UL 9540.

Statement of Problem and Substantiation for Public Input

This clarifies that an approved third-party certification organization should be involved and removes references to field evaluation since field evaluation alone is not equivalent to listing.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 164-NFPA 855-2023 [Section No. 4.6.1]	

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Committee: ESS-AAA

Committee Statement

Resolution: The proposed text would provide a pathway to circumvent the required listing.

Public Input No. 245-NFPA 855-2023 [Section No. A.4.6.1]

A.4.6.1

It is envisioned that equipment provided will be listed in accordance with the appropriate test standard (UL 9540) or an equivalent AHJ approved process by a recognized laboratory . ESS that are not listed in accordance with UL 9540 should be documented and verified as meeting the provisions of this standard using the equivalency requirements in Section 1.5, where technical documentation provided shows the ESS that is proposed results in a system that is no less safe than a system meeting the construction and performance requirements of UL 9540. If nonlisted equipment is to be evaluated for compliance with UL 9540, the evaluation and documentation should be provided as part of a Limited production certification (LPC) process or an AHJ approved field evaluation conducted by an OSHA approved recognized laboratory or third-party certification organization.

In specific instances, this standard will not require equipment such as lead-acid batteries to be listed or they can be listed to UL 1973 instead of UL 9540.

Statement of Problem and Substantiation for Public Input

While the intent of the 855 standard the requirements of the UL 9540 listing is to provide a BESS product that meets this standard through product components and fabrication production that is appropriately evaluated and found acceptable at a production level. This is not consistently happening to provide 9540 listings because of products that are stick built in the field, Products that have multiple fabrications points such as the batteries and modules that are manufactured in Asia, the containers are integrated in South American, and the finishing touches are completed on a clients site in the US. Or certain completed components are not part of the manufacturer's products such as the requirements for a UL listed inverter. Or the Batteries have been repurposed and production pathways are no longer viable to evaluate. Because of these issue production listings are not always achievable through manufacturing, so therefore it doesn't happen. Additional options are and should be available for ensuring a "listing". By providing definitions and clarification around listings, it provides a better compliance options for a system that lacks options for successful compliance.

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Committee: ESS-AAA

Committee Statement

Resolution: The proposed text would provide a pathway to circumvent the required listing.

Public Input No. 111-NFPA 855-2023 [Section No. A.4.6.9.1]

A.4.6.9.1

UL 9540 requires inverters, chargers, and charge control equipment that are part of an ESS to be designed and rated for use with the battery system employed in the ESS and evaluated to UL 1741, UL 62109-1, CAN/CSA C22.2 No. 62109-1, ~~UL 1012, UL 1778,~~ UL 1012, UL 62368-1, CAN/CSA C22.2 No 62368, UL 1778, or CAN/CSA C22.2 No. 107.1 as applicable to the power conversion equipment and its application in the system. UL 9540 also requires power conditioning systems for standalone and multi-mode applications to comply with UL 1741, UL 62109-1, CAN/CSA C22.2 No. 62109-1, or CSA C22.2 No. 107.1.

Statement of Problem and Substantiation for Public Input

UL 9540 STP has reached consensus on the addition of UL 62368-1 and CAN/CSA C22.2 No. 62368-1 to the requirements for listing of Inverters, chargers and charge control equipment. This proposal aligns with the forthcoming UL 9540 change.
This proposal adds "UL 62368-1, CAN/CSA C22.2 No 62368" with no other changes.

Submitter Information Verification

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Committee:	ESS-AAA

Committee Statement

Resolution: FR-35-NFPA 855-2023

Statement: This adds standards that are relevant to charging side of the BESS systems that ultimately are part of the UL 9540 listing.

Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]

A.4.6.11

It is not the intent of 4.6.11 to address the presence of toxic and highly toxic ~~gases~~ emissions that are produced during abnormal conditions, such as a fire in the building or thermal runaway (see section 9 .6.5.6). C ertain metal oxides, heavy metals, and toxic liquids or particulates that are not gasses may be emitted from various battery types.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date:	Sat Apr 22 12:08:04 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: CI-85-NFPA 855-2023

Statement: The technical committee is seeking public comment on this for the Second Draft,

While many ESS technologies use toxic materials and can produce toxic byproducts (particularly during an abnormal event, such as thermal runaway or fire), there is a difference between generation or released and emission. If the toxic species is generated internal to the battery (or by fire suppression system interaction with the ESS) but is consumed internally or is combusted or reacts to form other non-toxic compounds prior to human exposure it is not considered to be “emitted”.

Toxic emissions are not adequately addressed in the current addition of 855. Information on the generation and emission of gases is still limited. A new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 11-NFPA 855-2022 [Section No. A.4.8.1]

A.4.8.1

Very early warning smoke detection systems can provide an earlier indication of a potential fire with an ESS. Smoke detectors listed to UL 268 7th edition and later are optimized for general commercial applications and are designed to comply with the new cooking nuisance smoke test (Normal Application Smoke Detection). Smoke detectors designated for Special Applications in UL 268 7th edition are designed to be used in applications that require higher sensitivity and that are less likely to be exposed to cooking nuisances. In addition, NFPA 72 permits aspirated smoke detector transport time of up to 120 seconds, consideration should be given to keeping the transport time below 90 seconds for earlier warning. In addition to detectors on the ceiling, consider placing smoke detectors or air sampling ports in the path of airflow within the ESS including within electrical cabinets. Detectors outside of the return air envelope are likely to have a delayed response since the fire will have to grow to such a size that it can overcome the forces of the mechanically generated airflow.

For lithium-ion ESS, a smoke detection system can be supplemented by a listed or approved off-gas detection system. Off-gas detection can increase the effectiveness of the smoke detection system for providing early response of an off-normal condition.

Gas detection technology can also provide additional information on conditions inside the ESS enclosure.

Statement of Problem and Substantiation for Public Input

Smoke detectors listed to UL 268 7th edition and later are required to meet a new requirement for cooking nuisances. Because this limits how sensitive the detector can be, the standard allows detectors to be listed with a "special application" mode that allows them to bypass the nuisance test and hence, be more sensitive. Users of NFPA 855 may not be familiar with these requirements and would benefit from having this information in the Annex. Furthermore, detectors placed to intercept the airflow in an ESS will be better positioned to detect smoke at an earlier stage.

Submitter Information Verification

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Submittal Date: Tue Nov 29 13:46:51 EST 2022
Committee: ESS-AAA

Committee Statement

Resolution: FR-91-NFPA 855-2023
Statement: The appendix language is revised to account for the updates to UL 268.

Public Input No. 317-NFPA 855-2023 [Section No. A.4.8.1]

A.4.8.1

Very early warning smoke detection systems can provide an earlier indication of a potential fire with an ESS. Smoke detectors listed to UL 268 7th edition and later are optimized for general commercial applications and are designed to comply with the new cooking nuisance smoke test (Normal Application Smoke Detection). Smoke detectors designated for Special Applications in UL 268 7th edition are designed to be used in applications that require higher sensitivity and that are less likely to be exposed to cooking nuisances. In addition, NFPA 72 permits aspirated smoke detector transport time of up to 120 seconds, consideration should be given to keeping the transport time below 90 seconds for earlier warning. In addition to detectors on the ceiling, consider placing smoke detectors or air sampling ports in the path of airflow within the ESS including within electrical cabinets. Detectors outside of the return air envelope are likely to have a delayed response since the fire will have to grow to such a size that it can overcome the forces of the mechanically generated airflow.

For lithium-ion ESS, a smoke detection system can be supplemented by a listed or approved off-gas detection system. Off-gas detection can increase the effectiveness of the smoke detection system for providing early response of an off-normal condition.

Gas detection technology can also provide additional information on conditions inside the ESS enclosure.

Statement of Problem and Substantiation for Public Input

Provides additional guidance on the changes regarding smoke detector technology and approvals as it relates to ESS. It also emphasizes that the location of and type of smoke detector may impact the transport and response time.

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Submittal Date: Thu Jun 01 12:16:50 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-91-NFPA 855-2023

Statement: The appendix language is revised to account for the updates to UL 268.

Public Input No. 287-NFPA 855-2023 [Section No. A.4.8.2.2]

A.4.8.2.2

~~As part of the smoke detection system's local annunciation, providing a fire alarm annunciation panel for emergency responders in an approved location where it can annunciate the ESS(s) being monitored should be considered. The location and information provided should be covered by the emergency operations plan required by 4.3.2.1 and evaluated as part of the HMA~~ The intent of this section is to ensure that all the signals are aggregated at a single location that can be readily and safely observed throughout the duration of the event. This is defined as the Fire Command Center (FCC) but also may be referred to as a "First Responder Station", though this terminology is not preferred as first responders may refer to other emergency personnel other than the fire department (police, EMS, etc.) which may not need access to the FCC. All information that the fire service might need to rely on (smoke, gas, or heat detection, fan operation, fan control, etc.) should all be accessible and when necessary operable from the FCC .

Statement of Problem and Substantiation for Public Input

Clarifies the intent of the section, the use of the term FCC, and the meaning of First Responder Station.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 275-NFPA 855-2023 [Section No. 4.8.2.2]	Appendix material

Submitter Information Verification

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Committee: ESS-AAA

Committee Statement

Resolution: FR-43-NFPA 855-2023

Statement: This revision ensures that "other" approved locations are permitted as various sites may not have a formal fire command center or may have reporting to multiple locations.

This aligns the requirement with the defined fire command center and ties it in with the colloquial term "first responder station."

Public Input No. 128-NFPA 855-2023 [New Section after A.4.9.4.1]

A4.11 Electric Vehicle Battery Use.

Electric vehicles can be used to supply power for backup use and a variety of grid support functions. Vehicle to Grid (V2G) applications typically require Permission To Operate (PTO) as they run in parallel with the utility. A potential gap exists regarding projects that use EV batteries with bidirectional EVSE, running in parallel with the distribution grid as generating facilities and with an interconnection agreement with the utility company, because they do not meet the existing definition of mobile ESS. In many respects, these installations are similar to those defined in section 3.3.9.5, mobile ESS used in a stationary situation. They are mobile battery packs that are being charged and discharged at a specific, permitted and interconnected location, and these facilities can easily reach multi-megawatt scale.

However, because the battery packs used in the V2G case are EV battery packs installed in EVs, they do not have the UL 9540 listing required for 855 compliance. There are no requirements for EV batteries to be listed to UL 1973 or 2580, and as a result, cannot be listed as a stationary ESS to UL 9540.

Statement of Problem and Substantiation for Public Input

Providing the new V2G explanatory material.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 127-NFPA 855-2023 [New Section after 4.10]	

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Submittal Date: Wed May 17 17:20:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: CI-22-NFPA 855-2023 Most V2G applications would still be at the residential level, and thus the text in 15.11 kept.

Statement: The technical committee is seeking public comment on this for the Second Draft,

V2G is larger than just residential, and thus should be covered in Chapter 4, in addition to Chapter 15.

Public Input No. 92-NFPA 855-2023 [New Section after A.6.1.1.2]

A.6.1.3.2 Examples of the procedures to be used in documentation of the proper operation of the ESS and all associated operational controls and safety systems include the following:

(1) ESS input and output power should track the commands.

(2) ESS shuts down when shut-down command is sent.

(3) Procedures for safe start up and shut down as described in 7.1.2(1) and procedures for inspection and testing of associated alarms, interlocks, and controls as described in 7.1.2(2) is made available at the start of commissioning.

Statement of Problem and Substantiation for Public Input

This provides examples of safety systems that should be tested upon commissioning.

This Public Input was submitted by the Flow Battery Task Group TG20.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 91-NFPA 855-2023 [Section No. 6.1.3.2]	
Public Input No. 91-NFPA 855-2023 [Section No. 6.1.3.2]	

Submitter Information Verification

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Committee: ESS-AAA

Committee Statement

Resolution: FR-98-NFPA 855-2023

Statement: Where spill detection systems are provided, they should be tested. In the case of flow batteries, spill detection systems are an integral part of the safety systems.

Public Input No. 254-NFPA 855-2023 [Section No. A.6.4.2]

A.6.4.2

Listed software changes completed as part of providing new operating modes or functions should be considered system renewals ~~because it is a listed change~~ .

Statement of Problem and Substantiation for Public Input

This attempts to clarify that the addition of new operations and modes to listed software should be considered a system renewal.

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Submittal Date:	Wed May 31 21:41:45 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-150-NFPA 855-2023

Statement: It is important that significant software changes that alter the operating modes or functions be properly reviewed for approval and initiate a recommissioning qualification like other system renewals.

Public Input No. 214-NFPA 855-2023 [Section No. A.6.4.4]

A.6.4.4

When listed ESS is modified in the field, it can change its ability to comply with the requirements in the standard used to list the product. It is difficult or impossible for AHJs and service personnel to verify that the modified product complies with those requirements. Certification organizations have the expertise to evaluate product modifications and ~~have field evaluation programs to investigate the modified product and provide a field evaluation label~~ their impact on the product listing . It is not anticipated that ~~a field evaluation is needed~~ certification organizations need to evaluate modifications that are identified in the instruction manual provided with the listed equipment, such as swapping out or adding listed modules. It is also not anticipated that a ~~field evaluation is needed for~~ certification organization needs to evaluate like-for-like repairs that do not impair the overall safety of the product.

Statement of Problem and Substantiation for Public Input

This attempts to clarify certification organizations and their roles in evaluating modifications of listed products. This also removes mention of "field evaluation" since field evaluation is a term used by certification organizations and it is not equivalent to listing.

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Submittal Date: Wed May 31 11:42:50 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-143-NFPA 855-2023

Statement: The are instances where a field evaluation is necessary for ESS installations. The field evaluation should be done by a certification organization because while the field evaluation may not be the same as a listing, the field evaluation should be conducted in a manner that is as close as possible to a listing evaluation UL 9540. The first revision text allows for certification and field evaluations as necessary.

Public Input No. 356-NFPA 855-2023 [Section No. A.9.1.5.1]

A.9.1.5.1

A

~~UL 9540A test or equivalent test should evaluate the fire characteristics of the composition of gases generated at cell level, module level, and unit and installation levels for an indoor installation of an ESS that undergoes thermal runaway, such as what might occur due to a fault, physical damage, or exposure hazard. The evaluation of the fire characteristics during fire vent testing at the unit level and indoor installation level testing should document whether the fire event propagates to the neighboring ESS units and include radiant heat flux measurements at enclosing wall surfaces and at various distances from the ESS being tested at the unit level.~~

.9.1.5.1

The test methodology in UL 9540A determines the capability of a battery technology to undergo thermal runaway and then evaluates the fire and explosion hazard characteristics of those battery energy storage systems that have demonstrated a capability to undergo thermal runaway .

The test sequence in UL 9540A includes, in order, cell, module, unit and installation level tests. If the following individual test results are obtained no further testing in the sequence is needed.

Cell level test – Thermal runaway cannot be induced in the cell and the cell vent gas is nonflammable in air in accordance with ASTM E918.

Module level test – The effects of thermal runaway are contained by the module design, and cell vent gas (based on the cell level test) is nonflammable

Unit level test - All of the following results are obtained:

(1) Target BESS temperatures less than cell surface temperature at gas venting, and meets the heat flux limits for means of egress.

(2) Temperature increase of target walls less than 97 °C (175 °F)

(3) No explosion hazards exhibited by the product

(4) No flaming beyond outer dimensions of BESS unit (indoor, wall mount)

Installation level test – Acceptable performance includes all of the following:

(1) Target BESS temperatures less than cell surface temperature at gas venting, and meets the heat flux limits for means of egress.

(2) Temperature increase of target walls less than 97 °C (175 °F)

(3) The flame indicator does not propagate flames beyond the width of the initiating BESS

(4) No flaming outside the test room, and meets the heat flux limits for the means of egress.

The data generated by the fire and explosion testing is intended to be used by manufacturers, system designers, and AHJs to determine the need for fire and explosion protection required for an ESS installation.

Statement of Problem and Substantiation for Public Input

This proposal reflects criteria in the scope of UL 9540A, including the individual test performance criteria in Figure 1.1. It also describes the sequence of tests, and results that may allow additional tests in the sequence to not be conducted.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 355-NFPA 855-2023 [Section No. 9.1.5.1 [Excluding any Sub-Sections]]	
Public Input No. 366-NFPA 855-2023 [Section No. 9.1.5.2.1]	

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Submittal Date: Thu Jun 01 16:30:33 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-139-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]

A.9.1.5.1

A UL 9540A test or equivalent test should evaluate the fire characteristics of the composition of both explosive gases generated and toxic and highly toxic emissions at cell level, module level, and unit and installation levels for an indoor installation of an ESS that undergoes thermal runaway, such as what might occur due to a fault, physical damage, or exposure hazard. The evaluation of the fire characteristics during fire vent testing at the unit level and indoor installation level testing should document whether the fire event propagates to the neighboring ESS units and include radiant heat flux measurements at enclosing wall surfaces and at various distances from the ESS being tested at the unit level. The data generated by the fire and explosion testing is intended to be used by manufacturers, system designers, and AHJs to determine the need for fire and explosion protection required for an ESS installation.

Statement of Problem and Substantiation for Public Input

Clarification toxic and highly toxic emissions need to be collected during 9540A testing for evaluation of MAD and Plum studies as well as inclusion of the HMA.

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]

Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date:	Sat Apr 22 12:14:10 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-139-NFPA 855-2023

Statement: Since the code assumes compete failure of a unit or cabinets, this will require an ignition source to ignite those technologies that produce combustible gases during 9540A but do not catch fire. Currently an outdoor ESS unit can "pass" UL9540A if no visible flames are observed, however copious quantities of smoke/vent/off-gas may be emanating from the ESS. Based on cell and module level testing we know that this mixture is flammable and often may ignite in which case the fire may be sustained and propagate internally or to adjacent/target units. As these are one-off tests there is an aspect of uncertainty and thus ensuring that the gases released are ignited, if possible, will ensure that the fire propagation hazard is sufficiently evaluated.

Public Input No. 358-NFPA 855-2023 [Section No. A.9.1.5.2]

A.9.1.5.2

The test report will provide nonproprietary information that, among other things, describes the size and energy capacity rating of the unit being tested, model numbers of the modules and ESS units, orientation of ESS in the test facility, and proximity of the ESS unit under test to adjacent ESS, walls, and monitoring sensors. The test report also includes a complete set of test results and measurements. ~~For example, a complete UL 9540A test report that includes a unit level test should also include the UL 9540A cell and module level test.~~

Statement of Problem and Substantiation for Public Input

The deleted text is covered in new proposed A.9.1.5.2.1

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Committee: ESS-AAA

Committee Statement

Resolution: This data is critical to engineering evaluation for fire and explosion.

Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]

A.9.6.5.1

This section addresses hazards associated with the release of flammable gases from ESS during normal charging, discharging, and use conditions. Similar requirements have been in fire codes for many years primarily to address off-gassing of hydrogen from stationary vented lead-acid battery systems but not limited to that technology.

This section is not intended to provide protection against the release of flammable gases during abnormal charging or thermal runaway conditions. Those conditions are addressed in 9.6.5.6. In addition, this section does not regulate ventilation of toxic and highly toxic ~~gases~~ emissions , which are regulated by 4.6.11.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Submittal Date:	Sat Apr 22 12:50:50 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-73-NFPA 855-2023

Statement: Toxic emissions can include more than gasses.

Public Input No. 97-NFPA 855-2023 [New Section after A.9.6.5.1.5.4]

A.9.6.5.2 Spill control may be provided as part of the listed product or as part of the site installation. If spill control is not provided as part of a listed product, then the manufacturer's manual provides guidance for the installation.

Statement of Problem and Substantiation for Public Input

UL 9540 has provisions for secondary containment to be supplied at installation as long as this is included in the instruction manual. 9.6.5.2 currently implies that additional containment may be necessary even if it is supplied with the product under the scope of its listing. This change is intended to clarify when additional containment should be provided.

This Public Input was submitted by the Flow Battery Task Group TG20.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 96-NFPA 855-2023 [Section No. 9.6.5.2]	

Submitter Information Verification

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Submittal Date: Mon May 08 19:20:01 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-74-NFPA 855-2023

Statement: UL 9540 has provisions for secondary containment to be supplied at installation as long as this is included in the instruction manual. Section 9.6.5.2 currently implies that additional containment may be necessary even if it is supplied with the product under the scope of its listing. This change clarifies when additional containment should be provided.

Public Input No. 98-NFPA 855-2023 [Section No. A.9.6.5.3.1]

A.9.6.5.3.1

One method to determine compliance with the neutralization requirements of this subsection is found in UL Subject 2436. UL Subject 2436 investigates the liquid tightness, level of electrolyte absorption, pH neutralization capability, and flame spread resistance of spill containment systems. Where approved methods are specified for removal of spilled electrolyte, the neutralization can occur after removal from site. It may be safer to remove spilled electrolyte from site then neutralize it in a controlled environment.

Statement of Problem and Substantiation for Public Input

Flow batteries can leak large volumes of electrolyte. Providing for neutralization of such volumes can present electrochemical hazards resulting in significant heating if it is done in an uncontrolled fashion. If leaked electrolyte is contained and industry standard methods are available to extract and transport it, then neutralization can be done safely in a controlled manner.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

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Submittal Date: Mon May 08 19:23:30 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-76-NFPA 855-2023

Statement: For large spills of acidic or caustic electrolytes, whether of traditional batteries, or flow batteries, indoor neutralization can produce toxic gasses and possibly acidic or caustic mist. Therefore, neutralization may be best left until the absorbed spill products have been moved to a better ventilated area, such as outdoors. This change allows for that to happen rather than requiring indoor neutralization of all spills.

Public Input No. 174-NFPA 855-2023 [Section No. A.9.6.5.5]

A.9.6.5.5

A component of the thermal runaway protection might be integrated within the ESS battery management system or ESS management system that controls the charging and discharging to keep the ESS within its normal/safe operating limits when that device has been evaluated with the batteries or capacitors as part of the listing to UL 1973 or UL 9540, as applicable. The device might also initiate appropriate hazard mitigation as required elsewhere in this standard when the ESS is in an abnormal state such as overheating or off-gassing.

VRLA battery systems, if abused or neglected for long periods of time, may go into thermal walkaway. This condition is not to be confused with thermal runaway as seen in lithium-ion batteries. Much less heat and combustible gas is produced and is well known. Calculations for hydrgen gassing of lead-acid and nickel-cadmium batteries under thermal walk away conditions are found in IEEE 1635/ASHRAE 21. This is referenced in UL 1973. Thermal walkaway in VRLA batteries is typically prevented by use of temperature compensated charging. Even though a VRLA may occassionally go into thermal walkaway, no flame is produced. Melting of the jar container may occur, but no fire is instigated for VRLA batteries listed to UL 1973.

Statement of Problem and Substantiation for Public Input

There is a need to clarify misconceptions regarding aqueous battery thermal "runaway" Thermal walkaway can occur in aqueous batteries, but happens in most cases because of abuse or neglect and takes months/years to develop. It is easily controlled with temperature compensation charging and/or recommended maintenance. In contrast, thermal runaway is usually a very fast occurring process with limited or no warning and cannot be prevented at least at the individual cell level. The quantities of heat and combustible gasses produced by a lithium-ion thermal runaway event are orders of magnitude greater than those produced by an aqueous battery thermal walkaway.

Submitter Information Verification

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Submittal Date: Thu May 25 15:44:32 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-79-NFPA 855-2023

Statement: There is a need to clarify misconceptions regarding aqueous battery thermal "runaway" Thermal walkaway can occur in aqueous batteries, but happens in most cases because of abuse or neglect and takes months/years to develop. It is easily controlled with temperature compensation charging and/or recommended maintenance. In contrast, thermal runaway is usually a very fast occurring process with limited or no warning and cannot be prevented at least at the individual cell level. The quantities of heat and combustible gasses produced by a lithium-ion thermal runaway event are orders of magnitude greater than those produced by an aqueous battery thermal walkaway.

Public Input No. 150-NFPA 855-2023 [Section No. A.9.6.5.6]

A.9.6.5.6

During failure conditions such as thermal runaway, fire, and abnormal faults, some ESS, in particular electrochemical batteries and capacitors, begin off-gassing flammable and toxic gases, which can include mixtures of CO, H_2, ethylene, methane, benzene, HF, HCl, and HCN. Among other things, these gases present an explosion hazard that needs to be mitigated. Explosion control is provided to mitigate this hazard.

Both the exhaust ventilation requirements of 9.6.5.1 and the explosion control requirements of 9.6.5.6 are designed to mitigate hazards associated with the release of flammable gases in battery rooms, ESS cabinets, and ESS walk-in units. The difference is that exhaust ventilation is intended to provide protection for flammable gases released during normal charging and discharging of battery systems since some electrochemical ESS technologies such as vented lead-acid batteries release hydrogen when charging.

In comparison, the 9.6.5.6 provisions are designed to provide protection for electrochemical ESS during an abnormal condition, such as thermal runaway, which can be instigated by physical damage, overcharging, short circuiting, and overheating of technologies such as lithium-ion batteries, which do not release detectable amounts of flammable gas during normal charging and discharging but can release significant quantities of flammable gas during a thermal event.

VRLA battery systems, if abused or neglected for long periods of time, may go into thermal walkaway. This condition is not to be confused with thermal runaway as seen in lithium-ion batteries. Much less heat and gas is produced (see IEEE 1635/ASHRAE 21) so explosion control is not needed. Safety concerns are covered by ventilation requirements in 9.6.5.1. Thermal walkaway in VRLA batteries is typically prevented by use of temperature compensated charging.

Statement of Problem and Substantiation for Public Input

Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

Submitter Information Verification

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Submittal Date: Tue May 23 12:29:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As

technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]

A.9.6.5.6.3

The requirement recognizes that with some cabinet designs that have low internal volume, the application ~~of NFPA 68 or~~ <u>of</u> NFPA 69 might not be practical. It is possible that a quantitative explosion analysis is necessary to show there is no threat to life and safety. For example, the cabinet design might be installed such that any overpressure due to ignition of gases and vapors released from cells in thermal runaway within the enclosure are released to the exterior of the enclosure. There should be no uncontrolled release of overpressure of the enclosure. All debris, shrapnel, or pieces of the enclosure ejected from the system should be controlled. The UL 9540A unit level and installation level test identified in 9.1.5 will provide the test data referenced in 9.6.5.6.3, which is necessary for verification of the adequacy of the engineered deflagration safety of the cabinet.

<u>While NFPA 68 has been an approved method for explosion mitigation it is no longer a singular approved method, it may be provided as a supplement of NFPA 69 solutions in certain high-risk applications. If it is used as a supplementary explosion control option, then 9.6.5.6.4 would be required as a large-scale test.</u> NFPA 68 applies to the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure so that structural and mechanical damage is minimized, and provides criteria for design, installation, and maintenance of deflagration vents and associated components. NFPA 68 does not apply to detonations. Hydrogen accumulation in a confined space can lead to a detonation. For that reason, the combustion gases generated during the cell, module, and installation level testing under UL 9540A must be used when applying a NFPA 68 solution. Where the likelihood for detonation exists, alternative solutions such as ~~those in NFPA 69~~ <u>automatic door opening systems</u> should be considered.

NFPA 69 applies to the design, installation, operation, maintenance, and testing of systems for the prevention of explosions in enclosures that contain flammable concentrations of flammable gases, vapors, mists, dusts, or hybrid mixtures by means of the following methods:

(1) Control of oxidant concentration

(2) Control of combustible concentration

(3) Pre-deflagration detection and control of ignition sources

(4) Explosion suppression

(5) Active isolation

(6) Passive isolation

(7) Deflagration pressure containment

(8) Passive explosion suppression

Combustible gas concentration reduction can be a viable mitigation strategy for possible accumulation of flammable gases during abnormal conditions for lithium-ion batteries. Gas detection and appropriate interlocks can be used based on appropriate evaluation under an NFPA 69 deflagration hazard study. NFPA 69 allows concentration to exceed 25 percent LFL but not more than 60 percent with reliable gas detection and exhaust interlocks as demonstrated by a safety integrity level (SIL) 2 instrumented safety system rating.

Data on flammable gas composition and release rates, such as that included in UL 9540A fire and explosion testing, provide the information needed to design effective explosion control systems.

Statement of Problem and Substantiation for Public Input

NFPA 855 Explosion Control Task group recommendations - Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information added that still allows NFPA 68 as an supplementary option to NFPA 69 solutions.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 64-NFPA 855-2023 [Section No. G.8]	855 Explosion Task Group
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 84-NFPA 855-2023 [Section No. 9.5.3.2.6 [Excluding any Sub-Sections]]	855 Explosion Task Group
Public Input No. 85-NFPA 855-2023 [New Section after 9.6.5.6.7]	855 Explosion Task Group

Public Input No. 64-NFPA 855-2023 [Section No. G.8]
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]

Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]

Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]

Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]

Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]

Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]

Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 82-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date:	Thu Apr 27 15:36:04 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-109-NFPA 855-2023

Statement: The Technical Committee reaffirms the acceptance of TIA 20-2

This revision:

1) clarifies the exempt report requirements and adds standards as a condition of , and clarifies the application to ESS walk-in units and ESS cabinets It eliminates the reference to UL 1973 as a qualifier since it does not prevent the hazard.

2) For A9.6.5.6: Explosion control has never been an issue with lead-acid or nickel-cadmium batteries. If ventilation requirements as outlined in 9.6.1 are ignored, then a possible explosive situation could develop over time. However, requiring specific explosion control or deflagration equipment is not necessary.

3) For 9.6.5.6.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

4) For 9.6.5.6.1.1: This is a clarification for abnormal conditions. The revision also removes deflagration venting as this is a subset of explosion control.

5) For 9.6.5.6.1.2: Uninterruptable was corrected as a typo. item 4 was deleted with better clarification of Item 5. This adds clarifying conditions that support the exclusion of selected technologies by identifying the standards of IEEE 1635 and ASHRAE 21. It makes the conditions of exception more stringent. Safe is removed as it is not defined.

6) For 9.6.5.6.13: The standard does not identify how the gas composition and volume of a thermal runaway event is to be determined for the purpose of use in and NFPA 68 or NFPA 69 solution.

7) For 9.6.5.6.3: This change removes multiple area designations as they just cause confusion especially as technologies change. The requirement is simplified to apply to all ESS. The option for NFPA 68 compliance is removed as for large scale gas deflagrations, they have not shown to be effective at mitigating the pressure release.

8) For A.9.6.5.6.3: Removal of NFPA 68 as in option in 9.6.5.6.3 requires additional clarification and modification in the annex. Information was added that still allows NFPA 68 as a supplementary option to NFPA 69 solutions.

9) For 9.6.5.6.4: The adds the new defined term of registered designed professional. NFPA 68 is not viable as a standalone option. These requirements are reversed so that the design and testing per 9.1.5 comes first, and based on that the AHJ could approve forgoing NFPA 69.

10) For 9.6.5.6.5: An explosion of a "box in a box" was edited to clarify and explain this concept.

11) For 9.6.5.6.6: This section is no longer needed with edits in prior sections. Explosion requirements for a box in a box have been updated.

12) For 9.6.5.6.7: Clarity has been added for standby power tied to the new Section 4.10. and for locations that a failed condition must be annunciated for first responder protection. Additional sections were added for the survivability evaluation of the NFPA 69 system; interaction requirements between suppression system; and NFPA 69 system and inspection requirements.

13) For 9.6.5.6.8: NFPA 68 and explosion panels are not a viable option for explosion mitigation in duct work and HVAC system internal to a BESS which creates a box in a box type deflagration.

14) For 9.6.5.8.9: This simplifies from BESS specific configurations to only BESS. As technologies change the requirements for no propagation between systems will apply to any BESS configuration.

Public Input No. 206-NFPA 855-2023 [Section No. A.13.2.5]

A.13.2.5

Locations subject to high levels of vibration, such as near train tracks or large engine generators) can result in stress to the bearing systems and affect the safe operation of the FESS. However, FESS may be designed with some level of vibration dampening such that not all vibrations are transmitted to the flywheel. A flywheel could be installed in such a location when it can be shown that the transmitted vibration levels are low and will not affect the bearings.

Substantiation: The original clause is too vague and may be unnecessarily limiting. Add additional wording that is consistent with the intent described in the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Statement of Problem and Substantiation for Public Input

Substantiation: The original clause is too vague and may be unnecessarily limiting. Add additional wording that is consistent with the intent described in the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 200-NFPA 855-2023 [Section No. 13.2.5]	This is descriptive annex note material to go with noted section.

Submitter Information Verification

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Submittal Date:	Wed May 31 00:54:31 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-27-NFPA 855-2023

Statement: The original requirement was too vague and may be unnecessarily limiting. This revision adds wording that is consistent with the annex but with the clarification that the vibrations must actually be transmitted to the flywheel. It is possible to greatly reduce transmitted vibration in the design of the flywheel mounting so that they do not create stress on the bearings.

Public Input No. 207-NFPA 855-2023 [New Section after A.13.2.9]

TITLE OF NEW CONTENT

Type your content here ..

A13.2.10 The smoke and fire detection requirements of section 4.8 do not apply to FESS because FESS do not present a fire hazard. Follow applicable local building codes where they exist.

Substantiation: Add annex explanation regarding the intention of the clause.

Statement of Problem and Substantiation for Public Input

Substantiation: Add annex explanation regarding the intention of the clause.

Submitter Information Verification

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Submittal Date:	Wed May 31 00:58:50 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-30-NFPA 855-2023

Statement: This revision adds an annex explanation regarding the intent of the requirement.

Public Input No. 208-NFPA 855-2023 [New Section after A.13.2.9]

TITLE OF NEW CONTENT

Type your content here ..

A13.2.11 The fire control and suppression requirements of 4.9 do not apply to FESS because FESS do not present a fire hazard. Follow applicable local building codes where they exist.

Substantiation: Add annex explanation regarding the intention of the clause.

Statement of Problem and Substantiation for Public Input

Substantiation: Add annex explanation regarding the intention of the clause.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Submittal Date:	Wed May 31 01:00:09 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-31-NFPA 855-2023

Statement: This revision adds an annex explanation regarding the intent of the requirement.

Public Input No. 212-NFPA 855-2023 [Section No. A.13.2.12]

A.13.2.12

Parts or other debris from catastrophic failure of a flywheel could damage adjacent flywheels or energy storage systems if the housing does not fully contain the failure. Annex note 13.2.8 references two containment measures, housing containment or stringent rotor screening in production. Containment of a rotor burst within the primary flywheel housing means that no primary or secondary particles leave the space defined by the housing if the rotor ruptures. The risk of rotor rupture can be greatly mitigated by ensuring that the rotor design and its materials prevent rapid propagation of any cracks that could result in a sudden rupture. Or, alternatively, the risk of rotor rupture can be greatly mitigated with controls, if the design and monitoring system make the cracked condition detectable before a rupture can occur. Risk mitigation can be realized with stringent production controls put in place to verify that each rotor and its material meet the requirements needed to prevent sudden rupture. The production controls generally include regular destructive sampling of actual production pieces and subjecting them to ASTM or other standard tests to verify actual physical properties, and 100% non-destructive testing (ultrasound and surface inspections) of production rotors.

Statement of Problem and Substantiation for Public Input

Substantiation: The size and separation requirements of 9.4.2 are shown as N/A in table 13.2. Also, UL 9540 deals with design, securement, and containment of flywheels in the event of a fault. Such barriers should not be necessary with proper design, securement, and containment.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 203-NFPA 855-2023 [Section No. 13.2.12]	This is a proposed revision to the annex notes that map onto the noted section also under revision.

Submitter Information Verification

Submitter Full Name:	Seth Sanders
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Submittal Date:	Wed May 31 11:27:55 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: The proposed wording does not provide sufficient clarity to the requirements and would be difficult to enforce. The task group will continue to work on this section to improve the language including separation and quality control for inclusion in the Second Draft.

Public Input No. 99-NFPA 855-2023 [Section No. B.3.2]

B.3.2 Chemical Hazards.

Under normal operating conditions, the potential exists for exposure to hazardous materials by workers in contact with the system for maintenance, repair, and replacement of systems. OSHA and NIOSH have guidelines on exposures to hazardous materials, including limits for workers that have the potential for exposure during normal operation maintenance, and so forth.

Examples of chemical hazards are as follows:

(1) *Liquid hazards*:

(2) *Corrosive electrolytes* : Batteries with electrolytes in the range of pH ≤2 or ≥11.5 are considered corrosive (acid or caustic). This is an issue with systems with these electrolytes, where there can be a situation of leaks or spills during maintenance or normal operation. There should be measures for spill control, and workers should have appropriate safe work procedures and protective clothing

~~to~~

(a) and equipment such as an eye wash station or safety shower to work around systems with these corrosive liquids.

(b) *Toxic liquids* : The potential exists for exposure to toxic liquids during normal operating, servicing, and maintenance of some systems. Guidance for worker exposure to toxic liquids can be found in OSHA hazardous materials guidelines. Workers in contact with these systems need to be aware of potential hazards and have appropriate procedures and equipment/PPE to avoid these hazards.

(3) *Oxidizers*: The potential exists for oxidizers to be present within the ESS. An oxidizer will increase the flammability potential of other materials. Annex G in NFPA 400 provides information on tests to classify an oxidizer material and identifies known oxidizing materials under their classifications. Annex G in NFPA 400 also provides guidance on safety measures to use when there are significant exposed quantities of known oxidizers, which can occur during normal maintenance conditions of certain ESS technologies that contain them.

(4) *Gases — Toxic gases*: The potential exists for exposure to toxic gases under normal conditions of maintenance and service of some ESS systems. OSHA and NIOSH provide guidance for exposures, including permissible exposure limits (PEL), recommended exposure limits (REL) for exposure during an 8- or 10-hour workday, ceiling limits, which are the upper limit of a safe exposure, and IDLH, which represents concentrations that are immediately dangerous to life and health.

(5) *Solids*: Water-reactive and toxic metals that might be contained in some battery technologies typically are not exposed during routine maintenance and servicing of these systems but can present issues under abnormal conditions. Batteries containing these hazardous materials should be marked with the NFPA 704 diamond hazard symbols.

Statement of Problem and Substantiation for Public Input

Added "and equipment such as an eye wash station or safety shower" and made no other changes. In the case of some batteries, electrolyte is managed at site and provisions for eye wash stations and safety showers should be considered in addition to protective clothing. Lead acid and flow batteries may have electrolyte added after installation.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

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Submittal Date: Mon May 08 19:28:21 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-7-NFPA 855-2023

Statement: In the case of some batteries, electrolyte is managed at site and provisions for eye wash stations and safety showers should be considered in addition to protective clothing. Lead acid and flow batteries may have electrolyte added after installation.

Public Input No. 235-NFPA 855-2023 [New Section after B.5]

B.5.8 Nickel Hydrogen

Rechargeable nickel hydrogen batteries under charge conditions, the Nickel Hydroxide becomes Nickel Oxide hydroxide and hydrogen. During discharge the hydrogen is recombined with the Nickel Oxide hydroxide to give Nickel Hydroxide. The amount of hydrogen generated is a fixed amount that is a function of the amount of Nickel hydroxide

Hazard considerations for Nickel Hydrogen batteries under normal operating conditions are as follows:

(1)Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards: Not applicable.

(3)Electrical hazards: There are electrical hazards associated with routine maintenance of these batteries if they are at hazardous voltage and energy levels.

(4)Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards during maintenance if the batteries cannot be isolated for maintenance or replacement.

(5)Physical hazards: Not applicable.

Hazard considerations for nickel hydrogen under emergency/abnormal conditions are as follows:

(1) Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards: None indicated

(3)Electrical hazards: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4) Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards if the batteries are exposed to abnormal conditions where they might still contain hazardous levels of energy. Damaged batteries might contain stored energy that can be a hazard during disposal if care is not taken.

(5)Physical hazards: Depending on the design of the system, the potential exists for physical hazards under abnormal conditions if accessible parts are overheating or if there is exposure to moving hazardous parts such as fans where guards might be missing.

Statement of Problem and Substantiation for Public Input

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized multiple tables in the standard. These changes in appendix B is intended to add the technology to clarify and support these new technologies in the tables. The task group heard 7 presentations from various manufacturers and evaluated the submitted information through the open task group process.

Submitter Information Verification

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Submittal Date: Wed May 31 19:58:58 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-10-NFPA 855-2023
Statement: This revision provides the combination of annex text similar to other chemistries.

Public Input No. 236-NFPA 855-2023 [New Section after B.5]

B.5.8 Zinc-Manganese Battery systems

Rechargeable Zn-MnO 2 batteries are composed of a zinc (Zn) anode, a manganese dioxide (MnO 2) cathode, and concentrated potassium hydroxide (KOH) solution as the electrolyte. The rechargeability of the battery is made possible by limiting the depth of discharge (DOD) of both the Zn anode and the MnO 2 cathode, and by controlling the discharge end voltage to avoid undesirable side reactions of the MnO 2 reduction. During discharge, the Zn anode follows a dissolution-precipitation process to give electrons and the MnO 2 cathode typically undergoes a proton intercalation process to close the loop.

Hazard considerations for Zinc-Manganese batteries under normal operating conditions are as follows:

(1)Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards: Not applicable.

(3)Electrical hazards: There are electrical hazards associated with routine maintenance of these batteries if they are at hazardous voltage and energy levels.

(4)Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards during maintenance if the batteries cannot be isolated for maintenance or replacement.

(5)Physical hazards: Not applicable.

Hazard considerations for Zinc-Manganese batteries under emergency/abnormal conditions are as follows:

(1) Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards:

(3)Electrical hazards: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4) Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards if the batteries are exposed to abnormal conditions where they might still contain hazardous levels of energy. Damaged batteries might contain stored energy that can be a hazard during disposal if care is not taken.

(5)Physical hazards: Contact with internal components may cause irritation or burns. Potassium hydroxide (KOH) electrolyte is irritating to eyes, respiratory system, and skin.

Statement of Problem and Substantiation for Public Input

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized multiple tables in the standard. These changes in appendix B is intended to add the technology to clarify and support these new technologies in the tables. The task group heard 7 presentations from various manufacturers and evaluated the submitted information through the open task group process.

Related Public Inputs for This Document

Related Input	Relationship

Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]

Submitter Information Verification

Submitter Full Name:	Michael O`Brian
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Submittal Date:	Wed May 31 20:02:26 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: FR-11-NFPA 855-2023

Statement: This revision provides the combination of annex text similar to other chemistries.

Public Input No. 237-NFPA 855-2023 [New Section after B.5]

B.5.8 Zinc-Bromide

Zinc-Bromide, non flow batteries

Hazard considerations for Zinc-Bromide batteries under normal operating conditions are as follows:

(1)Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards: Not applicable.

(3)Electrical hazards: There are electrical hazards associated with routine maintenance of these batteries if they are at hazardous voltage and energy levels.

(4)Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards during maintenance if the batteries cannot be isolated for maintenance or replacement.

(5)Physical hazards: Not applicable.

Hazard considerations for Zinc-Bromide batteries under emergency/abnormal conditions are as follows:

(1) Fire hazards: Thermal runaway not noted during testing

(2)Chemical hazards:

(3)Electrical hazards: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4) Stranded or stored energy hazards: There can be the potential for stranded or stored energy hazards if the batteries are exposed to abnormal conditions where they might still contain hazardous levels of energy. Damaged batteries might contain stored energy that can be a hazard during disposal if care is not taken.

(5)Physical hazards: Contact with internal components may cause irritation or burns.

Statement of Problem and Substantiation for Public Input

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized multiple tables in the standard. These changes in appendix B is intended to add the technology to clarify and support these new technologies in the tables. The task group heard 7 presentations from various manufacturers and evaluated the submitted information through the open task group process.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date: Wed May 31 20:14:01 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-12-NFPA 855-2023

Statement: This revision provides the combination of annex text similar to other chemistries. The technical committee is looking for information through the code development process for the Second Draft to further clarify the new technologies.

Public Input No. 100-NFPA 855-2023 [Section No. B.5.1.3]

B.5.1.3 Zinc Air Flow Batteries.

Hazard considerations for zinc air flow batteries under normal operating conditions are as follows:

(1) *Fire hazards*: There is the potential for concentrations of hydrogen from the charged electrolyte if the area where the electrolyte tank(s) are located is not properly ventilated. However, this should be taken care of if the installation complies with the codes.

(2) *Chemical hazards*: They contain corrosive liquid that might present a safety concern under normal conditions if there is a need to handle/replenish the electrolyte as part of maintenance.

(3) *Electrical hazards*: There are electrical hazards associated with routine maintenance of these batteries if they have hazardous voltage and energy levels. Technicians should follow accepted maintenance and installation procedures when working on flow batteries.

(4) *Stranded or stored energy hazards*: Not applicable.

(5) *Physical hazards*: Not applicable.

Hazard considerations for zinc air flow batteries under emergency/abnormal conditions are as follows:

(1) *Fire hazards*: In the presence of electrolyte heating due to an abnormal condition occurring internally to the system or from an external source, there is the potential for concentrations of hydrogen from the charged electrolyte if the area where the electrolyte tank(s) are located is not properly ventilated. ~~With continued heating, the water will evaporate and any hydrogen production will diminish.~~

(2) *Chemical hazards*: There are large amounts of corrosives that can create a hazard if the containment fails.

(3) *Electrical hazards*: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4) *Stranded or stored energy hazards*: Not applicable.

(5) *Physical hazards*: Depending on the design of the system, the potential exists for physical hazards under abnormal conditions if accessible parts are overheating, if there is insufficient pressure relief when the system is overheating and gas is generated, or if there is exposure to moving hazardous parts such as fans or exposed pump parts where guards might be missing.

Statement of Problem and Substantiation for Public Input

The last sentence has been deleted because it does not describe a hazard.

This Public Input was submitted by the Flow Battery Task Group TG20.

Submitter Information Verification

Submitter Full Name: Steve Edley
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Submittal Date: Mon May 08 19:37:55 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-8-NFPA 855-2023
Statement: The last sentence has been deleted because it does not describe a hazard.

Public Input No. 184-NFPA 855-2023 [Section No. B.5.4]

B.5.4 Lithium Metal, Solid State Batteries — General Description.

Lithium metal batteries employing liquid electrolytes have been developed for commercial use but have had safety and performance problems in the field. ~~These batteries have not been developed at this time for stationary battery energy storage.~~ Commercially available lithium metal batteries utilized for ESS do not employ liquid electrolytes. The current lithium metal technologies use solid polymer electrolytes, a lithium metal negative electrode and a metal oxide cathode such as vanadium oxide combined with lithium salt and polymer to form a plastic composite. The SPE-type lithium metal batteries must be heated to about 140°F to 176°F (60°C to 80°C) in order to be activated.

Hazard considerations for lithium metal batteries under normal operating conditions are as follows:

(1) *Fire hazards*: There can be the potential for fire hazards ~~if~~ depending on the cell architecture and amount of lithium metal utilized if there are defects within the cells or design issues with the controls that prevent thermal runaway of the cells. Systems need to be evaluated for their ability to prevent propagation due to these defects.

(2) *Chemical hazards*: Not applicable.

(3) *Electrical hazards*: There are electrical hazards associated with routine maintenance of these batteries if they are at hazardous voltage and energy levels.

(4) *Stranded or stored energy hazards*: There can be the potential for stranded or stored energy hazards during maintenance if the batteries cannot be isolated for maintenance or replacement.

(5) *Physical hazards*: Not applicable.

Hazard considerations for lithium metal batteries under emergency/abnormal conditions are as follows:

(1) *Fire hazards*: There can be the potential for thermal runaway if the batteries are not maintained at appropriate operating parameters as a result of abnormal conditions and if not evaluated for ability to prevent propagation due to latent defects. Also there might be fire hazards due to short-circuiting abnormal conditions.

(2) *Chemical hazards*: The ~~potential exists for~~ potential for exposure of water-reactive lithium metal is minimal due to the small amount of lithium metal utilized in a cell . Water application would still the method of extinguishment.

(3) *Electrical hazards*: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4) *Stranded or stored energy hazards*: There can be the potential for stranded or stored energy hazards if the batteries are exposed to abnormal conditions where they might still contain hazardous levels of energy. Damaged batteries might contain stored energy that can be a hazard during disposal if care is not taken.

(5) *Physical hazards*: Depending on the design of the system, the potential exists for physical hazards under abnormal conditions if accessible parts are overheating or if there is exposure to moving hazardous parts such as fans where guards might be missing.

Statement of Problem and Substantiation for Public Input

The following proposal has been submitted by task group 8 “new technology” of the NFPA 855 technical committee. The committee heard multiple proposals from various products which outlined a desire to be recognized multiple tables in the standard. These changes in appendix B is intended to add the technology to clarify and support these new technologies in the tables. The task group heard 7 presentations from various manufacturers and evaluated the submitted information through the open task group process.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	
Public Input No. 181-NFPA 855-2023 [Section No. 1.3 [Excluding any Sub-Sections]]	

Submitter Information Verification

Submitter Full Name:	Michael O`Brian
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Submittal Date:	Tue May 30 04:46:39 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution:	FR-9-NFPA 855-2023
Statement:	These changes address the changing use of lithium metal batteries in ESS systems as the technologies grow

Public Input No. 230-NFPA 855-2023 [New Section after B.5.7.2]

B.5.8 Metal Air Batteries - General Description

Metal-air batteries have a metal anode (negative electrode) and an air "breathing" cathode

(positive electrode) with an aqueous alkaline electrolyte. The combination of a metal anode with

an air cathode provides an inexhaustible cathode reactant and the potential for high energy

density. The capacity limit is determined by the amp-hour capacity of the anode and the means

used to address reaction products. Metal air batteries are available in primary (non-

rechargeable), reserve, and secondary (rechargeable) designs. The secondary designs can be

either electrically rechargeable or mechanically rechargeable (replacing the discharged metal

electrode) configurations. Electrical recharging of metal-air batteries requires either a third

electrode (to sustain oxygen evolution on charge) or a bi-functional electrode (a single electrode

capable of both oxygen reduction and evolution). This section of Annex B covers the electrical

recharging designs. There are multiple technologies under the electrically rechargeable metal

air battery category including iron-air batteries, zinc-air batteries, and magnesium-air batteries.

B.5.8.1 Iron-Air Batteries. Hazard considerations for iron-air batteries under normal operating conditions are as follows:

(1) Fire hazards: There is the potential for concentrations of hydrogen from iron-air batteries if the area where the batteries are located is not properly ventilated. However, this should be taken care of if the installation complies with the codes.

(2) Chemical hazards: These batteries have caustic electrolyte that is contained within the system during normal operation. Exposure risks may occur when handling electrolyte as a part of commissioning, decommissioning, and maintenance. Workers handling electrolyte need to use proper PPE.

(3) Electrical hazards: There are electrical hazards associated with routine maintenance of these batteries if they are at hazardous voltage and energy levels.

(4) Stranded or stored energy hazards: Not applicable.

(5) Physical hazards: Not applicable.

Hazard considerations for iron-air batteries under emergency/abnormal conditions are as follows:

(1)

Fire hazards: These systems have aqueous electrolytes, so the potential of hydrogen concentration buildup exists if the area where the batteries are located is not properly ventilated.

(2) **Chemical hazards: There is the potential for contact with caustic electrolyte during abnormal conditions should electrolytes leak. First responders, in emergency situations, need to be aware of potential caustic electrolyte spills that can occur and use appropriate caution around these batteries.**

(3) **Electrical hazards: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.**

(4) **Stranded or stored energy hazards: Not applicable.**

(5) **Physical hazards: The potential exists for overheating due to severe electrolyte loss from leaking. Exposure to moving parts such as fans where guards may be missing.**

Statement of Problem and Substantiation for Public Input

Form Energy proposes to add a section on metal air to Annex B to provide critical hazard information on iron-air chemistry that is not currently included in the code. The information provided in the proposal outlines the primary hazards associated with iron-air chemistry including caustic electrolyte, hydrogen generation, and overheating from electrolyte loss. Form Energy has test data available to present to the committee to support these claims.

Submitter Information Verification

Submitter Full Name: Alli Nansel
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Submittal Date: Wed May 31 17:26:30 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-13-NFPA 855-2023
Statement: This revision provides the combination of annex text similar to other chemistries.

Public Input No. 239-NFPA 855-2023 [Section No. B.6.2]

B.6.2 ~~Reserved.~~ ~~Hybrid Super capacitors~~

Hazard considerations for Hybrid Super capacitors under normal operating conditions are as follows:

(1)Fire hazards:

(2)Chemical hazards: Not applicable.

(3)Electrical hazards: There are electrical hazards associated with routine maintenance if they are at hazardous voltage and energy levels. Technicians should follow accepted maintenance and installation procedures when working on these capacitors.

(4)Stranded or stored energy hazards: Although not as energy dense as batteries, there is the potential for some level of stranded energy in these devices. Care should be taken to discharge them prior to handling or disposal. Technicians should follow accepted maintenance and installation procedures when working on these capacitors.

(5)Physical hazards: Not applicable.

Hazard considerations for Hybrid Super capacitors under emergency/abnormal conditions are as follows:

(1)Fire hazards:

(2)Chemical hazards:

(3)Electrical hazards: Electrical hazards might be present under abnormal conditions if the system is at hazardous voltage and energy levels.

(4)Stranded or stored energy hazards: Although not as energy dense as batteries, there is the potential for some level of stranded energy in these devices if they are exposed to abnormal conditions. Damaged capacitors might contain stored energy that can be a hazard during disposal if care is not taken. Technicians should follow accepted procedures when working on these capacitors where these capacitors are subjected to abnormal conditions.

(5)Physical hazards: Depending on the design of the system, the potential exists for physical hazards under abnormal conditions if accessible parts are overheating or if there is exposure to moving hazardous parts such as fans where guards might be missing.

Statement of Problem and Substantiation for Public Input

Hybrid supercapacitors concentrate standby power through unique means with what appears to be relatively decent testing. This is intended to be a placeholder to update the appendix language on providing details on what this technology is.

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Submittal Date: Wed May 31 20:29:26 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-195-NFPA 855-2023

Statement: This revision provides the combination of annex text similar to other chemistries. The technical committee is looking for information through the code development process for the Second Draft to further clarify the new technologies.

Public Input No. 269-NFPA 855-2023 [Section No. C.3]

C.3 Suppression Systems.

Some ESS design validations have included pre-engineered inert or clean agent fire suppression systems for fire protection. These system installations were often approved without validation based on fire and explosion testing in accordance with 9.1.5 by nationally recognized testing laboratories. Such systems are often validated with large extrapolation factor as experimental tests have been done in a small scale using only single or few lithium-ion cells as a fire load. Evidence-based data is needed to ensure ESS designers specify appropriate fire protection systems based on the material involved and physical design characteristics. Several early research papers from multiple organizations, including NFPA's Fire Protection Research Foundation, and third-party engineering groups have shown that fires involving lithium-ion cells must be cooled to terminate the thermal runaway process. Water is the agent of choice, yet system cabinet design could pose a significant barrier to the efficient application of water while simultaneously allowing the free movement of fire and combustion gases.

Statement of Problem and Substantiation for Public Input

There are fire protection systems that are marketed being suitable for ESS protection, although validation test data includes only very small scale experiments (even with single cell). This is not a good practice and this should be emphasised in the standard.

Submitter Information Verification

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Submittal Date: Thu Jun 01 05:35:15 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-54-NFPA 855-2023

Statement: There is open disagreement upon whether clean agents or an encapsulating agent combined with water are acceptable to use to fight Lithium fires. The added sentence acknowledges that while certain testing has been done, results using extrapolation factors along with the lack of system level testing is insufficient. Thus, the added sentence supports the rest of the text that additional evidence based data is needed.

Public Input No. 330-NFPA 855-2023 [Section No. C.3]

C.3 Suppression Systems.

Some ESS design validations have included pre-engineered inert or clean agent fire suppression systems for fire protection. These system installations were often approved without validation based on fire and explosion testing in accordance with 9.1.5 by nationally recognized testing laboratories. Evidence-based data is needed to ensure ESS designers specify appropriate fire protection systems based on the material involved and physical design characteristics. Several early research papers from multiple organizations, including NFPA's Fire Protection Research Foundation, and third-party engineering groups have shown that fires involving lithium-ion cells must be cooled to terminate the thermal runaway process. Water ~~is the agent~~ or water with an additive, Encapsulting Agent (EA), are the agents of choice, yet system cabinet design could pose a significant barrier to the efficient application of water while simultaneously allowing the free movement of fire and combustion gases.

Additional Proposed Changes

File Name	Description	Approved
NIOSH_report.pdf	NIOSH- Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires	

Statement of Problem and Substantiation for Public Input

Encapsulating Agents have been tested by many orignization and have been found to be effective on Lithium-Ion battery fires.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 352-NFPA 855-2023 [Section No. G.6.1.3.3 [Excluding any Sub-Sections]]	

Submitter Information Verification

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Submittal Date: Thu Jun 01 12:53:33 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: There is no evidence to support the statement that water with an encapsulating agent is an agent of choice.

Mining, Metallurgy & Exploration
https://doi.org/10.1007/s42461-023-00765-7

Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires

Wei Tang[1] · Liming Yuan[1] · Richard Thomas[1] · John Soles[1]

Received: 5 December 2022 / Accepted: 25 April 2023

Abstract
Lithium-ion battery pack fires pose great hazards to the safety and health of miners. A detailed experimental study has been conducted at the National Institute for Occupational Safety and Health (NIOSH) Pittsburgh Mining Research Division (PMRD) to investigate the effectiveness of different fire suppression systems on Li-ion battery pack fire extinguishment. Tests were conducted in a well-ventilated container. Two sizes of battery packs (12 V, 24 V) were heated by heater strips to trigger thermal runaway and fire. Water mist with different flow rates, ABC powder, type D dry chemical, and water mist with F500 additives were used as the fire suppression agents. Multiple thermocouples were installed on the battery packs to measure the temperature evolution during the tests. The results indicated that the water mist with F500 additives is the most effective suppressant among the agents tested. Dry chemicals, however, do quench the fire for a moment, but cannot prevent re-ignition of the battery since they do not provide enough cooling. The findings of this paper can be used to develop safer battery fire suppression techniques in mining environments.

Keywords Lithium-ion battery · Fire suppression · Water mist · Dry chemical

1 Introduction

As an important alternative to fossil fuels, lithium-ion (Li-ion) batteries have seen their applications growing from consumer electronic products to large electric vehicles. In the mining industry, Li-ion battery powered electric vehicles (BEVs) are believed to be a promising replacement for diesel-powered vehicles whose emission of diesel particulate matter (DPM) is a major concern to the safety and health of miners [1]. The introduction of BEVs into the mining industry has not been trouble-free as the potential use of Li-ion BEVs in gassy underground mines escalates the fire and explosion risks [1]. Methane-air mixtures are found in many types of mines, and the energy released by a Li-ion battery during thermal runaway or accidents resulting in fire can be an ignition source for such mixtures [2, 3]. A safer and more reliable design and application of Li-ion BEVs could help reduce and mitigate the risk of fire and explosion accidents underground. The size of a battery pack fire can be indicated by the heat release rate (HRR). Wang et al. [4] used cone calorimetry tests and found that the peak HRR and total heat release increase with state of charge of the battery. Most of the HRR measurement of battery fires used the oxygen consumption theory [5, 6].

While preventing the fire and explosion of Li-ion batteries from occurring is necessary, suppression of such incidents when they occur is just as vital [7, 8]. In a mining environment where fire suppression resources are limited, an effective battery fire suppression technique is critical to the safety and health of miners. Numerous studies have been conducted to investigate the effectiveness of traditional fire suppression techniques on battery or battery pack fires. Unlike traditional fire suppression, battery fire suppression requires extensive cooling even after the fire is visually quenched [9-12] to reduce battery temperature and prevent re-ignition due to chemical reactions inside the batteries. Liu et al. [13] found that water mist can well control the thermal runaway of a battery by cooling the battery below a certain critical temperature. Larsson et al. [14] reported that the effectiveness of water mist on battery fire suppression is not obvious, and that hydrogen fluoride concentration increased after the application of water mist. Blum et al. [15] conducted large-scale

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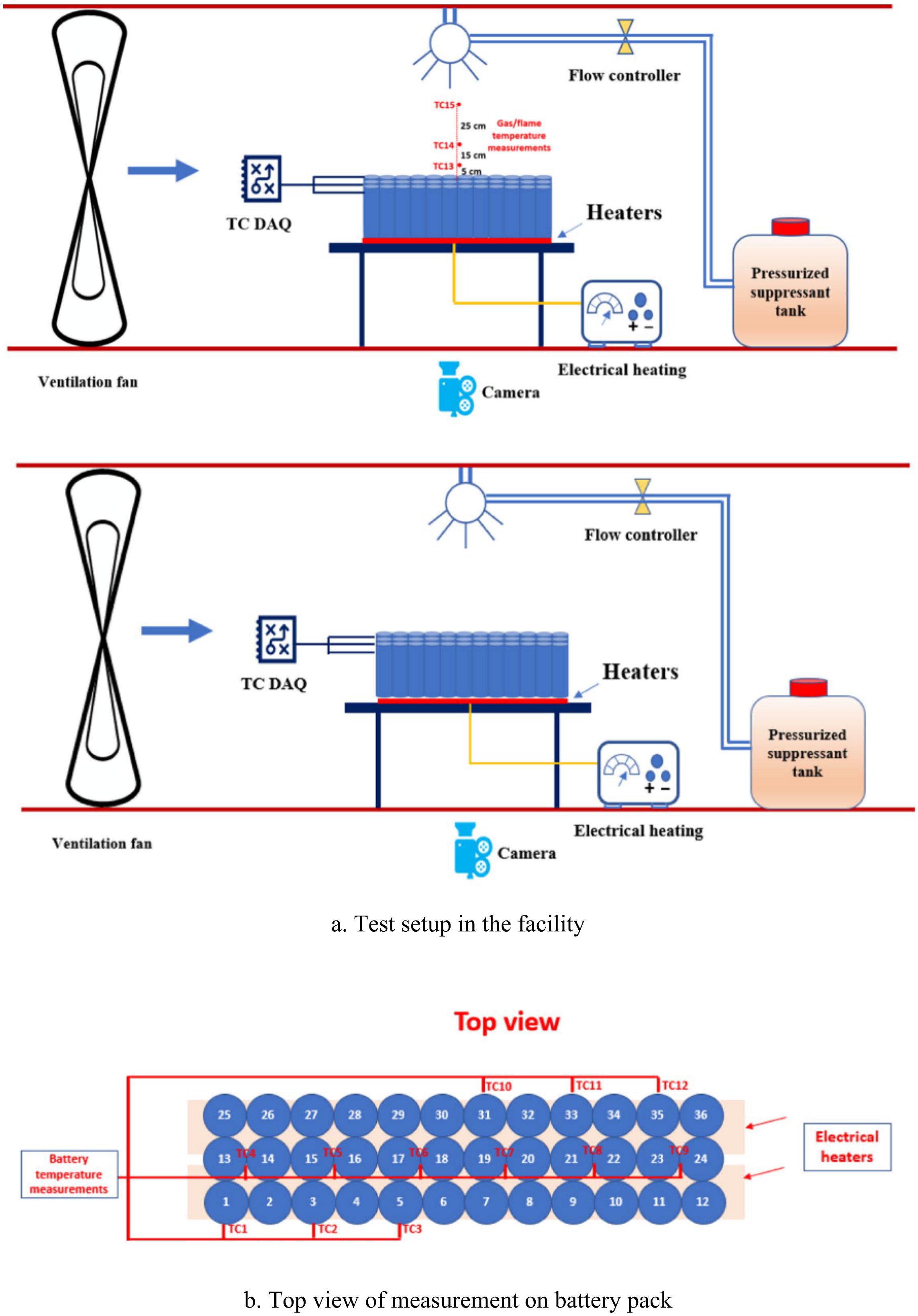


Fig. 1 Battery fire suppression test setup

Table 1 Test conditions

Test number	Battery size	Agent
1	12 V	Free burn
2	12 V	Water mist, 3 GPM
3	12 V	Dry chemical
4	24 V	Free burn
5	24 V	Water mist, 3 GPM
6	24 V	Dry chemical
7	12 V	Water mist, 1 GPM
8	12 V	Water mist, 2 GPM
9	12 V	Water mist 3 GPM with F500 additive

battery fire suppression tests and noticed that a large amount of water is needed to extinguish BEV fires. Research on effective fire suppression technique for small and large battery pack fires in a mining environment is limited.

In this work, detailed experimental research was conducted to investigate the effectiveness of different fire suppression systems on Li-ion battery pack fires. Two sizes of Nickel/Manganese/Cobalt (NMC) Li-ion battery packs and five fire suppression systems were chosen. Results of the fire suppression tests will be discussed and compared.

2 Experiments

Experiments were conducted within an open-ended shipping container (12.2-m length by 2.4-m width by 2.9-m height) located at the Pittsburgh Mining Research Division. Two types of Li-ion battery packs were used for the tests: a 12 V, 30Ah battery pack composed of 36 NMC cylindrical 18,650 batteries and a 24 V, 40Ah battery pack composed of 72 NMC cylindrical 18,650 batteries. Two 750-W electric-controlled metal heater strips with dimensions of 45 cm × 3.8 cm × 0.8 cm (length × width × thickness) were placed under the battery packs to induce thermal runaway. K-type thermocouples were attached on the battery pack to measure the battery temperature (as shown in Fig. 1). Several fire suppression systems were used for the tests. Each used a flow controller and suppression spray placed 0.5 m above the battery pack. Video cameras were used to record the fire and suppression behaviors.

The battery tests included free burn and the use of fire suppression agents: water mist (1, 2, 3 gallon per minute (GPM) and 3 GPM with F500 additive), ABC powder, and type D sodium chloride (NaCl) dry chemical. During the tests, the battery pack was placed on the two electric heater strips to induce a thermal runaway and trigger a fire. Timing information for the first visible release of smoke and fire was noted. Electrical heating was turned off after the first jet of fire was observed; suppression, if used, was initiated at the same time. Table 1 summarizes the test conditions. Fire and smoke behaviors were observed and noted throughout the tests. A low-speed ventilation (~ 0.5 m/s) was applied to clear the smoke and gases.

3 Results and Discussion

With temperature measurements, comparisons were made between the free burn case and the suppression cases with distinctions drawn after suppression was applied to the battery pack fire.

3.1 Free Burn versus Water Suppression

Test 1 is the free burn case where no suppression was applied. In this case, smoke was observed to release at about 3.5 min after heating started, and the flame started at about 10 min. The explosion and fire continued for about 8 min before the battery pack burnout. During the test, it was observed that some of the batteries exploded and ejected from the pack, which is a potential ignition source for other combustibles nearby. Figure 2 shows the four sequences

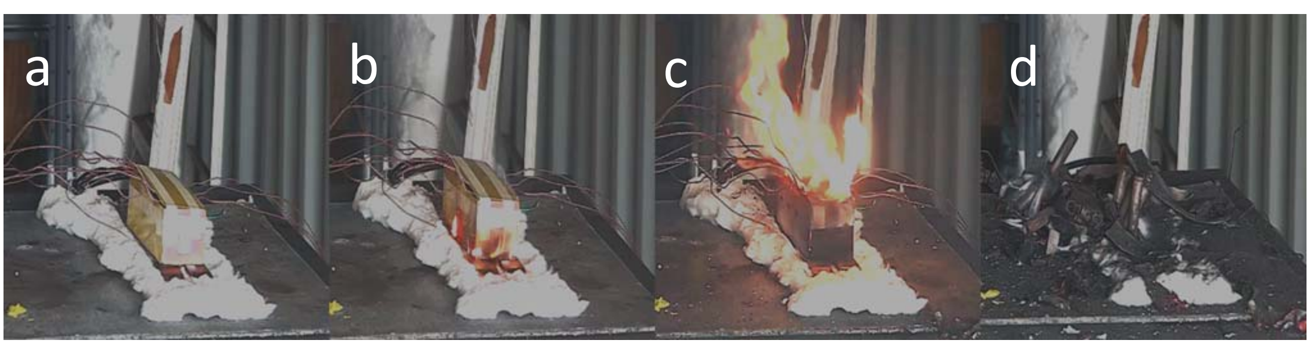


Fig. 2 Four sequences of free burn of a 12 V battery pack fire (**a** smoke starts, **b** flame starts, **c** explosion, **d** burnout)

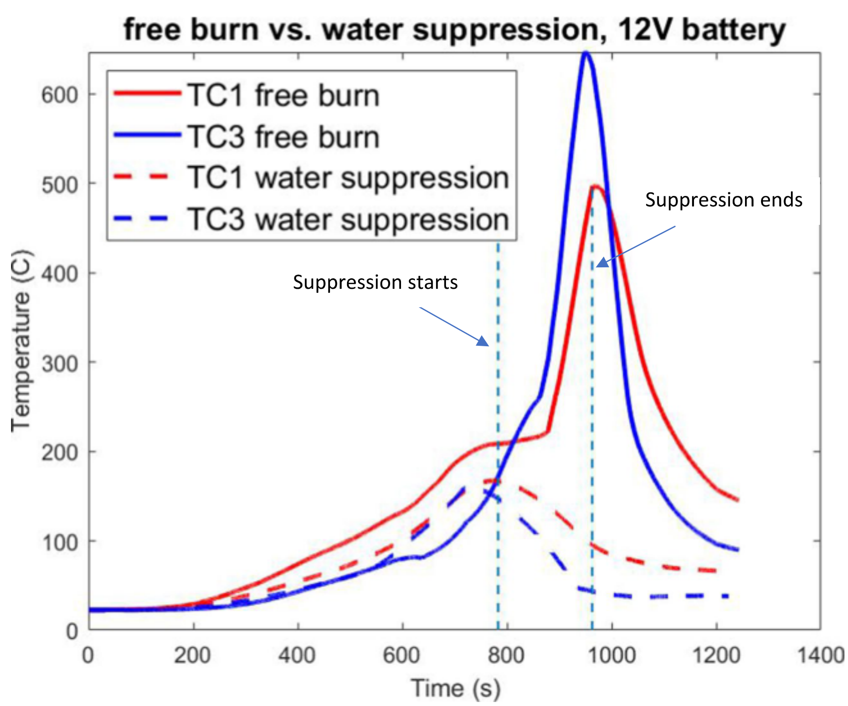
Fig. 3 Three sequences of water mist suppression of a 12 V battery pack (**a** flame starts, **b** water suppression starts, **c** extinguishment)

of the free burn for the battery pack starting from smoke emission to battery burnout. As shown in the images, most of the batteries were completely burned out. However, it is worthwhile to note that some of the batteries were not burned even after the test was over due to the explosion and shootout behaviors. Some temperature measurements of the batteries were invalid due to the shootout behavior.

Test 2 is the water mist suppression with 3 GPM flow rate. In this case, smoke was observed to release at about 3 min after heating started, and the flame started at about 10 min. Heaters were unplugged at about 10.5 min. Water suppression started at about 13.5 min when the flame was fully established. Water suppression was turned off at about 16.5 min and the battery pack fire was completely extinguished. Re-examination of the battery pack after the test revealed that 8 batteries fully burned or exploded, but 28 of the batteries were partially burned or remained intact. There was no re-ignition after the battery fire was extinguished. Figure 3 shows the sequences of the water mist fire suppression

Temperatures were compared between the free burn of a 12V battery pack and a burn with water suppression. Figure 4 shows the temperature history of two temperature measurements. The two vertical dashed lines represent the water suppression period. It was observed from Figure 4 that battery temperatures of the free burn tests were much higher than the water mist suppression tests. In the free burn case, batteries went into thermal runaway and caught fire with sharp increases in battery temperatures. In the water suppression case, after water suppression was applied, the two thermocouple temperatures quickly dropped and remained below 200°C for the rest of the test. No re-ignition was observed. The cooling effect of water suppression was probably the key in containing the fire and preventing re-ignition.

Fig. 4 Temperature comparison of free burn and water mist suppression



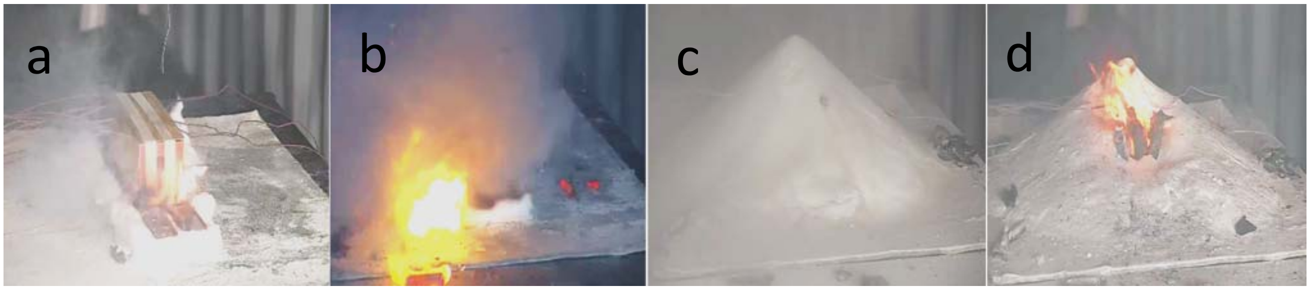


Fig. 5 The sequences of NaCl dry chemical suppression (**a** flame starts, **b** suppression starts, **c** battery fire quenched, **d** re-ignition and explosion)

3.2 Free Burn versus Dry Chemical Suppression

Test 3 is a fire suppression case with type D dry chemical. In this case, the battery fire started at about 10.5 min after heating. The suppressant was discharged at 12.5 min and lasted for about 45 s before the suppressant was depleted. The battery pack was buried under the dry chemical, and the fire visually disappeared as shown in Fig. 5 c. Shortly after the fire was quenched, re-ignition occurred, then the explosion followed. The battery fire continued until burnout. In this case, the dry chemical was able to quench the fire temporarily but failed to extinguish the fire completely.

The temperatures were compared between the free burn of a 12V battery pack and a burn with type D NaCl dry chemical suppression. Figure 6 shows the temperature history of two temperature measurements. The two vertical dashed lines represent the dry chemical suppression period. For the suppression case, it was observed that after suppression was applied, battery temperatures had a noticeable drop before they went up again due to re-ignition. In this case, the lack of cooling effect afforded by the dry chemical application probably played a major role in the re-ignition as the chemical reactions inside the battery continued despite external flame quenching and air exclusion.

3.3 Large Size Battery Pack

Test 4 is a free burn of a large battery pack (24V), test 5 is a water mist suppression case of the large battery pack (24V) fire with 3 GPM flow rate, and test 6 is the ABC dry chemical suppression case of the large battery pack (24V) fire. Figure 7 shows the comparison of free burn with water mist suppression and ABC dry chemical suppression regarding battery temperatures. The vertical dashed lines in both figures represent the suppression period. In the water mist suppression case (Fig. 7a), the application of water

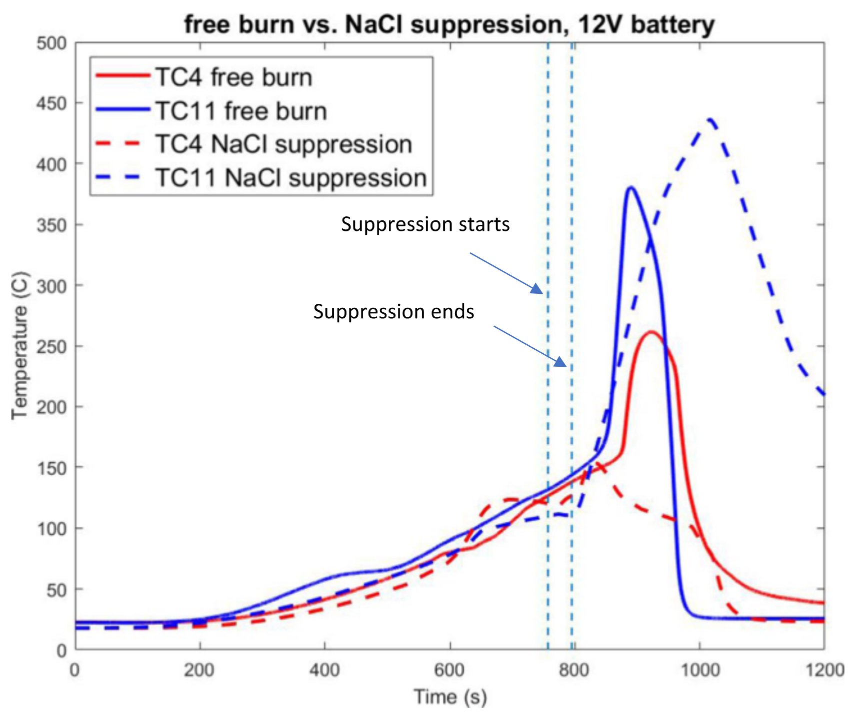


Fig. 6 Temperature comparison of free burn and dry chemical suppression

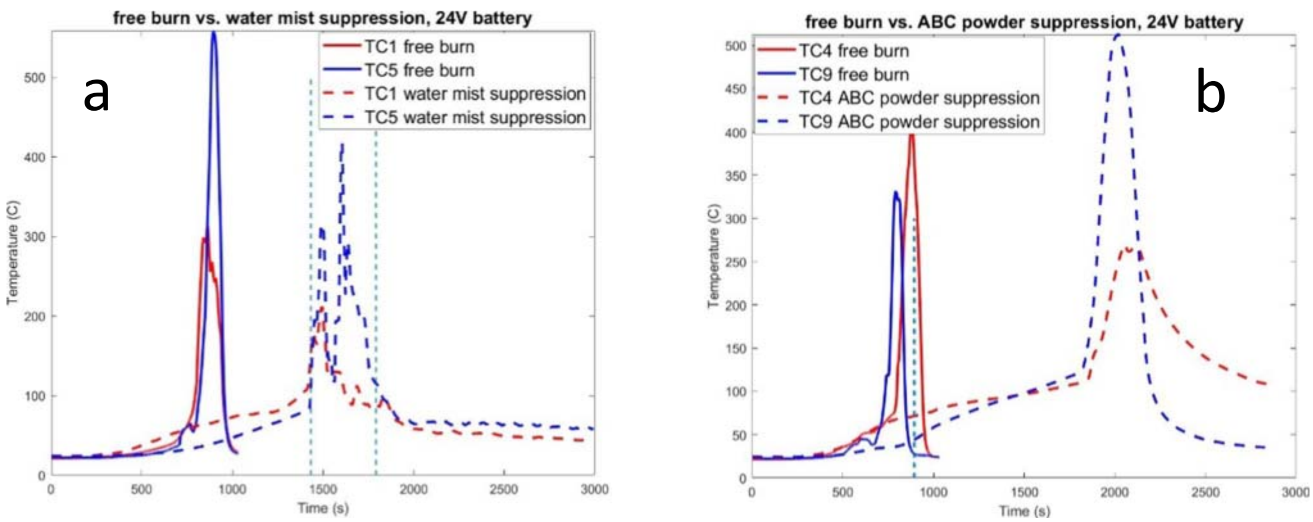


Fig. 7 Comparison of free burn of large size battery pack with suppressions: **a** 3 GPM water mist suppression, **b** ABC powder suppression

slowed the heating, but fire and explosion occurred during the suppression period. The 3 GPM water mist failed to suppress the fire of large size battery pack. In the ABC dry chemical suppression case (Fig. 7b), the initial application put out the flame temporarily, but battery temperatures still climbed slowly and eventually fire and explosion followed. The dry chemical also failed to contain and suppress the large battery pack fire.

3.4 The Effect of Water Mist Flow Rate

Different flow rates of water mist suppression were also used to study their impact on the small battery pack fire. Test 7 used water mist at 1 GPM, test 8 used water mist at 2 GPM, and test 9 used water mist at 3 GPM with F500 additive. In all three of these tests, water mist suppression started when the first explosion was observed. Four thermocouple data were plotted to demonstrate the battery temperature evolution against the time, shown in Figure 8. It was observed that

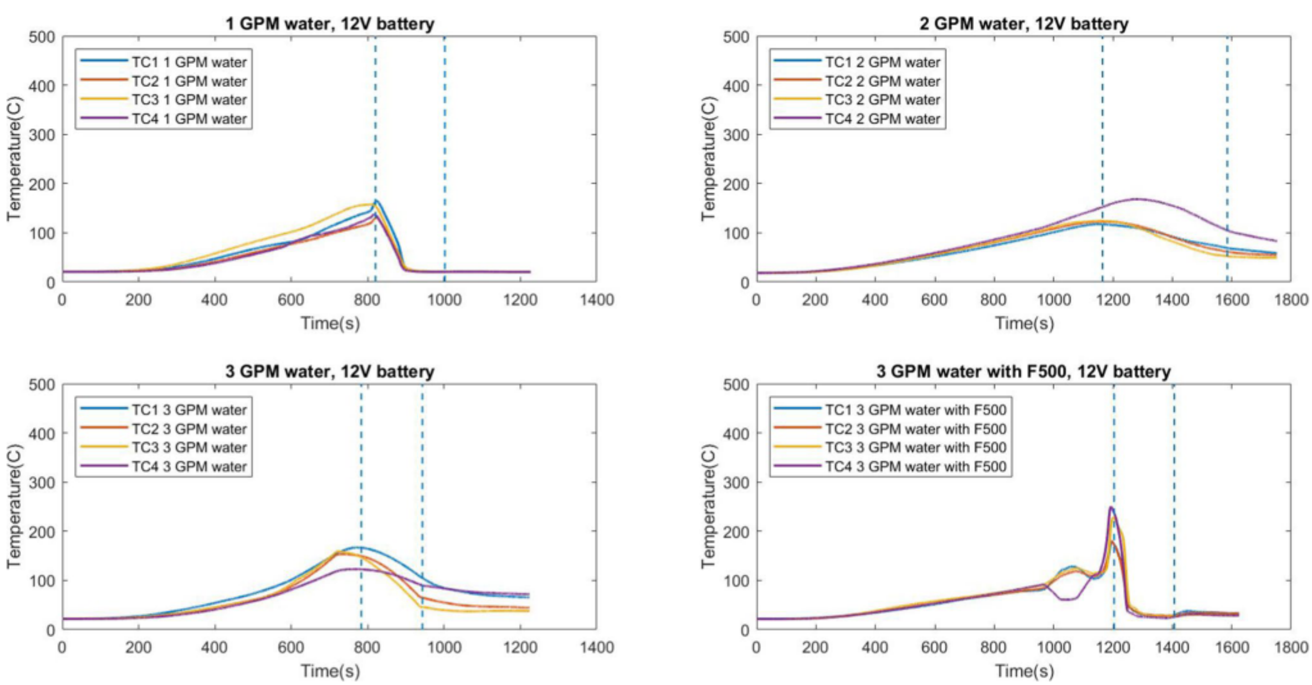


Fig. 8 The effect of water mist flow rate on suppression

water mist of all three flow rates can contain and suppress the small size battery fire without re-ignition. The 3 GPM flow rate with F500 additive might be the most effective since the drop in temperature was the quickest and most significant decrease.

4 Conclusions

Battery pack fire suppression tests were conducted at the NIOSH Pittsburgh Mining Research Division as part of its continual effort to develop workplace solutions to reduce the risk of mine disasters and mine workers' risk of injuries and fatalities. Water mist with different flow rates and/or additives, type D NaCl, and dry chemical ABC powder were used to study their effectiveness in Li-ion battery pack fire suppression. The results indicated that water mist can suppress a small battery pack fire, and its cooling effect prevents re-ignition from occurring. Water mist suppression with F500 as an additive can better suppress the fire. Type D NaCl and dry chemical ABC powder fire suppressants could quench the battery pack fire temporarily but failed to cool the battery, and re-ignition occurred. The results from this study can be used to develop an improved Li-ion battery pack fire suppression system for a mining environment.

Acknowledgements Data from this manuscript have been presented at the 2023 SME Annual Conference & Expo, February 26 – March 1, Denver, Colorado.

Declarations

Disclaimer The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of any company or product does not constitute endorsement by NIOSH.

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Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]

C.4.2 Fires.

Fires in electrochemical ESS are often a result of a process called *thermal runaway.* Thermal runaway can simply be defined as the process in which a battery creates heat but cannot dissipate that heat, resulting in dynamic temperature increase. Initial signs of thermal runaway might include pressure increase at the cell level, temperature increase, and off-gassing. As the process continues, additional signs might include vent gas ignition, exploding cells, projectile release, heat propagation, and flame propagation.

As the failure cascades, responders should also be prepared for toxic and highly toxic emissions and potentially explosive gas release. Though fire and explosion testing in accordance with 9.5.3.2 to determine battery burn outcomes, including toxic gas release calculations, remains incomplete, responders should treat them as highly dangerous and use their full suite of PPE and breathing apparatus when responding.

Proper response to electrochemical ESS fires should include the following procedures and steps:

(1) System isolation and shutdown

(2) Hazard confinement and exposure protection

(3) Fire suppression

(4) Ventilation

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Committee: ESS-AAA

Committee Statement

Resolution: FR-55-NFPA 855-2023

Statement: This revision includes the danger of highly toxic emissions for which fire fighters and first responders need to be aware. These are industry accepted technical terms with definitions for both.

Public Input No. 331-NFPA 855-2023 [Section No. C.5.1]

C.5.1 Lithium-Ion (Li-ion) Batteries.

Water or water with a water addtive, Ecnpasulating Agent (EA), is considered the preferred agent for suppressing lithium-ion battery fires. Water has superior cooling capacity, is plentiful (in many areas), and is easy to transport to the seat of the fire. While water or water with an Encapsulating Agent (EA) might be the ~~agent~~ agents of choice, the module/cabinet configuration could make penetration of water difficult for cooling the area of origin, but might still be effective for containment. Water spray has been deemed safe as an agent for use on high-voltage systems. The possibility of current leakage back to the nozzle, and ultimately the firefighter, is insignificant based on testing data published in the Fire Protection Research Foundation report *Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results*. Firefighting foams are not considered to be effective for these chemistries because they lack the ability to cool sufficiently and can conduct electricity. There is also some evidence that foams might actually encourage thermal runaway progression by insulating the burning materials and exacerbating heat rise.

Firefighting dry chemical powders can eliminate visible flame. However, they also lack the ability to cool burning battery components. Quite often, even if visible flame is removed, the thermal runaway inside the battery will continue resulting in reignition. Carbon dioxide and inert gas suppressing agents will also eliminate visible flame but will likely not provide sufficient cooling to interrupt the thermal runaway process. ESS with clean agent suppression systems installed have ventilation systems that are tied in with the fire detection and control panel so that the HVAC shuts down and dampers close to ensure the agents have sufficient hold times at the proper concentration levels to be effective suppressants. In some fire suppression systems, the HVAC recirculates and does not shut down and provides a means of dispersing the clean agents. Responders must ensure adequate hold time has occurred prior to accessing battery room/container. Manufacturer-recommended times should be made clear. These agents might also reduce flammability by suppressing oxygen levels, but data has identified that flammable gases will continue to be produced due to the continued heating and could create an environment ripe for flashover or backdraft when oxygen is reintroduced into the system.

Statement of Problem and Substantiation for Public Input

While water is a good agent to fight Lithium-Ion battery fires, copious amounts of plain water are needed. Water with a water additive Encapsulating Agent (EA) has been shown to be more effective, with less water usage and run off than plain water, on controlling LIB fires.

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Committee: ESS-AAA

Committee Statement

Resolution: This is presented as a technical fact and thus the proposed text reads more like a sales/marketing statement than a technical rationalization. Additional technical documentation, large scale fire testing, and proper testing results need to be presented. This should include testing in a loaded rack configuration with close module spacing.

Public Input No. 349-NFPA 855-2023 [Section No. F.2]

F.2 Historical Development of Codes.

F.2.1 1997 Uniform Fire Code.

Section 6401 of the 1997 edition of the *Uniform Fire Code*, based on approved modifications to the 1994 edition, contained the following requirements for stationary lead-acid battery systems:

SECTION 6401 SCOPE. Stationary lead-acid battery systems having a liquid capacity of more than 100 gallons (378.5 L) used for facility standby power, emergency power or uninterrupted power supplies shall be in accordance with Article 64. Stationary lead-acid battery systems with individual lead-acid batteries exceeding 20 gallons (75.7 L) each shall also comply with Article 80. [**UFC,** 1997]

The requirements addressed were as follows:

(1) Safety venting

(2) Occupancy separation

(3) Spill control

(4) Neutralization

(5) Ventilation

(6) Signs

(7) Seismic protection

(8) Smoke detection

Note that the scope was not open ended. The individual battery limitation was set at 20 gallons and exceeding that amount per battery still triggered the more extensive hazardous material provisions in the UFC.

The topics addressed were based upon normal operation. Overcharging, thermal runaway, or other abnormal operational conditions were not considered, if in fact they were even recognized safety concerns at the time.

F.2.2 2000 International Code Council Codes.

The targeted regulation of stationary lead-acid battery systems that began with the 1997 *Uniform Fire Code* was carried forward as the three legacy model code organizations merged as the International Code Council and completed work on the development of, among others, the 2000 *International Fire Code* and 2000 *International Building Code*. The topics covered were as follows:

(1) Safety venting

(2) Room design and construction

(3) Spill control and neutralization

(4) Ventilation

(5) Signs

(6) Seismic protection

(7) Smoke detection

The threshold for application was reduced to 50 gal (190 L)and the 20 gal (75 L) per battery limitation was eliminated compared to the 1997 UFC. In addition, the *International Building Code* classified the battery storage as incidental use areas and added an exemption from the high-hazard use classification.

The purpose of the requirements was to provide for relief for certain battery system applications from being designated a high-hazard occupancy due to the amount of hazardous materials that were contained within the batteries. In practice, if a stationary lead-acid battery system satisfies these requirements then the facility containing those batteries is not regulated as a hazardous material occupancy and would not be designated a high-hazard use. That said, if the hazardous material maximum allowable quantities (MAQ) relative to the amount of electrolyte was exceeded then the battery system would result in a hazardous material classification.

The requirements for stationary lead-acid battery systems were brought into the 2000 *International Fire Code* as Section 608 with the topics listed in F.2.2 addressed. For room design and construction, the user was pointed to the 2000 *International Building Code* where the battery systems were identified as an incidental use area and required to be separated from the remainder of the occupancy by fire resistance rated assemblies.

As with the 1997 UFC, the topics addressed were based upon normal operation. Overcharging, thermal runaway, or other abnormal operating conditions were not considered or recognized at the time.

F.2.3 2003 International Code Council Codes and NFPA 1, *Fire Code*.

In Section 608 of the 2003 *International Fire Code*, the scope of lead-acid battery systems was changed to lead-acid battery systems using vented (flooded) lead-acid batteries. A new Section 609 was added to the IFC covering valve-regulated lead-acid battery systems and contained similar language. The requirements in the 2003 *International Building Code* remained the same applying to lead-acid batteries generally.

Section 608 vented (flooded) lead-acid batteries covered the following:

(1) Safety venting

(2) Room design and construction

(3) Spill control and neutralization

(4) Ventilation

(5) Signs

(6) Seismic protection

(7) Smoke detection

Section 609 valve-regulated lead-acid battery systems covered the following:

(1) Safety venting

(2) Thermal runaway

(3) Room design and construction

(4) Spill control and neutralization

(5) Ventilation

(6) Cabinet ventilation

(7) Signs

(8) Seismic protection

(9) Smoke detection

It should be noted that NFPA 1, *Fire Code*, did not have any requirements for stationary storage battery systems in the 2000 edition. The requirements were added to the 2003 edition of NFPA 1 from the same source used for the 2000 edition of the *International Fire Code*, the *Uniform Fire Code*, along with the added coverage of valve-regulated lead-acid batteries. The NFPA 1, *Fire Code*, battery storage provisions then remained unchanged until the 2009 edition.

F.2.4 2006 International Code Council Codes and NFPA 1, *Fire Code*.

In the 2006 edition of the *International Fire Code* (IFC), Section 608 was rewritten to cover the following:

(1) Flooded lead-acid batteries

(2) Flooded nickel-cadmium (Ni-Cad) batteries

(3) Valve-regulated lead-acid (VRLA) batteries

(4) Lithium-ion batteries

This edition of the IFC signaled a recognition for and the introduction of new chemistries such as nickel-cadmium and lithium-ion batteries.

The same general topics were covered in the revisions to the 2003 IFC that were implemented as the 2006 IFC, including the need for a separate room or space created in accordance with the building code. That said, beyond the separate room, only the IFC signage, seismic protection, and smoke detection requirements applied to the lithium-ion batteries. Figure F.2.4 provides the overview of the 2006 IFC provisions.

Figure F.2.4 2006 International Fire Code Battery Requirements. ***(Source: 2006 International Fire Code.)***

TABLE 608.1
BATTERY REQUIREMENTS

REQUIREMENT	NONRECOMBINANT BATTERIES		RECOMBINANT BATTERIES	
	Flooded Lead Acid Batteries	Flooded Nickel-Cadmium (Ni-Cd) Batteries	Valve Regulated Lead Acid (VRLA) Batteries	Lithium-Ion Batteries
Safety caps	Venting caps (608.2.1)	Venting caps (608.2.1)	Self-resealing flame-arresting caps (608.2.2)	No caps
Thermal runaway management	Not required	Not required	Required (608.3)	Not required
Spill control	Required (608.5)	Required (608.5)	Not required	Not required
Neutralization	Required (608.5.1)	Required (608.5.1)	Required (608.5.2)	Not required
Ventilation	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Not required
Signage	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)
Seismic protection	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)
Smoke detection	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)

There were no changes made between the 2003 and the 2006 edition of NFPA 1, *Fire Code*. As such, it continued to apply only to the flooded lead-acid and valve-regulated lead-acid batteries.

F.2.5 2009 International Code Council Codes and NFPA 1, *Fire Code*.

The 2009 edition of NFPA 1, *Fire Code*, contained new provisions that added lithium-ion and nickel-cadmium technologies, and both NFPA 1 *(see Table F.2.5)* and the IFC *(see Figure F.2.5)* contained new provisions that added lithium metal polymer batteries to the list of regulated battery technologies. The key difference in treatment between lithium-ion batteries and lithium metal polymer batteries was the requirement for thermal runaway protection for lithium metal polymer batteries. It should be noted that although Table 52.1 of the 2009 edition of NFPA 1 indicates no thermal runaway requirement for lithium-ion batteries, the technical language in 52.3.2 indicates thermal runaway was required for lithium-ion as well.

Thermal Runaway. VRLA and lithium-ion and lithium metal polymer battery systems shall be provided with a listed device or other approved method to preclude, detect, and control thermal runaway. [**1:**52.3.2, 2009]

A change to the *International Building Code* (IBC) unrelated to battery storage systems limited all incidental uses, the classification the IBC applies to battery systems, to no more than 10 percent of the area of the floor of the building they are located on.

Table F.2.5 Battery Requirements

	Nonrecombinant Batteries		Recombinant Batteries		Other
Requirement	Flooded Lead-Acid	Flooded Nickel-Cadmium (Ni-Cd)	Valve-Regulated Lead–Acid (VRLA)	Lithium-Ion	Lithium Metal Polymer
Safety caps	Venting caps	Venting caps	Self-resealing flame-arresting caps	No caps	No caps
Thermal runaway management	Not required	Not required	Required	Not required	Required
Spill control	Required	Required	Not required	Not required	Not required
Neutralization	Required	Required	Required	Not required	Not required
Ventilation	Required	Required	Required	Not required	Not required
Signage	Required	Required	Required	Required	Required
Seismic control	Required	Required	Required	Required	Required
Fire detection	Required	Required	Required	Required	Required

[**1:**Table 52.1, 2009]

Figure F.2.5 2009 International Fire Code Battery Requirements. ***(Source: 2009 International Fire Code.)***

TABLE 608.1
BATTERY REQUIREMENTS

	NONRECOMBINANT BATTERIES		RECOMBINANT BATTERIES		OTHER
REQUIREMENT	Flooded Lead Acid Batteries	Flooded Nickel-Cadmium (Ni-Cd) Batteries	Valve Regulated Lead Acid (VRLA) Batteries	Lithium-Ion Batteries	Lithium Metal Polymer
Safety caps	Venting caps (608.2.1)	Venting caps (608.2.1)	Self-resealing flame-arresting caps (608.2.2)	No caps	No caps
Thermal runaway management	Not required	Not required	Required (608.3)	Not required	Required (608.3)
Spill control	Required (608.5)	Required (608.5)	Not required	Not required	Not required
Neutralization	Required (608.5.1)	Required (608.5.1)	Required (608.5.2)	Not required	Not required
Ventilation	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Required (608.6.1; 608.6.2)	Not required	Not required
Signage	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)	Required (608.7)
Seismic protection	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)	Required (608.8)
Smoke detection	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)	Required (608.9)

F.2.6 2012 and 2015 International Code Council Codes and NFPA 1, *Fire Code.*

Between the 2009 and 2012 editions of the fire codes, there were insignificant changes made to the requirements associated with battery systems. Between the 2012 and 2015 editions no changes were made. Essentially the 2009 and 2015 editions were the same with respect to battery systems.

F.2.7 2018 International Code Council Codes and NFPA 1, *Fire Code*.

Recognizing the development of new battery technologies and the evolution of battery storage into a more robust and wider energy storage industry in relation to the requirements in the various fire and building codes, the International Code Council's Fire Code Action Committee created an Energy Storage Systems Work Group (ESS WG). The work of the ESS WG resulted in a new chapter being approved for inclusion in the 2018 *International Fire Code* — Chapter 12, Energy Systems — into which all the key energy-storage-related requirements (including batteries) were moved including the following:

(1) Emergency and stand-by power systems

(2) Solar photovoltaic power systems

(3) Stationary fuel cell power systems

(4) Electrical energy storage systems

As part of this work the requirements of the former stationary storage battery systems chapter took on the broader application of electrical energy storage systems and addressed the following topics:

(1) Battery storage system threshold quantities

(2) Construction documents

(3) Hazard mitigation analysis

(4) Fault condition

(5) Thermal runaway

(6) Seismic and structural design

(7) Vehicle impact protection

(8) Combustible storage

(9) Testing, maintenance, and repair

(10) Location and construction

(11) Stationary battery arrays

(12) Outdoor installations

(13) Maximum allowable quantities

(14) Storage batteries and equipment

(15) Fire-extinguishing and detection systems

(16) Specific battery-type requirements

(17) Capacitor energy storage systems

A major change within this work of the IFC was the introduction of array (unit) spacing as follows:

1206.2.8.3 Stationary battery arrays. Storage batteries, prepackaged stationary storage battery systems and preengineered stationary storage battery systems shall be segregated into stationary battery arrays not exceeding 50 kWh (180 megajoules) each. Each stationary battery array shall be spaced not less than 3 feet (914 mm) from other stationary battery arrays and from walls in the storage room or area. The storage arrangements shall comply with Chapter 10. [**IFC,** 2018]

This is intended to restrict the amount of energy in arrays (units) and requires a larger footprint for an energy storage system installation due to the 3 ft separation requirement. Exceptions were provided that eliminate lead-acid and nickel-cadmium storage batteries from this limitation, allow listed prepackaged units to have a 250 kWh threshold for separation, and elimination of the limits based upon fire and explosion testing as follows:

Exceptions:

(1) *Lead acid and nickel cadmium storage battery arrays.*

(2) *Listed preengineered stationary storage battery systems and prepackaged stationary storage battery systems shall not exceed 250 kWh (900 megajoules) each.*

(3) *The fire code official is authorized to approve listed, preengineered and prepackaged battery arrays with larger capacities or smaller battery array spacing if large-scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving one array will not propagate to an adjacent array, and be contained within the room for a duration equal to the fire-resistance rating of the room separation specified in Table 509 of the International Building Code.*

[**IFC,** 2018]

The IFC relies upon 1- or 2-hour fire-resistant construction to separate systems from the remainder of the building and an assessment that that level of protection can contain the fire impacts within the room or space where a system is installed. A fire and explosion test is needed to document such containment.

The other significant change between the 2015 and 2018 IFC editions was the specification of a maximum allowable battery quantity *(see Figure F.2.7)*.

Figure F.2.7 2018 International Fire Code Maximum Allowable Battery Quantities. *(Source: 2018 International Fire Code.)*

TABLE 1206.2.9
MAXIMUM ALLOWABLE BATTERY QUANTITIES

BATTERY TECHNOLOGY	MAXIMUM ALLOWABLE QUANTITIES[a]	GROUP H OCCUPANCY
Flow batteries[b]	600 kWh	Group H-2
Lead acid, all types	Unlimited	Not Applicable
Lithium, all types	600 kWh	Group H-2
Nickel cadmium (Ni-Cd)	Unlimited	Not Applicable
Sodium, all types	600 kWh	Group H-2
Other battery technologies	200 kWh	Group H-2[c]

For SI: 1 kilowatt hour = 3.6 megajoules.
a. For batteries rated in amp-hours, Kilowatt-hours (kWh) shall equal rated battery voltage times the amp-hour rating divided by 1,000.
b. Shall include vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.
c. Shall be a Group H-4 occupancy if the fire code official determines that a fire or thermal runaway involving the battery technology does not represent a significant fire hazard.

This was the first time there was an upper limit applied to the amount of energy allowed to be stored in an energy storage system located in a room or space. As with the spacing limitations, there was an exception that could be applied based upon fire and explosion testing as follows:

Exception: Where approved by the fire code official, areas containing stationary storage batteries that exceed the amounts in Table 1206.2.9 shall be treated as incidental use areas and not Group H occupancies based on a hazardous mitigation analysis in accordance with Section 1206.2.3 and large-scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory. [**IFC,** 2018]

Along with the provisions in the 2018 IFC, energy storage language was added to the 2018 *International Residential Code* for the first time. In summary, the new language in the *International Residential Code* required energy storage systems to be listed and precluded them from being installed within the habitable space of a dwelling unit.

The 2018 NFPA 1, *Fire Code*, Chapter 52 contained modifications to the 2015 edition that were very similar to all of the new requirements introduced to the 2018 IFC.

F.2.8 2021 International Code Council Code Development and 2019 NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*.

While the code revision process was being completed for the 2018 editions of the IFC and NFPA 1, NFPA developed the new standard NFPA 855, *Standard for the Installation of Stationary Energy Storage Systems*. The work of the NFPA 855 technical committee closely tracked and utilized the 2018 language added to the fire codes along with the language from NFPA 853, *Standard for the Installation of Stationary Fuel Cell Power Systems*, for the initial NFPA 855 draft document.

With the adoption and availability of the 2018 editions of the codes, a broader audience was reached that generated additional input to the NFPA 855 committee on the impact of the requirements and questions on how to apply them in differing circumstances such as follows:

(1) Roof installs

(2) Open parking garage installs

(3) Remote installations

(4) Dedicated ESS buildings

(5) Array (unit) spacing threshold

(6) Maximum allowable quantity impact

(7) Incidental use 10 percent of floor area limitation

(8) Appropriate requirements based upon technology

(9) Deflagration prevention/venting

(10) Suppression system selection

(11) Fire detection method and where required

Going into the NFPA 855 First Draft process, language improvements were coordinated with work in progress on the proposals for the 2021 editions of the *International Fire Code*, *International Building Code*, and the *International Residential Code*.

Key areas addressed by the current proposals approved by the ICC Fire Code Action Committee and the Fire Code Committee at the proposal hearings for the 2021 edition code change process were as follows:

(1) Permits, operational as well as installation

(2) Fire and explosion test reliance on new UL 9540A

(3) Fire remediation actions and personnel

(4) Commissioning

(5) Decommissioning

(6) Operation and maintenance

(7) Repairs, retrofits, and replacements

(8) Reused and repurposed equipment

(9) Toxic and highly toxic gases

(10) Security of installations

(11) Occupied work centers

(12) Walk-in units

(13) Size and separation threshold reduction

(14) Maximum allowable quantities as simply a testing trigger

(15) Remote installations

(16) ESS dedicated-use buildings designated as an F-1 Group use

(17) Non-dedicated-use buildings

(18) Elimination of incidental use 10 percent of floor area restriction and H Group designation

(19) Explosion control

(20) Outdoor installations

(21) Rooftop installations

(22) Open parking garage installations

(23) Mobile ESS equipment and operations

Though some of the new language is more conservative, such as the threshold before fire and explosion testing and the requirement for explosion protection for lithium-ion energy storage systems, other proposed changes provide relief from some requirements such as ESS dedicated-use buildings, remote locations, and rooftop and open parking garage installations.

The most restrictive requirements were maintained to address when an energy storage system is installed within a mixed-use occupancy building and it is important to contain an event for life safety and property protection.

The changes proposed for the 2021 I-Codes, and coordinated with the 2019 NFPA 855 development process, are significantly different from the 2018 provisions because of industry participation. The initial language of the 2018 editions of the fire codes and the draft of NFPA 855 are intended to obtain an acceptable level of safety recognizing how challenging and dynamic events from batteries and energy storage systems can be, whether the system instigates an issue or is a casualty of outside events. Those who verify code compliance and others working on the code language have maintained an open view, and where industry has provided data on different technologies and/or on documented safety practices, or a reduction in exposure hazards, there has been a willingness to modify the requirements in recognition of the new information and data.

F2.9 NFPA 18A 2022 Edition includes an Encapsulator- Spherical Micelle Stability Test (Liquid phase fuels). This test allow water additives to be tested to a standard, making the use of NFPA 18A agents more readily accepted.

F2.10 NIOSH conducted a Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires that concluded that a water mist system with F-500 (an Encapsultor Agent (EA)) can better suppress a Litium-ion nbattery fire.

Additional Proposed Changes

File Name	Description	Approved
NIOSH_report.pdf	NIOSH report	

Statement of Problem and Substantiation for Public Input

While NFPA will not accept the NIOSH report submitted here, it was previously submitted for technical review in the comments to NFPA 10.

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
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Street Address:
City:
State:
Zip:
Submittal Date: Thu Jun 01 14:54:53 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: This is presented as a technical fact and thus the proposed text reads more like a sales/marketing statement than a technical rationalization. Additional technical documentation, large scale fire testing, and proper testing results need to be presented. This should include testing in a loaded rack configuration with close module spacing.

Mining, Metallurgy & Exploration
https://doi.org/10.1007/s42461-023-00765-7

Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires

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Abstract
Lithium-ion battery pack fires pose great hazards to the safety and health of miners. A detailed experimental study has been conducted at the National Institute for Occupational Safety and Health (NIOSH) Pittsburgh Mining Research Division (PMRD) to investigate the effectiveness of different fire suppression systems on Li-ion battery pack fire extinguishment. Tests were conducted in a well-ventilated container. Two sizes of battery packs (12 V, 24 V) were heated by heater strips to trigger thermal runaway and fire. Water mist with different flow rates, ABC powder, type D dry chemical, and water mist with F500 additives were used as the fire suppression agents. Multiple thermocouples were installed on the battery packs to measure the temperature evolution during the tests. The results indicated that the water mist with F500 additives is the most effective suppressant among the agents tested. Dry chemicals, however, do quench the fire for a moment, but cannot prevent re-ignition of the battery since they do not provide enough cooling. The findings of this paper can be used to develop safer battery fire suppression techniques in mining environments.

Keywords Lithium-ion battery · Fire suppression · Water mist · Dry chemical

1 Introduction

As an important alternative to fossil fuels, lithium-ion (Li-ion) batteries have seen their applications growing from consumer electronic products to large electric vehicles. In the mining industry, Li-ion battery powered electric vehicles (BEVs) are believed to be a promising replacement for diesel-powered vehicles whose emission of diesel particulate matter (DPM) is a major concern to the safety and health of miners [1]. The introduction of BEVs into the mining industry has not been trouble-free as the potential use of Li-ion BEVs in gassy underground mines escalates the fire and explosion risks [1]. Methane-air mixtures are found in many types of mines, and the energy released by a Li-ion battery during thermal runaway or accidents resulting in fire can be an ignition source for such mixtures [2, 3]. A safer and more reliable design and application of Li-ion BEVs could help reduce and mitigate the risk of fire and explosion accidents underground. The size of a battery pack fire can be indicated by the heat release rate (HRR). Wang et al. [4] used cone calorimetry tests and found that the peak HRR and total heat release increase with state of charge of the battery. Most of the HRR measurement of battery fires used the oxygen consumption theory [5, 6].

While preventing the fire and explosion of Li-ion batteries from occurring is necessary, suppression of such incidents when they occur is just as vital [7, 8]. In a mining environment where fire suppression resources are limited, an effective battery fire suppression technique is critical to the safety and health of miners. Numerous studies have been conducted to investigate the effectiveness of traditional fire suppression techniques on battery or battery pack fires. Unlike traditional fire suppression, battery fire suppression requires extensive cooling even after the fire is visually quenched [9-12] to reduce battery temperature and prevent re-ignition due to chemical reactions inside the batteries. Liu et al. [13] found that water mist can well control the thermal runaway of a battery by cooling the battery below a certain critical temperature. Larsson et al. [14] reported that the effectiveness of water mist on battery fire suppression is not obvious, and that hydrogen fluoride concentration increased after the application of water mist. Blum et al. [15] conducted large-scale

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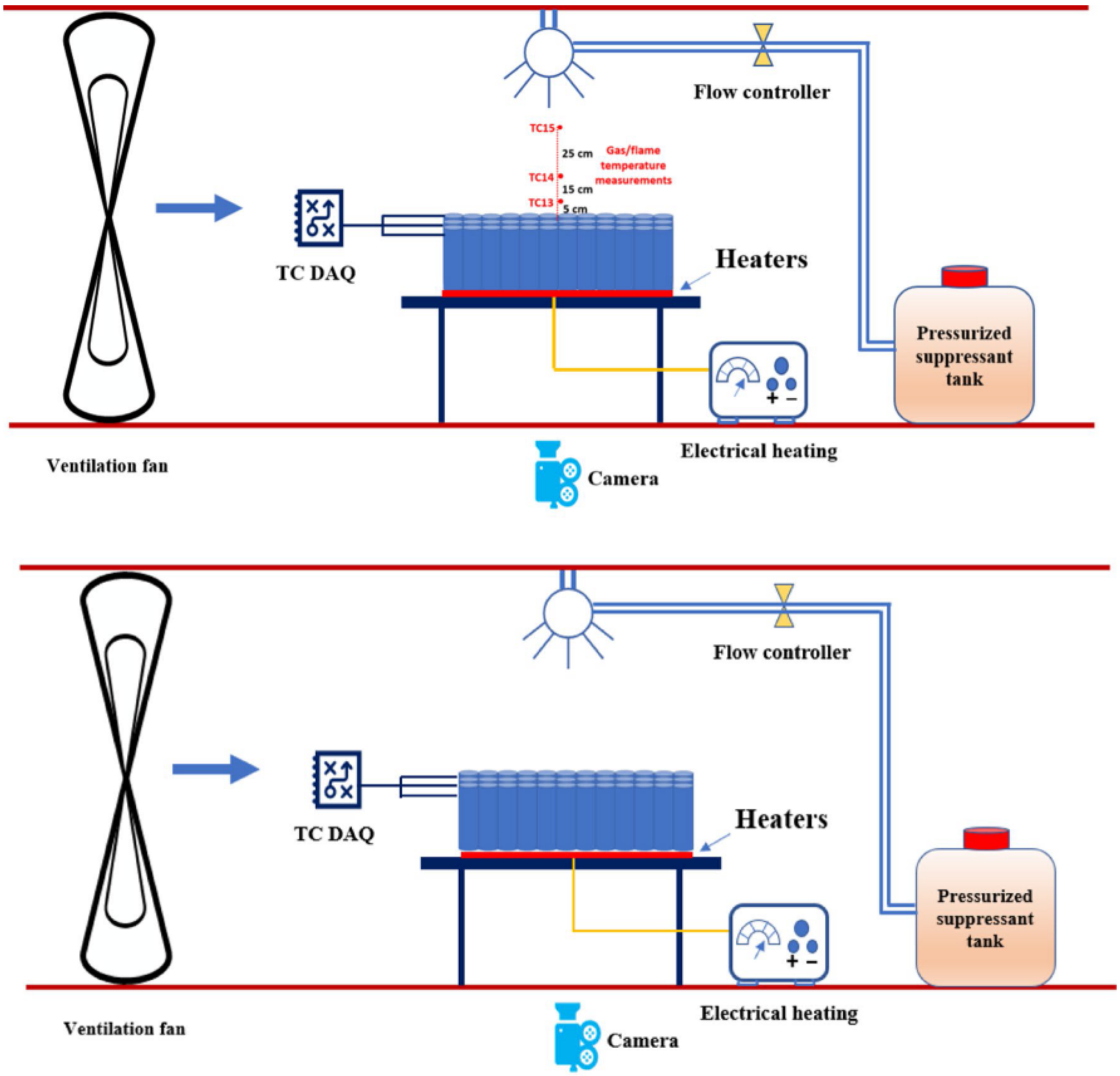
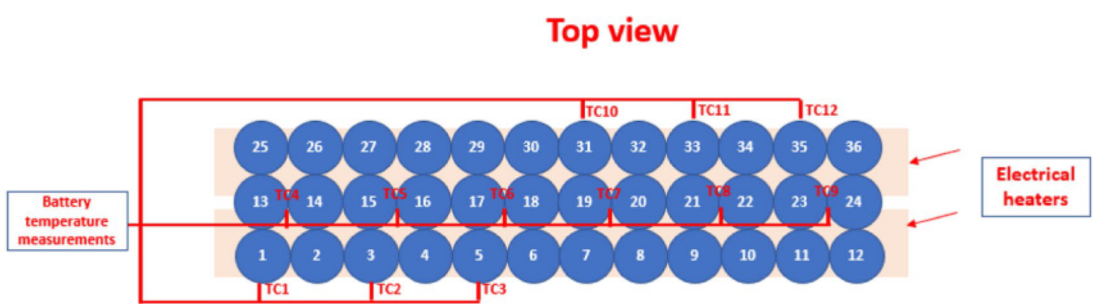


a. Test setup in the facility



b. Top view of measurement on battery pack

Fig. 1 Battery fire suppression test setup

Table 1 Test conditions

Test number	Battery size	Agent
1	12 V	Free burn
2	12 V	Water mist, 3 GPM
3	12 V	Dry chemical
4	24 V	Free burn
5	24 V	Water mist, 3 GPM
6	24 V	Dry chemical
7	12 V	Water mist, 1 GPM
8	12 V	Water mist, 2 GPM
9	12 V	Water mist 3 GPM with F500 additive

battery fire suppression tests and noticed that a large amount of water is needed to extinguish BEV fires. Research on effective fire suppression technique for small and large battery pack fires in a mining environment is limited.

In this work, detailed experimental research was conducted to investigate the effectiveness of different fire suppression systems on Li-ion battery pack fires. Two sizes of Nickel/Manganese/Cobalt (NMC) Li-ion battery packs and five fire suppression systems were chosen. Results of the fire suppression tests will be discussed and compared.

2 Experiments

Experiments were conducted within an open-ended shipping container (12.2-m length by 2.4-m width by 2.9-m height) located at the Pittsburgh Mining Research Division. Two types of Li-ion battery packs were used for the tests: a 12 V, 30Ah battery pack composed of 36 NMC cylindrical 18,650 batteries and a 24 V, 40Ah battery pack composed of 72 NMC cylindrical 18,650 batteries. Two 750-W electric-controlled metal heater strips with dimensions of 45 cm × 3.8 cm × 0.8 cm (length × width × thickness) were placed under the battery packs to induce thermal runaway. K-type thermocouples were attached on the battery pack to measure the battery temperature (as shown in Fig. 1). Several fire suppression systems were used for the tests. Each used a flow controller and suppression spray placed 0.5 m above the battery pack. Video cameras were used to record the fire and suppression behaviors.

The battery tests included free burn and the use of fire suppression agents: water mist (1, 2, 3 gallon per minute (GPM) and 3 GPM with F500 additive), ABC powder, and type D sodium chloride (NaCl) dry chemical. During the tests, the battery pack was placed on the two electric heater strips to induce a thermal runaway and trigger a fire. Timing information for the first visible release of smoke and fire was noted. Electrical heating was turned off after the first jet of fire was observed; suppression, if used, was initiated at the same time. Table 1 summarizes the test conditions. Fire and smoke behaviors were observed and noted throughout the tests. A low-speed ventilation (~ 0.5 m/s) was applied to clear the smoke and gases.

3 Results and Discussion

With temperature measurements, comparisons were made between the free burn case and the suppression cases with distinctions drawn after suppression was applied to the battery pack fire.

3.1 Free Burn versus Water Suppression

Test 1 is the free burn case where no suppression was applied. In this case, smoke was observed to release at about 3.5 min after heating started, and the flame started at about 10 min. The explosion and fire continued for about 8 min before the battery pack burnout. During the test, it was observed that some of the batteries exploded and ejected from the pack, which is a potential ignition source for other combustibles nearby. Figure 2 shows the four sequences

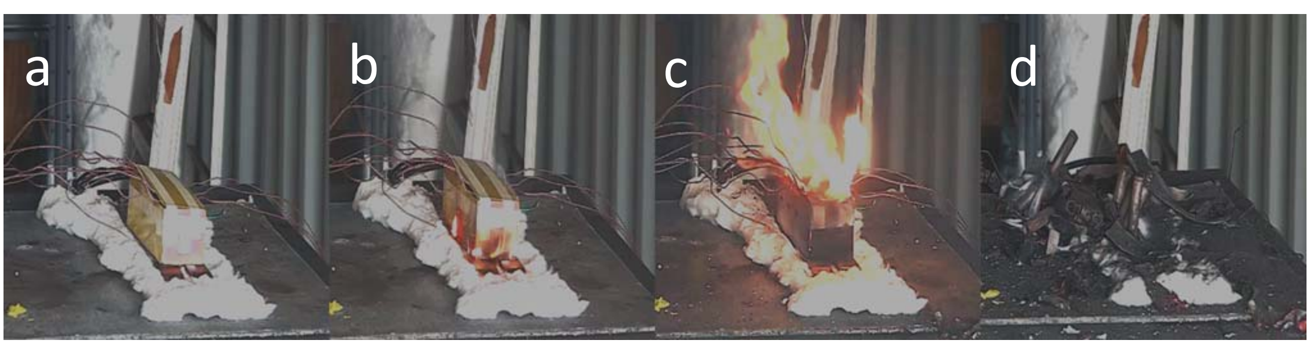


Fig. 2 Four sequences of free burn of a 12 V battery pack fire (**a** smoke starts, **b** flame starts, **c** explosion, **d** burnout)

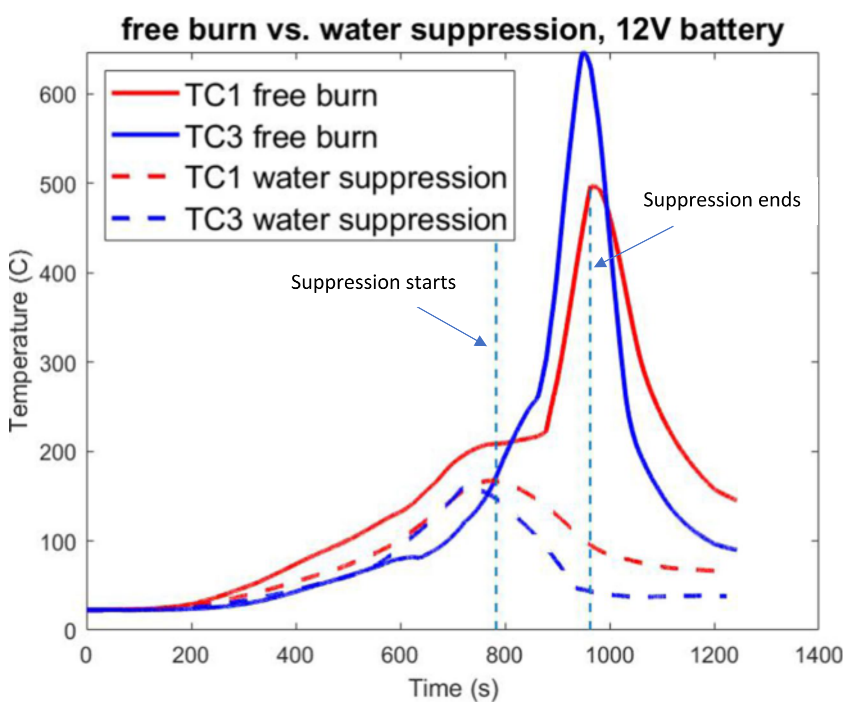
Fig. 3 Three sequences of water mist suppression of a 12 V battery pack (**a** flame starts, **b** water suppression starts, **c** extinguishment)

of the free burn for the battery pack starting from smoke emission to battery burnout. As shown in the images, most of the batteries were completely burned out. However, it is worthwhile to note that some of the batteries were not burned even after the test was over due to the explosion and shootout behaviors. Some temperature measurements of the batteries were invalid due to the shootout behavior.

Test 2 is the water mist suppression with 3 GPM flow rate. In this case, smoke was observed to release at about 3 min after heating started, and the flame started at about 10 min. Heaters were unplugged at about 10.5 min. Water suppression started at about 13.5 min when the flame was fully established. Water suppression was turned off at about 16.5 min and the battery pack fire was completely extinguished. Re-examination of the battery pack after the test revealed that 8 batteries fully burned or exploded, but 28 of the batteries were partially burned or remained intact. There was no re-ignition after the battery fire was extinguished. Figure 3 shows the sequences of the water mist fire suppression

Temperatures were compared between the free burn of a 12V battery pack and a burn with water suppression. Figure 4 shows the temperature history of two temperature measurements. The two vertical dashed lines represent the water suppression period. It was observed from Figure 4 that battery temperatures of the free burn tests were much higher than the water mist suppression tests. In the free burn case, batteries went into thermal runaway and caught fire with sharp increases in battery temperatures. In the water suppression case, after water suppression was applied, the two thermocouple temperatures quickly dropped and remained below 200°C for the rest of the test. No re-ignition was observed. The cooling effect of water suppression was probably the key in containing the fire and preventing re-ignition.

Fig. 4 Temperature comparison of free burn and water mist suppression



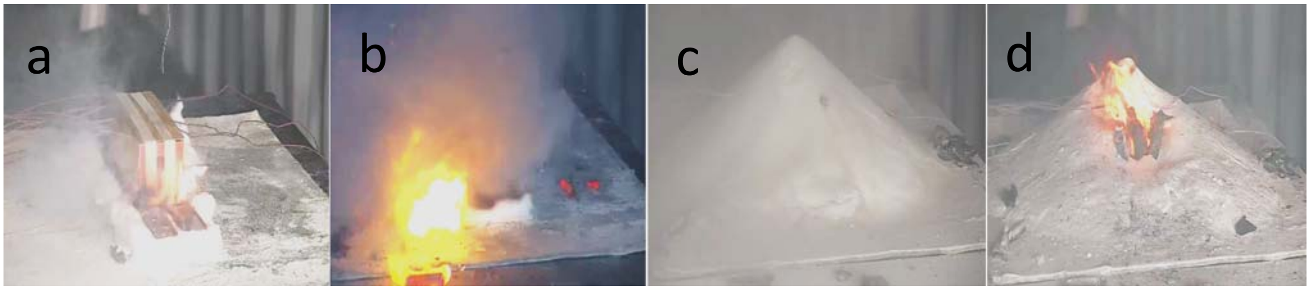


Fig. 5 The sequences of NaCl dry chemical suppression (**a** flame starts, **b** suppression starts, **c** battery fire quenched, **d** re-ignition and explosion)

3.2 Free Burn versus Dry Chemical Suppression

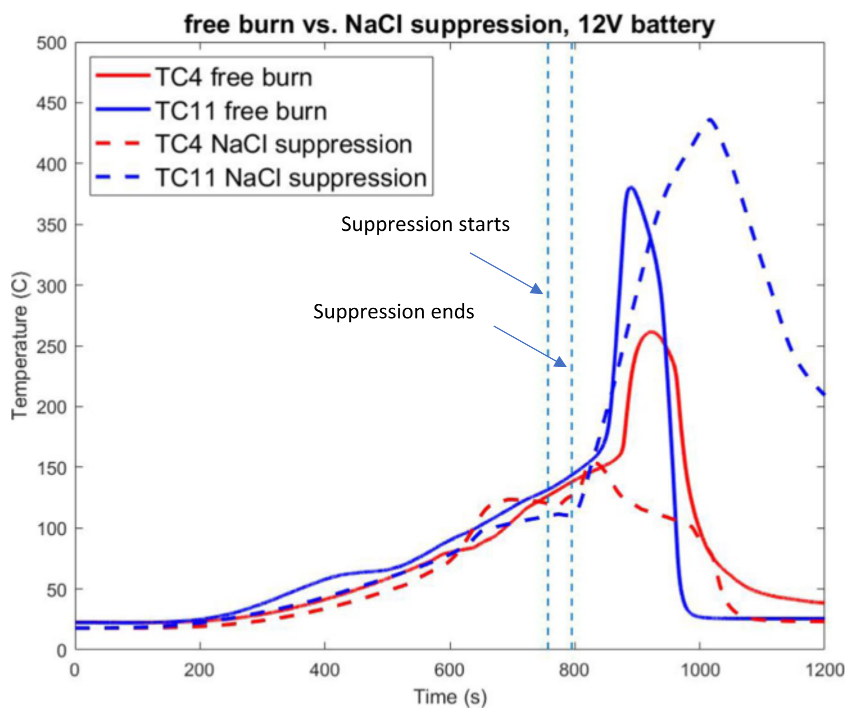
Test 3 is a fire suppression case with type D dry chemical. In this case, the battery fire started at about 10.5 min after heating. The suppressant was discharged at 12.5 min and lasted for about 45 s before the suppressant was depleted. The battery pack was buried under the dry chemical, and the fire visually disappeared as shown in Fig. 5 c. Shortly after the fire was quenched, re-ignition occurred, then the explosion followed. The battery fire continued until burnout. In this case, the dry chemical was able to quench the fire temporarily but failed to extinguish the fire completely.

The temperatures were compared between the free burn of a 12V battery pack and a burn with type D NaCl dry chemical suppression. Figure 6 shows the temperature history of two temperature measurements. The two vertical dashed lines represent the dry chemical suppression period. For the suppression case, it was observed that after suppression was applied, battery temperatures had a noticeable drop before they went up again due to re-ignition. In this case, the lack of cooling effect afforded by the dry chemical application probably played a major role in the re-ignition as the chemical reactions inside the battery continued despite external flame quenching and air exclusion.

3.3 Large Size Battery Pack

Test 4 is a free burn of a large battery pack (24V), test 5 is a water mist suppression case of the large battery pack (24V) fire with 3 GPM flow rate, and test 6 is the ABC dry chemical suppression case of the large battery pack (24V) fire. Figure 7 shows the comparison of free burn with water mist suppression and ABC dry chemical suppression regarding battery temperatures. The vertical dashed lines in both figures represent the suppression period. In the water mist suppression case (Fig. 7a), the application of water

Fig. 6 Temperature comparison of free burn and dry chemical suppression



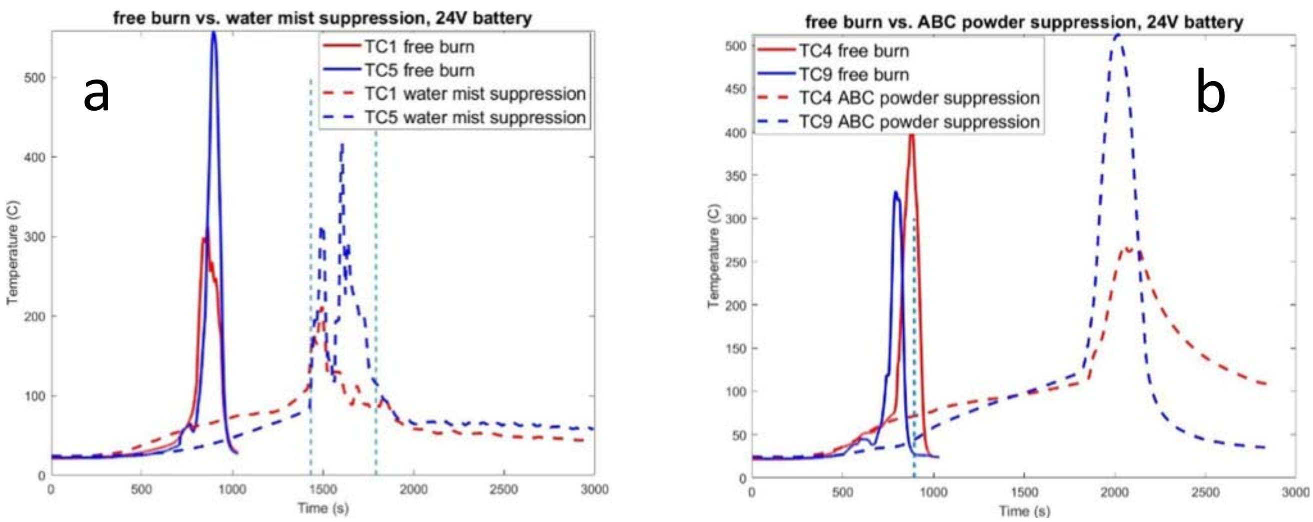


Fig. 7 Comparison of free burn of large size battery pack with suppressions: **a** 3 GPM water mist suppression, **b** ABC powder suppression

slowed the heating, but fire and explosion occurred during the suppression period. The 3 GPM water mist failed to suppress the fire of large size battery pack. In the ABC dry chemical suppression case (Fig. 7b), the initial application put out the flame temporarily, but battery temperatures still climbed slowly and eventually fire and explosion followed. The dry chemical also failed to contain and suppress the large battery pack fire.

3.4 The Effect of Water Mist Flow Rate

Different flow rates of water mist suppression were also used to study their impact on the small battery pack fire. Test 7 used water mist at 1 GPM, test 8 used water mist at 2 GPM, and test 9 used water mist at 3 GPM with F500 additive. In all three of these tests, water mist suppression started when the first explosion was observed. Four thermocouple data were plotted to demonstrate the battery temperature evolution against the time, shown in Figure 8. It was observed that

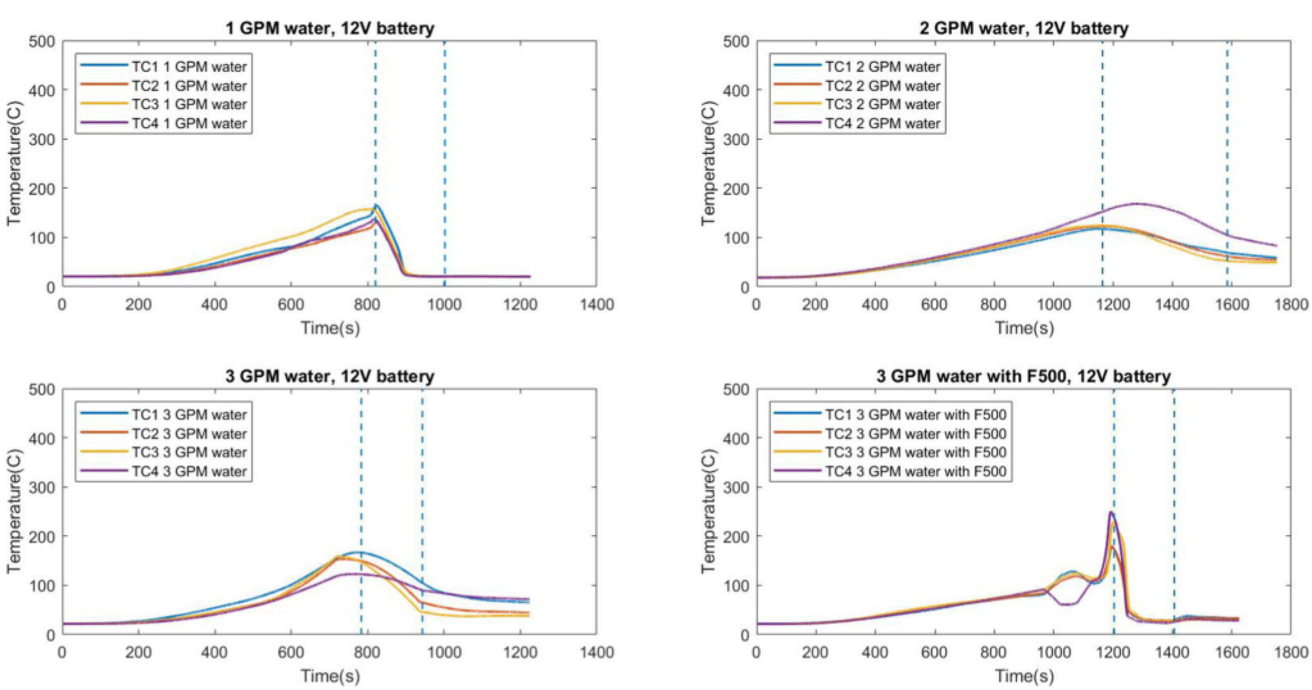


Fig. 8 The effect of water mist flow rate on suppression

water mist of all three flow rates can contain and suppress the small size battery fire without re-ignition. The 3 GPM flow rate with F500 additive might be the most effective since the drop in temperature was the quickest and most significant decrease.

4 Conclusions

Battery pack fire suppression tests were conducted at the NIOSH Pittsburgh Mining Research Division as part of its continual effort to develop workplace solutions to reduce the risk of mine disasters and mine workers' risk of injuries and fatalities. Water mist with different flow rates and/or additives, type D NaCl, and dry chemical ABC powder were used to study their effectiveness in Li-ion battery pack fire suppression. The results indicated that water mist can suppress a small battery pack fire, and its cooling effect prevents re-ignition from occurring. Water mist suppression with F500 as an additive can better suppress the fire. Type D NaCl and dry chemical ABC powder fire suppressants could quench the battery pack fire temporarily but failed to cool the battery, and re-ignition occurred. The results from this study can be used to develop an improved Li-ion battery pack fire suppression system for a mining environment.

Acknowledgements Data from this manuscript have been presented at the 2023 SME Annual Conference & Expo, February 26 – March 1, Denver, Colorado.

Declarations

Disclaimer The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention. Mention of any company or product does not constitute endorsement by NIOSH.

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Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]

G.2.3.3

The following similar hazards are present during abnormal operation, but should be considered more likely as a result of upset or damage:

(1) *Corrosive spills*: A liquid with a pH ≤2 or ≥11.5 is considered corrosive and hazard level 3 and can cause serious or permanent eye injury for someone who comes in direct contact with it per Table B.1 in NFPA 704. With some systems that contain corrosive liquids, there can be the possibility of leaks or spills from the system under emergency/abnormal conditions.

(2) *Toxic liquid exposure*: There are different levels of toxicity from vapors generated under emergency conditions such as fires and hazardous toxic liquid leaks and spills. NFPA and OSHA provide extensive guidance on classifying the hazards associated with toxic liquids and vapors.

(3) *Water-reactive material exposure*: Water-reactive materials in ESS could be exposed under abnormal conditions, resulting in a violent reaction with the moisture in the air.

(4) *Toxic gas exposure*: Toxic gases can be released during abnormal operation or following damage to an ESS. This may include toxic gases produced from the interaction of clean agent suppression systems with a battery fire . OSHA and NFPA 704 contain guidelines for classification of these hazards.

(5) *Toxic particulate exposure:* In addition to gases, some of the particulates produced in a battery fire may be toxic.

(6) *Toxic metal exposure:* Toxic/heavy metals and/or metal oxides may be released during an abnormal event.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group

Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	

Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

Submitter Information Verification

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Submittal Date: Sat Apr 22 13:58:11 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-110-NFPA 855-2023

Statement: Information on the generation and emission of toxic gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]

G.3.1.1

The risk assessment design process should be directed by ~~parties~~ a registered design professional experienced in fire protection engineering and in energy storage risk assessment and plant operation of the type of, or similar to the, plant under consideration.

Statement of Problem and Substantiation for Public Input

The term "Registered design professional" is used and required for evaluation of multiple required reports in the standard including an HMA. This guidance section needs to confirm RDP instead of qualified person.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	Qualified Persons
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	Qualified Persons
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	Qualified Persons
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	Qualified Persons
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	Qualified Persons
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	
Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]	

Submitter Information Verification

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Submittal Date: Sun Apr 23 11:59:03 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-111-NFPA 855-2023

Statement: The term "registered design professional" is used and required for evaluation of multiple required reports in the standard including an HMA. This guidance section needs to confirm RDP instead of qualified person.

Public Input No. 350-NFPA 855-2023 [Section No. G.4.3.1.1.5]

G.4.3.1.1.5 Water-Based Suppression System.

Water-based suppression systems include sprinklers, sprayers, deluge systems, or water mist systems designed to suppress fire.

Statement of Problem and Substantiation for Public Input

The lanuguage highlight the fact that water mist systems with water additives are an acceptable option.

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
Organization: Hazard Control Technologies
Street Address:
City:
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Submittal Date: Thu Jun 01 15:22:15 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The public input didn’t include any outlined modifications therefore no modification can be made. The submitter should clarify with a public comment.

Public Input No. 373-NFPA 855-2023 [Section No. G.6.1.1]

G.6.1.1 Sprinklers.

There are two known publicly available fire and explosion tests ~~, equivalent to UL 9540A,~~ supporting the use of ceiling-level sprinkler systems for the protection of LIB ESS. One test evaluated a 83 kWh system made up of lithium-iron-phosphate batteries and another evaluated a 125 kWh system made up of nickel-manganese-cobalt-oxide batteries. In both tests, protection was provided by ceiling sprinklers having a K-factor of 5.6 gpm/psi$^{1/2}$ operating at a discharge pressure of 2 bar (29 psi) to provide a nominal discharge density of 0.3 gpm/ft^2. The results show that fire and explosion testing is needed to determine the following:

(1) Ceiling sprinkler protection can prevent or delay a fire from spreading beyond the ESS rack of origin, but obstructions caused by the design of ESS system (e.g., solid-metal cabinet encompassing tightly packed battery modules) limit the ability to suppress or extinguish fire within the rack of origin.

(2) Minimum space separation has been provided from the ESS to surrounding combustibles to limit the potential for additional fire spread, including nearby ESS racks

(3) Minimum space separation has been provided from the ESS to surrounding noncombustible objects to limit the potential for damage

(4) If fire does spread to an adjacent ESS rack (i.e., installed side-by-side), it does not impact the design and electrical capacity of battery components as well as the design of the ESS cabinet that houses the battery components (e.g., battery modules)

(5) Adequate cooling of the batteries is provided to prevent reignition, which can occur after a fire appears to be extinguished. A fire watch should be present until all potentially damaged ESS equipment containing Li-ion batteries is removed from the area following a fire event.

(6) Adequate building component rating is provided to withstand the expected intensity and duration of an ESS fire event.

The wide range of results highlight the need for fire and explosion testing to evaluate sprinkler protection for each unique ESS to ensure the expected level of protection is provided. Protection system considerations that would require a fire and explosion test include a reduction in the specified sprinkler system design density, a reduction in the minimum separation distance from nearby combustible and noncombustibles, changes in ESS cabinet, or increasing ESS electrical capacity.

Statement of Problem and Substantiation for Public Input

Documentation has not been provided on these "two known publicly available fire and explosion tests" to demonstrate they are equivalent to UL 9540A. That reference should be deleted, which doesn't impact the overall points made in this section.

Submitter Information Verification

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Submittal Date: Thu Jun 01 18:55:34 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-112-NFPA 855-2023

Statement: Documentation has not been provided on these "two known publicly available fire and explosion tests" to demonstrate they are equivalent to UL 9540A. That reference should be deleted, which doesn't impact the overall points made in this section

Public Input No. 353-NFPA 855-2023 [Section No. G.6.1.3.2]

G.6.1.3.2 Standards.

For more information on water mist systems and Encapsulating Agents (EA) , see NFPA 750 adn NFPA 18A respectfully .

Statement of Problem and Substantiation for Public Input

Adding Encapsulating Agents from NFPA 18A provides a better fire protection solution to be considered.

Submitter Information Verification

Submitter Full Name:	Craig Leadbetter
Organization:	Hazard Control Technologies
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City:	
State:	
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Submittal Date:	Thu Jun 01 16:07:25 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: Technical information and large- scale fire testing has not been submitted supporting the use NFPA 18A for LIB. Submitter should provide backup information during public comment stage.

Public Input No. 270-NFPA 855-2023 [Section No. G.6.1.3.3 [Excluding any Sub-Sections]]

For more information on fire and explosion testing for Li-ion battery fire suppression with water mist, see the following:

(1) DNVGL Battery Safety Joint Development Project Report, “Technical Reference for Li-ion Battery Explosion Risk and Fire Suppression.”

(2) Marioff Corporation – Fire Test Summary #57/BR/AUG15, “HI-FOG® Systems for Protection of Li-ion Rooms.”

(3) IFAB GmbH, Fraunhofer Heinrich-Hertz-Institut and FOGTEC Brandschutz GmbH, "White Paper - Fixed Firefighting Solutions for Stationary Energy Storage Systems (ESS)"

Statement of Problem and Substantiation for Public Input

The SUVEREN project provides a public download for the White Paper: "Fixed Firefighting solutions for Stationary Energy Storage Systems (ESS)". It can be downloaded from https://9zrbabbv.sibpages.com/

Fire tests described were performed in 2022 using real-scale mock-up and fire load. High-pressure water mist was used inside an ESS-container unit.

Submitter Information Verification

Submitter Full Name: Stephan Klh
Organization: FOGTEC Brandschutz GmbH
Street Address:
City:
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Submittal Date: Thu Jun 01 05:51:37 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The submitter needs to provide the documents during public comment stage for evaluation for inclusion as a reference.

Public Input No. 352-NFPA 855-2023 [Section No. G.6.1.3.3 [Excluding any Sub-Sections]]

For more information on fire and explosion testing for Li-ion battery fire suppression with water mist, see the following:

(1) DNVGL Battery Safety Joint Development Project Report, "Technical Reference for Li-ion Battery Explosion Risk and Fire Suppression."

(2) Marioff Corporation – Fire Test Summary #57/BR/AUG15, "HI-FOG® Systems for Protection of Li-ion Rooms."

(3) NOISH- Comparison of Fire Suppression Techniques on Lithium-Ion BatteryPack Fires

Statement of Problem and Substantiation for Public Input

The NIOSH report concludes that water mist suppression with F-500 (Encapsulating Agent EA)) as an additive can better suppress the fire.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 330-NFPA 855-2023 [Section No. C.3]	

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
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Submittal Date: Thu Jun 01 15:32:45 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The submitter needs to provide the documents during public comment stage for evaluation for inclusion as a reference.

Public Input No. 354-NFPA 855-2023 [Section No. G.6.5]

G.6.5 Encapsulation. ~~(Reserved)~~

NFPA 18A Standard on Water Additives for Fire Control and Vapor Mitigation Section A.4.3 states- Lithium-ion battery and lithium-ion battery energy storage system (BESS) fires are unique electrochemical fire hazards that involve multiple fire classes (Class A, Class B, Class C, Class D) within one entity. While BESS are covered by NFPA 855, it should be noted that lithium-ion battery fires as a stand-alone hazard are not currently addressed in any NFPA standard. According to NFPA research reports, copious amounts of plain water are required to extinguish lithium-ion battery fires, and they can still exhibit thermal runaway up to 72 hours after initial extinguishment.

Water additive based on spherical micelle technology (encapsulator agents) conforming to Section 7.7 has been tested extensively by independent third-party testing organizations, including Kiwa, Dekra, Daimler, Dutech, Bosch, Fraunhofer University, and TU Clausthal. This testing has been controlled, scientific, and highly instrumented, documenting fire suppression, control and elimination of thermal runaway, and encapsulation of both flammable electrolyte and other explosive off-gases, rendering them nonexplosive. Encapsulating technology reduces the toxicity of HF gas exposure to humans.

In addition, the copious amounts of water used to suppress lithium-ion battery fires create copious amounts of run-off containing hydrofluoric acid, creating an environmental issue and expensive HAZMAT disposal cost. Compared to water, water additive solution uses a reasonable amount of solution and has been documented to modify the chemistry of the run-off, making it suitable for additional dilution and disposal in a municipal water treatment plant. Testing documentation can be found in the NFPA Research Library and Archives.

This space should be reserved for futher clarifcatoin on the uses of micelle technolgies and its application in various systems, i.e. sprinkler system, water mist system, etc. in this standard during this revision cycle.

Statement of Problem and Substantiation for Public Input

Encapsulation technology is now better defined in NFPA 18A. 7.7 testing protocol which makes its implementation into this Standard easier.

Submitter Information Verification

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Submittal Date:	Thu Jun 01 16:12:06 EDT 2023
Committee:	ESS-AAA

Committee Statement

Resolution: Technical information and large-scale fire testing has not been submitted supporting the use NFPA 18A for LIB. Submitter should provide backup information during public comment stage.

Public Input No. 318-NFPA 855-2023 [Section No. G.7.3.1]

G.7.3.1 BMS.

While not technically a detection system, a BMS can provide input into the fire system as a first-stage warning. A BMS can monitor fault conditions, abnormal voltages, and increase in heat—all potential precursors to LIB failure. The BMS, in conjunction with other detection technologies, can provide a better indication of the type of fire condition—either internal or external to the batteries. If the BMS is used to inform first responders it must be appropriately interfaced and information must be able to be reliably transmitted.

Statement of Problem and Substantiation for Public Input

There is increasing desire to deliver information to first responders from the BMS which often has more information about the SOC, cell temperature, and other potentially useful information. This note makes it clear that if BMS data is provided and relied upon that the mechanism must be reliable.

Submitter Information Verification

Submitter Full Name: Noah Ryder

Organization: Fire and Risk Alliance

Affiliation: Submitted on behalf of NFPA 855 TG9

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City:

State:

Zip:

Submittal Date: Thu Jun 01 12:20:38 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-113-NFPA 855-2023

Statement: There is increasing desire to deliver information to first responders from the BMS which often has more information about the SOC, cell temperature, and other potentially useful information. This note makes it clear that if BMS data is provided and relied upon that the mechanism must be reliable.

Public Input No. 320-NFPA 855-2023 [Section No. G.7.3.2]

G.7.3.2 Smoke Detection.

Standard spot-type smoke detection is applicable to nonbattery fires and can detect conditions that can lead to a battery failure or thermal runaway event . In a battery failure, smoke ~~is~~ may be detected after thermal runaway ~~and is not applicable to early detection of LIB failures. Smoke detection can be applied at a cabinet level for a quicker response to an LIB failure~~ but may not be detected during the early stages of LIB failures. In general the smaller the LIB enclosure the quicker the response time of the detector . Spot-type smoke detection can be used as an interlock for fire suppression system release.

Statement of Problem and Substantiation for Public Input

Provides additional details on SD response at various stages of an event

Submitter Information Verification

Submitter Full Name: Noah Ryder

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Submittal Date: Thu Jun 01 12:22:59 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-114-NFPA 855-2023

Statement: This provides additional details on smoke detector response at various stages of an event.

Public Input No. 322-NFPA 855-2023 [Section No. G.7.3.3]

G.7.3.3 Flame Detection.

~~Flames do~~
Flame detection is a specific form of radiant energy detection and it may use imaging or non-imaging technology. Flames are not present until after an LIB has gone into thermal runaway. Flame detection can be applied internal or external to an installation. Internal application would be to the container, enclosure, or building. It would not traditionally be applied inside a cabinet. For example, it can be used to monitor a hot isle. External application would be to ESS facilities with single or multiple containers. It would provide a detection if internal measures failed , however will not alarm until flame energy is released externally . It can also be tied to video cameras to provide situation information to first responders of an incident. Some flame detectors include HD video cameras and onboard recording capability.

Statement of Problem and Substantiation for Public Input

Provides additional information on flame detection related to LIB events

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
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City:
State:
Zip:
Submittal Date: Thu Jun 01 12:25:38 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-169-NFPA 855-2023
Statement: This provides additional information on flame detection related to LIB events.

Public Input No. 323-NFPA 855-2023 [Section No. G.7.3.4]

G.7.3.4 Heat Detection.

Spot-type heat detection is applicable to nonbattery fires and can detect conditions that can lead to a battery failure or thermal runaway. In a battery failure, heat is detected after thermal runaway and is not applicable to early detection. Heat detection can be used as an interlock for fire suppression system release. The best use of heat detection is as a high-flow ESFR head attached to a dry stand-pipe or fire department connection to apply water to the building, area, container, or cabinet in LIB failure. Heat detection or temperature monitoring integral to the BMS can provide early indication of a battery failure prior to thermal runaway.

Linear type heat detection has UL and FM approval and actively measures the temperature along the length of the fiber, is accurate to within 0.1°C, and may be installed on the ceiling, along power cable bundles and beside battery modules. This type of detection can provide early warning increase above a fixed temperature as well as fast rate of temperature rise indication and integrate with the BMS and fire alarm systems. These systems may supplement the online condition monitoring systems.

Statement of Problem and Substantiation for Public Input

Provides additional information on heat detectors, specifically linear heat detection which could be installed within an ESS enclosure.

Submitter Information Verification

Submitter Full Name: Noah Ryder
Organization: Fire and Risk Alliance
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City:
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Submittal Date: Thu Jun 01 12:27:12 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-170-NFPA 855-2023

Statement: This provides additional information on heat detection and its potential use for detection of LIB fires

Public Input No. 325-NFPA 855-2023 [Section No. G.7.3.5]

G.7.3.5 Thermal Imaging—Temperature Monitoring and Early Warning Fire Detection.

Thermal imaging is another form of radiant energy detection and it might be applicable to early detection of overheating that may lead to fires including LIB failure. With proper placement, detectors are capable of detecting small changes in temperature associated with battery failure and early detection. It requires a line of ~~site~~ sight to the protected area and might ~~not function~~ require special lenses in a small container or cabinet. ~~It can provide the added benefit of visual images. It can~~ The thermal imager may be combined with a visual camera that can provide situational awareness. Thermal imaging can be used internal or external to the BESS. First responders can use the images to access the internal condition of the ESS.

Thermal radiation is invisible electromagnetic radiation emitted by a body or object based on its surface temperature. Thermal imaging technology (i.e., thermal radiometry) makes it possible to view, record, and alarm on the slightest temperature anomalies, making it an effective solution in monitoring batteries during normal load or test.

Fixed-mounted thermal cameras provide a predetermined field of view and continuous temperature monitoring as opposed to hand-held units requiring personnel time and potential for variation of readings and views. As a fixed unit, the camera tracks temperature and can provide graphical data over time that can be utilized in a preventative maintenance program and post-event evaluation of battery failures. Alarm relay outputs are available for monitoring by a PLC for equipment shutdown and annunciation.

Thermal radiometry hand-held cameras are commonly carried by first responders into smoke-filled buildings, as the technology can see hot spots through the smoke. Along these lines, fixed thermal radiometry cameras in an ESS building with many racks will simplify first responders' evaluation of the fire size and location, providing situational awareness and lead them directly to the fire and away from potential danger, which minimizes their time in the hazard.

Thermal radiometry cameras are available in wide to narrow field of view, various resolutions of image sensor pixel count, and software platforms. Care should be taken to ensure that the correct product is selected allowing the resolution required to accurately measure the required temperature variations at the specified distance.

Camera software can provide live or recorded video, floating-crosshair indicating pixel(s) with highest or lowest temperature, various color schemes representing temperatures, email notification of alarm, as well as configuration of multiple areas of interest with unique temperature monitoring, alarm, and graphical information within a single camera image.

Statement of Problem and Substantiation for Public Input

Provides additional information on thermal imaging and its potential use for detection of LIB fires

Submitter Information Verification

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Submittal Date: Thu Jun 01 12:28:33 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-171-NFPA 855-2023

Statement: This provides additional information on thermal imaging and its potential use for detection of LIB fires.

Public Input No. 327-NFPA 855-2023 [Section No. G.7.3.6.1]

G.7.3.6.1 Cell-Level Event.

~~Carbon monoxide (CO) is one of the main components present for the longest period of time and is considered especially important for early stage detection.~~

~~Off-gas in the early stages of thermal runaway events will be colder than off-gas in the later stages. The early off-gas can therefore become heavier than the air, collecting at floor level. It should therefore be considered if gas detection related to room explosion risks should be applied at both levels, close to the floor and close to the ceiling. Both sensor and ASD detection technologies can provide off-gas detection in the early stages of lithium-ion battery thermal runaway events. In addition to off-gas detection, ASD detection can provide very early smoke detection.~~

~~Tests conducted in this project indicate that solely relying on lower explosion limit (LEL) sensors and cell voltage levels to detect early stages of a thermal runway event is insufficient.~~

~~Cell-level detection, close to or inside the affected module, has proven the most reliable means of pre-thermal-runaway warning. The early detection of thermal runaway has also proven that a cell can be disconnected, effectively stopping the overheating process.~~

~~One important aspect of the protection of LIB systems in ESS is the prevention of thermal runaway and propagation of cell failures. While there are many ways to detect and prevent thermal runaway, off-gas monitoring or off-gas particle detection is, perhaps, the most effective because it provides the most amount of time to react to the condition. Off-gas monitors or detectors are installed at the battery rack level and capable of sensing the off-gas byproducts from a single cell. In this way, they can provide up to 30 minutes of time for investigation and intervention by automatic deactivation of charging before thermal runaway.~~

~~Off-gas sensors or detectors must be designed to detect the variety of different gases from the many types of LIB chemistries. The gases emitted during the early stages of battery failure are a precursor to the much larger and more dangerous issue of thermal runaway and potential propagation of fire from cell to cell and module to module. This is why, for thermal runaway prevention, LEL gas detectors are not adequate because the concentrations of flammable gases are not high enough. Flammable gas detection has a role to play in other aspects of the protection of the ESS *(see 9.6.5.6)*.~~
Battery cells will release flammable gases throughout the cell venting and thermal runaway stages of failure, however the species composition, release rate, and temperature will vary based on the phase. Ideally during cell venting, the battery's safety features are activated, leading to the release of gas and other reactive materials in a controlled manner to prevent an uncontrolled explosion. In this scenario, the gas species primarily consists of carbon dioxide (CO_2), carbon monoxide (CO), hydrogen (H_2) and VOCs. The gas temperature during cell venting is generally around 100-150°C.

During cell thermal runaway, the battery undergoes a rapid, self-sustaining increase in temperature. In this situation, additional flammable and toxic gas species may be produced including hydrogen fluoride (HF), hydrogen cyanide (HCN), various hydrocarbon gases (CH_4, C_2H_4, C_2H_6, etc.), in addition to those gases produced during cell venting. The gas temperature during thermal runaway can reach much higher levels, often exceeding 500°C, resulting in the rapid release of large volumes of flammable and/or toxic gases, posing a significant hazard to human health and the environment.

Off-gas detection in the early stages may target different gas species than that during cell thermal runaway. In all cases the detection method should be tied to the cell chemistry, sensor location relative to the cell(s), volume of the enclosure (ie a cabinet or a large room), and objective of detection in order to ensure that the sensor is aligned with the safety objectives. Technologies are advancing rapidly however early and rapid detection must also be paired with response, thus costly systems that may provide some level of advanced notice may not provide a significant increase in actions or improved safety outcomes. In contrast to smoke detectors in occupied structures, knowledge of a cell failure several minutes earlier, may not result in any difference in outcome unless the detection system is also tied into a viable thermal runaway protection system which stops the event.

Off-gas detection systems of various types have been shown to be effective at detecting cell failure prior to thermal runaway, in some cases as much as 30 minutes prior, however this advanced knowledge must be tied into other mitigation systems in order to prevent thermal runaway from occurring or propagating.

Off-gas sensors or detectors are typically mounted in each battery rack or module, with the exact location of the sensors or detectors being dictated by the actual rack design. But, in general, the sensors must be mounted in the path of airflow. This could mean that, depending upon rack design, the sensor or detector could be either at the top or bottom of the rack. For specific detection design requirements, refer to the manufacturer's published installation and operation manuals and any relevant regulatory approvals/listings for the intended purpose of "off-gas detection" from the incipient stages of a lithium-ion battery thermal runaway.

~~To~~ Presently, to be most effective, the network of sensors or detectors throughout the many battery racks in the ESS must be connected with a central controller that allows for the supervision for failures of the individual sensors and a coordinated response when one or more sensors or detectors detect an off-gas event. The responses can be either automated or human generated.

Statement of Problem and Substantiation for Public Input

Provides additional details on cell level gas detection and the methods that may be best suited

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Committee:	ESS-AAA

Committee Statement

Resolution:	FR-172-NFPA 855-2023
Statement:	This provides additional details on cell level gas detection and the methods that may be best suited.

Public Input No. 132-NFPA 855-2023 [Section No. G.7.3.6.3]

G.7.3.6.3 Effects on H_2 Gas Detection After Suppression Discharge.

Hydrogen is a ~~significate percentage~~ significant percentage of the gases released during thermal runaway of an LIB. Traditional gas detection technology for detection of H_2 is a catalytic bead. A catalytic bead burns the gases across the sensor to determine concentration level or LFL. LIBs also release other HCs during failure. These other HCs will be burned on the sensor and recognized as H_2.

A catalytic sensor will not perform well in a low-oxygen or suppression environment as the sensor's ability to burn the gases will be limited. The sensors might fail or underreport the percentage of LFL. Other technology exists for detection of H_2 but can be overwhelmed and fail in a high H_2 release. In conjunction with a suppression system, a secondary sensor monitoring CO or CO_2 might be necessary to monitor as a reference gas. It is seen that for overheating and overcharging, CO is the most continuously present gas and thus provides a good indication of the full spectrum of gas profiles that can be expected. A similar profile can be found by monitoring CO_2. Rising levels of CO or CO_2 indicate a battery failure or cascading event.

Gas release data should be utilized from the fire and explosion testing at a cell, module, and installation level for evaluation of appropriate gas detection. Cell to module to installation is not always a linear progression; meaning scaling up the test results might not give you an actual gas release. These conditions can change due to additional construction material and incorporated barriers. Installation testing can show more or less propagation than cell- or module-level tests.

Statement of Problem and Substantiation for Public Input

Corrects a typo.

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Committee: ESS-AAA

Committee Statement

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Statement: This is a spelling correction.

Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]

G.7.3.7.2 High-Risk Equipment Protection.

Certain equipment in ESS facilities are designated high-risk. The consequences of a fire event within such equipment could create or exacerbate other hazards. Examples of these types of equipment include the following:

(1) Those that are likely to promote a fast developing fire.

(2) Those that will generate corrosive and toxic ~~gas species~~ and highly toxic emissions .

(3) Those whose unnecessary shutdown would result in substantial network service losses.

(4) System losses that could create conditions for battery failure such as HVAC or BMS system loss.

Sampling location considerations are often similar to those for cabinet protection and include the following:

(1) Sampling should be conducted within or around high-risk equipment for the earliest possible detection of smoke.

(2) Where appropriate and within the system design capacity, capillary tubes branched from the main sampling pipe can be used to penetrate equipment or equipment cabinets. Normally, dedicated systems should be used unless in small rooms.

(3) All sampling pipes should be airtight, firmly secured, and held clear of equipment, especially moving parts, to avoid physical damage to the pipe network or the equipment.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group

Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
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Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]

Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]

Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]

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Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
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Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]
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Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Statement: The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions.

Public Input No. 64-NFPA 855-2023 [Section No. G.8]

G.8 Flammable Gas, Deflagration Hazard Studies, and Use of NFPA 68 and NFPA 69 for Lithium-Ion Batteries. ~~(Reserved)~~

(1) ~~Introduction~~

~~The increase in the number of failures of lithium-ion battery stationary energy storage systems within the international market sector has demonstrated the importance of understanding the inherent risks associated with the design, development and deployment of innovative battery systems. As an emerging industry with many unknown variables, equipping First Responders and Authority Having Jurisdiction (AHJ) with information of the inherent hazards is essential to minimize the risks of equipment loss and injury to personnel.~~

~~While the failure mechanisms of lithium-ion battery chemistries is highly researched, the body of knowledge does not contain research of the consequences of containerized explosions.~~

~~This work is intended to assist AHJs, stakeholders, and practitioners with engineering design and risk mitigation considerations to minimize the likelihood and consequences of an explosion event. This effort is not intended to prescribe how hazard and risks analysis are performed, rather presents principles and methodologies to assist the energy storage practitioner in the qualitative and quantitative analysis process to properly characterize the risk and hazards associated with the deployment of lithium-ion battery energy storage systems.~~

~~The following information is the integration of numerous international consensus standards, applicable publications, peer reviewed research and journal articles, and state and local municipal codes and standards applicable to the energy storage market sector.~~

~~This guidance document is divided into two sections: Part (1) presents a summary to assist AHJs by outlining key elements to consider when evaluating proposed stationary energy storage systems, and Part (2) presents a detailed discussion intended to assist stakeholders and practitioners in navigating the numerous international consensus standards and highlighting recognized and generally accepted good engineering practices leading to well-designed engineering and administrative controls to mitigate the identified hazards.~~

(1) ~~Part I: Lithium-ion Battery Mitigation Considerations~~

(2) ~~*Lithium-ion Battery Explosion Basics*~~

~~Lithium-ion batteries offer high energy and power densities but have a narrower stability operating range when compared to other battery types and contain reactive and flammable materials that when electrically and thermally abused, may result in high energy fires.~~

~~Lithium-ion cell failures can result from a variety of sources including manufacturing defects, physical abuse, thermal abuse, electrical abuse and mechanical damage [1-7]. In some instances, these failures can lead to cell internal degradation resulting in exothermic reactions, causing the cell to undergo thermal runaway. In a thermal runaway event, the exothermic reactions increases the cell temperature, resulting in internal generation of gases. These gases build within the cell and can ultimately lead to rupture of the cell and release of the gases. The released flammable gas mixture consists of various mixtures of hydrogen, carbon-monoxide, carbon-dioxide and various hydrocarbons including methane and propane. As the cells enter thermal runaway the expelled electrolyte material can ignite flammable gases can resulting in fire, deflagration, or explosion scenarios that pose a significant risk to surrounding life and property [8]. Since January 2019, the Electric Power Research Institute (EPRI) has recorded 27 Stationary Energy Storage Failure Events [9].~~

~~From a firefighting and explosion mitigation perspective, the source of the flammable gas generation is typically not accessible within the battery module and is extremely difficult to mitigate. These complex thermal runaway events have elements of multiple types of ignition sources (metallic, chemical, etc.) as well as being exothermic and potentially producing its own oxygen [10]. Lithium-ion battery cell failure can lead to failure propagation of the adjacent cells resulting in the exponential generation of flammable gases and increasing generated heat fluxes eventually propagating throughout the energy storage unit and having involved the entire battery system.~~

(1)

(a) ~~*Essential Hazard Mitigation Analysis Elements*~~

~~Typically, explosion risk is quantified by assessing probability of occurrence, consequences of the event, and detectability of the generation flammable gases of an event. Although the probability of an explosion is low in listed and labeled BESS, the effects and consequences can be extremely high. Some explosion risk mitigation strategies include flammable gas exhaust, deflagration venting, inerting, suppression, hardening and increased standoff distance to personnel and assets [11]. When evaluating an explosion analysis it is recommended AHJs understand the characterization of three key gas properties as these values determine the strength of the explosion:~~

- ~~lower flammability limit of the gases,~~
- ~~flame speed, and~~
- ~~the maximum adiabatic overpressure~~

~~Additional important analyses to be included in the hazard mitigation analysis includes the conclusions and outputs associated with the identification and quantification of the explosive risks associated with the BESS design.~~

~~Lithium-ion batteries present unique explosive risks due to the complex nature of their failure mechanisms: they produce large volumes of flammable gases and produce sufficient oxygen to sustain exothermic reactions can emit particles hot enough to ignite gases.~~

~~As discussed in the BESS fire risks Chapter X.?, the cell vented off-gas constitutes both an explosive and a toxic hazard are to be evaluated. The core element behind explosion prevention is the avoidance of the collection of highly flammable gas concentrations within a well-designed ventilation system. Design trends within the energy storage market sector include the different philosophies used to dilute and flammable gas concentrations. The main design considerations include containing the battery modules and off-gas in gas-tight enclosures leading directly to a safe area, without passing the battery room [10]. The other options may include opening battery rack enclosures to the external environment where off-gas released into the battery compartment before being diffused by a forced exhaust system of sufficient air changes per hours (ACH). Exposing the battery compartment to external environment is a means for the NFPA 855 explosion prevention and deflagration venting requirements [12].~~

~~Each BESS equipment provider should conduct an explosion hazard analysis in accordance with NFPA 68 or NFPA 69 to quantify the risks and hazards [13, 14]. Elements to be evaluated as part of the explosion hazard analysis should include:~~

- ~~lower flammability limit (LFL),~~
- ~~laminar flame speed, and~~
- ~~maximum overpressure are key metrics used to evaluate the overall hazard.~~

~~When reviewing the computational fluid dynamics or other analyses performed, the AHJ should consider other important elements are presented in the explosion hazard analysis for both the NFPA 68 and NFPA 69 should consider:~~

- ~~Enclosure reaction force~~
- ~~Enclosure geometry~~
- ~~Enclosure internal surface area including partial volumes~~
- ~~Surface area of internal structures~~
- ~~Flammable gas properties~~
- ~~Best and worst case scenario – one cell failure (may be the same as UL 9540A if the cells do not show propagation)~~
- ~~UL9540A failure level, one or more cells, module, or unit based on the test results.~~
- ~~Limited propagation failure. This adds a safety margin to the UL9540A. Example if one~~

cell failed with no propagation, then evaluate a 3-cell failure, one on either side. If a module failed but did not propagate, then evaluate 3 module failure the one above and below

- 25% LFL failure - determine how may cells does it take to reach 25% LFL in the enclosure.
- Partial volume deflagration – how many cells can fail with a resulting deflagration that does not produce a pressure value that will cause the enclosure to fail.
- Worst total failure – assumes all cell in the ESS fail. No evaluation required

(1) Part II: Lithium-ion Battery Fire and Explosion Hazard Identification and Mitigation

Lithium-ion battery use within the residential, commercial, industrial and transportation markets is rapidly changing, and each unique design presents challenges to the fire and explosion risks to engineers and practitioners who are responsible for developing engineering and administrative controls for safe operation.

In the design of these systems, engineers must balance criteria for performance, cost, size, and safety concerns. Achieving a high level of safety is especially important in applications in densely populated environments, such as indoor installations, where a thermal-runaway event is more likely to lead to high losses of the structure and property. While performance measures are generally well characterized for battery designers (UL1642, UL1973, UL9540), safety analysis techniques that can impact design decisions are not as well-defined. The engineering and safety guidelines and requirements for lithium-ion battery technologies required for applications such as energy storage are slowly emerging in current and proposed codes and standards.

Part 2 is intended to answer the question of "what to consider" when designing safe energy storage systems rather than "how to do it". References are provided to assist in the computational and numerical analysis that could be used in the quantification of fire and explosive hazard risk assessments and subsequent mitigation measures.

(1)

(a) *Explosion Risks*

The governing national consensus standards available to the stakeholder and practitioner are NFPA 68, Standard on Explosion Protection by Deflagration Venting, and NFPA 69, Standard on Explosion Prevention Systems [13, 15]. These standards should be used in conjunction with this Guide when analyzing explosion prevention systems. The information presented in this section is intended to assist with the compliance verification of the Section 1207 of the International Fire Code (ICC-IFC) [16].

Energy storage system enclosures can be a room, a building, externally design container, or within spaces specifically designed process equipment. In the unlikely event a lithium-ion cell degrades to the point where exothermic reactions and thermal runaway events occur, the cells will vent a highly flammable combination of hydrocarbons and without mitigation measures may reach flammability limits of the enclosure.

In explosion hazard analysis, lower flammability limit (LFL), laminar flame speed, and maximum overpressure are key metrics used to evaluate the overall hazard. The impetus for analyzing the explosion hazard is to establish the technical basis mitigation measures including detection and ventilation or explosion venting.

(1)

(a) *Explosion Mitigation: Deflagration Venting*

Explosion venting is the discharge of combustion gases during a deflagration to maintain pressures below the enclosure damage threshold [15].

The discharge vent opening is usually covered initially by one or more transient pressure relieving panels, rupture discs, or other engineered vent devices. Since explosion vents usually open after the explosion is initiated to limit the pressure rise, they cannot be used for detonations because the maximum pressure occurs instantaneously when the shock front reaches a given location. The most effective explosion venting systems are those that deploy early in the deflagration, have as large a vent area as possible, and allow unrestricted venting of combustion gases. Early vent deployment requires that the vent release at the lowest possible pressure without interfering with normal operations and pressure fluctuations in the enclosure. In the case of vents on exterior walls and roofs of buildings, the minimum feasible vent release pressure is usually slightly larger than the highest expected differential pressure associated with wind loads (typically 0.14 to 0.21 psig ; i.e., 0.96 to 1.44 kPa).

Crucial aspects of both vented-gas-explosion data correlations are:

(1) mixture reactivity,

(2) turbulence sources (both initial turbulence and obstacle-flame interaction turbulence),

(3) vessel volume (scale) effects, and

(4) vessel geometry (primarily length/diameter ratio), as well as the vent parameters: vent area, vent release pressure, and vent panel inertia.

Vented gas-explosion testing has the additional complication of various flame instabilities, some of which are dependent on ignition location, enclosure wall lining, and the presence of equipment within the enclosure

The amount of vent area needed for effective explosion venting depends on the size of the enclosure and the rate of pressure rise within it. According to Equation X of NFPA 68, the rate of pressure rise in an unvented enclosure is proportional to the product of the mixture effective burning velocity and flame surface area and varies inversely with the enclosure volume. The rate of pressure reduction due to venting is proportional to the product of vent area and gas velocity through the vent. The vent velocity is dependent on the instantaneous pressure in the enclosure and the composition of the vented gas (i.e., the relative proportions of burned and unburned gas). These considerations have been implemented in the formulation of theoretical models, scaling correlations for test data, and guidelines for determining the required vent area.

One of the most catastrophic failures of a lithium-ion battery system is a cascading thermal runaway event where multiple cells in a battery module fail due to a failure starting at one individual cell. Thermal runaway can occur due to exposure to excessive thermal abuse and repetitive exposure to elevated temperatures, electrical abuse and external shorts due to faulty wiring, or internal shorts due to cell defects. Thermal runaway events result in the venting of toxic and highly flammable gases and the release of significant energy in the form of heat. If ignited, these gases can cause enclosed areas to over pressurize, and if unmitigated, this overpressure can result in an explosion and severe damage to the battery and surrounding equipment or people.

Li-ion cells are sealed units, and thus under normal usage conditions, venting of electrolyte should not occur. In normal usage, cell electrolyte should not be encountered by anyone handling a Li-ion battery, making the risk of a spill of electrolyte from any commercial Li-ion battery pack remote. If subjected to abnormal heating or other thermal abuse conditions, electrolyte and electrolyte decomposition products can vaporize and be vented from cells.

Vented electrolyte is flammable, and may ignite on contact with a competent ignition source, such as an open flame, spark, or a sufficiently heated surface. Vented electrolyte may also ignite on contact with cells undergoing a thermal runaway reaction. Cell vent gas composition will depend upon a number of factors, including cell composition, cell state of charge, and the cause of cell venting. Vent gases may include volatile organic compounds (VOCs, such as alkyl-carbonates, methane, ethylene, and ethane), hydrogen gas, carbon dioxide, carbon monoxide, soot, and particulates containing oxides of nickel, aluminum, lithium, copper, and cobalt. Additionally, phosphorus pentafluoride (PF5), phosphoryl fluoride (POF3), and hydrogen fluoride (HF) vapors may form. Vented gases may irritate the eyes, skin, and throat. Cell vent gases are typically hot and upon exit from a cell, can exceed 1500 °C (1773 °F)

More than one scenario should be evaluated during the deflagration hazard study. It should include the 9540A cell and module test as a realistic option for failure. However, this only provides one data point and this does not provide any margin of safety for potential other failure modes such an arc flash on a module. Conservatism should always be applied to ensure a safety margin.

Recommended evaluation modes

(1) Best *case scenario* : One cell failure (may be the same as UL 9540A if the cells do not show propagation)

(2) *UL 9540A* failure level One or more cells, module, or unit based on the test results.

(3) Limited propagation *failure* : This adds a safety margin to the UL 9540A. Example if one cell failed with no propagation, then evaluate a 3 cell failure, one on either side. If a module failed but did not propagate, then evaluate 3 module failure the one above and below

(4) 25% LFL failure Determine how may cells does it take to reach 25% LFL in the enclosure.

(5) Partial volume *deflagration* : how many cells can fail with a resulting deflagration that does not produce a pressure value that will cause the enclosure to fail.

(6) Worst *total failure* : Assumes all cell in the ESS fail. No evaluation required

Based on these levels of evaluation it can then be incorporated in the Hazard Mitigation Analysis (HMA) with a determination of acceptable risk.

These factors that determine the release rate and initial geometry of a hydrocarbon gas release. The most significant is whether the gas is under pressure or released at atmospheric conditions. Depending on the release source the escaping gas can last from several minutes, hours, or days, until the supply is isolated, depleted, or fully depressurized, and routed for safe disposal [2]. These factors are:

(1) The size, type, configuration (pressurized), and location of the ignition source

(2) The type, amount, position, spacing, orientation, and surface area of the fuel packages

(3) The geometry of the enclosure

(4) The size and location of the compartment openings

(5) The material properties of the enclosure boundaries [83].

The following simplified generic event tree can be developed for an explosion of flammable gases that accumulate inside the container, cabinet or enclosure upon thermal runaway of the Li-Ion batteries.

If released under atmospheric conditions, the gas will either rise or fall depending on its vapor density and will be carried into the path of forced air of the design of the Heating ventilation and air conditioning (HVAC) system of the energy storage enclosure.

Numerous UL 9540A unit tests indicate that in the absence of forced air movement, and in the presence of an ignition source, the flammable gas will burn relatively close to the source point, normally in a vertical position with flames of short length. For the lighter gases, the height of a gas plume will mostly be limited by enclosure environmental conditions. If gases are ignited, the height of the plume will rise due to the increased buoyancy of the high temperature gases from the combustion process [17].

If the lithium battery releases gas releases under pressure, there are a number of determining factors that influence the release rates and initial geometry of the escaping gases. The pressurized gas is released as a gas jet and depending on the nature of the failure, may be directed in the direction of the module colling systems exhaust pathway [17]. Escaping gases are normally very turbulent and air will immediately be drawn into the mixture. The mixing of air will also reduce the velocity of the escaping gas jet. Obstacles such as the module racking system, cable trays, conduit, HVAC ducting, buswork, structures, etc., will disrupt momentum forces of any pressurized release. These releases if not detected and/or ignited will then generally form a vapor cloud that would naturally disperse in the atmosphere or if later then ignited, cause an explosive blast if the cloud is in a relatively confined area. Where turbulent dispersion processes are prevalent (e.g., high pressure flow, winds, congestion, etc.) the gas will spread in both horizontal and vertical dimensions while continually mixing with available oxygen in the air. Initially, escaping gases are above the UEL, but with dispersion and turbulence effects, they will rapidly pass into the flammable limits. If not ignited

~~and given an adequate distance for dilution by the environment, they will eventually disperse below the LEL. Various computer software programs are currently available that can calculate the turbulent gaseous jet dispersion, downwind explosive atmospheric locations, and volumes for any given flammable commodity, release rates, and atmospheric date input (i.e., wind direction and speed) [17].~~

~~For ESS enclosures that are typically vented at only one end, the maximum effective vent area to use to determine the expected P_{red} shall be the enclosure cross section. For enclosures that can be vented at more than one point along the major axis, the vents shall be permitted to be distributed along the major axis and sized based on the length to diameter (*L/D*) between vents. The maximum effective vent area at any point along the major axis shall be the enclosure cross section [18].~~

~~The *L/D* of an elongated enclosure shall be determined based upon the general shape of the enclosure, the location of the vent, the shape of any hopper extensions, and the farthest distance from the vent at which the deflagration could be initiated. The maximum flame length along which the flame can travel, *H*, should be determined based on the maximum distance, taken along the central axis, from the farthest end of the enclosure to the opposite end of the vent.~~

~~Where multiple vents are provided, a single value of *H*, and *L/D,* shall be permitted to be determined for the enclosure based on the farthest vent. Where multiple vents are located along the central axis, the value of *H*, and *L/D*, shall be permitted to be determined for each section using the maximum distance from the closest end of one vent to the opposite end of the next vent. The effective volume of the enclosure, V_{eff}, should be determined based on the volume of that part of the enclosure through which the flame can pass as it travels along the maximum flame length,~~

~~Partial volume shall not be considered in the determination of effective volume for the safe release of the deflagration pressure transient. Where multiple vents are provided, a single value of V_{eff} shall be permitted to be determined for the enclosure based upon the farthest vent. Where multiple vents are located along the central axis, V_{eff} shall be permitted to be determined for each section using the maximum distance from the closest end of one vent to the opposite end of the next vent. When V_{eff} is less than the total volume of the enclosure, only those vents located within the effective volume shall be considered as providing venting for the event [18].~~

(1)

(a) ~~*Explosion Risk Assessment Considerations and Analysis Techniques*~~

~~Ignition of a gas-air mixture generated by lithium-ion batteries in thermal runaway in an unvented compact enclosure will usually result in a deflagration that produces a pressure increase because of hot gas and unburned gas confinement. Determining the amount of flammable gases that can be contained within the lower and upper flammability limits is a function of the total free-air volume of an enclosure as well as the forces exerted on the enclosure during a pressure transient due to the rapid expansion of air due to deflagration or detonation. The process for calculating the surface area for deflagration venting is presented in NFPA 68 and the parameters to accomplish this analysis include:~~

(1) ~~Determining the volume of the area to be protected~~

(2) ~~Enclosure strength~~

(3) ~~Enclosure reaction force(s)~~

(4) ~~Enclosure geometry~~

(5) ~~Enclosure internal surface area~~

(6) ~~Surface area of internal structures~~

(7) ~~Gas vapor fuel properties~~

(8) ~~Gas properties used in vent area calculation~~

(9) ~~Turbulent flame enhancement factor~~

(10) ~~Partial volume corrections~~

(11) ~~Panel inertia corrections~~

~~The following information is intended to assist the stakeholder and practitioner in understanding the parameters required to be identified and included in the analysis of the enclosure and is intended to be accompanied by the information within NFPA 68:2018. NFPA 68 provides the recognized guidance for the design, location, installation, maintenance, and use of devices and systems that vent the combustion gases and pressures resulting from a deflagration within an enclosure. However, it is noted NFPA 68 does not apply to emergency vents for pressure generated during runaway exothermic reactions, self-decomposition reactions, internal vapor generation resulting from electrical faults, or pressure generation mechanisms other than deflagration.~~

(1)

(a)

i. ~~*Determine the Volume of Area to be Protected.*~~

~~The pressure developed in the enclosure is dependent on the extent of flame propagation and the temperature and composition of the burned gas. If the flame has propagated throughout the enclosure, the ratio of the deflagration pressure to the initial pressure in the enclosure can be obtained from the ideal gas equation as it applies to the post deflagration and pre deflagration gas air mixtures, both of which occupy the same enclosure volume. Therefore, understanding the volume of the enclosure or volume to be protected has to be clearly understood and documented. Specifically, information that delineates the following is required:~~

(1)

(a) ~~Include any additional features that add to the volume of the area.~~

(b) ~~Subtract any stationary features that can subtract from the volume to be protected.~~

(2) ~~*Enclosure Strength*~~

~~The purpose for understanding the strength of an enclosure is directly related to the safety integrity of the operating envelope. The essential safety element behind understanding the enclosure strength is to confidently quantitatively characterize the theoretical performance of the enclosure under transient conditions to limit the damage to property and minimizing the likelihood of projectiles resulting in injury to the general public.~~

(1)

(a)

i. ~~*Enclosure Reaction Force*~~

~~Knowing the duration of the reaction force can aid in the design of certain support structures for enclosures with deflagration vents.~~

~~The supporting structure for the enclosure shall be strong enough to withstand any reaction forces that develop as a result of operation of the vent, including the dynamic effect of the rate of force application, as expressed by a *DLF* .~~

~~The following equation shall be used to determine the reaction force applicable to enclosures without vent ducts:~~

$$F_r = a * DLF * A_v * P_{red} \quad (1)$$

~~Where~~

~~Fr is maximum reaction force resulting from combustion venting [kN (lbf)]~~

~~“a” = units conversion~~

~~DLF= 1.2~~

~~A_v = vent area [m^2 (in.^{2})]~~

~~P_{red} = maximum pressure developed during venting [bar-g (psig)]~~

~~Modification of the value of *DLF* based on a documented analysis of the vented explosion pressure profile and the supporting structure's response shall be permitted. The total reaction force shall be applied at the geometric center of the vent. The calculation of reaction forces on the enclosure shall be permitted to be eliminated when all of the following conditions are satisfied:~~

(1)

(a) ~~Vent panels are of the rupture diaphragm type.~~

(b) ~~Vent panels are located at opposing positions on the enclosure.~~

(c) ~~The P_{stat} of each vent panel is equal and less than or equal to 0.1 bar-g.~~

(d) ~~Vent panels are of equal area.~~

~~The duration of the reaction force shall be calculated according to the equation below, which is shown to represent the available duration data within a minus 37 percent and a plus 118 percent:~~

~~t f =b P max P red 0.5 V A v~~

$$t_f = b\left(\frac{P_{max}}{P_{red}}\right)^{0.5}\left(\frac{V}{A_v}\right)$$

~~(2)~~

~~Where,~~

~~t_f = duration of pressure pulse after vent opening (s)~~

~~b = 4.3*10^{-3} (1.3*10^{-3})~~

~~P_{max} = maximum pressure developed in an unvented explosion [bar-g (psig)]~~

~~P_{red} = maximum pressure developed during venting [bar-g (psig)]~~

~~V = enclosure volume~~

~~A_v = area of vent (without vent duct) [m^2 (ft^2)]~~

(1)

(a)

i. ~~*Enclosure Geometry*~~

~~The factors that influence the development of a fire in an enclosure can be divided into two main categories: those that have to do with the enclosure itself, and those that have to do with the fuel [19]. The geometry and operating conditions of the combustion chamber in many practical devices (e.g., spark ignition engines and furnaces) are important because of their effects on the flame speed and heat release distribution [20].~~

~~It shall be permitted to conservatively determine both *H* and *Veff*, or *H* alone, but not *Veff* alone, based on the total enclosure, irrespective of vent location. The effective area, *Aeff*, shall be determined by dividing *Veff* by *H*. The effective hydraulic diameter, *Dhe*, for the enclosure shall be determined based on the general shape of the enclosure taken normal to the central axis:~~

~~D he =4 A eff p~~

$$D_{he} = 4\left(\frac{A_{eff}}{p}\right)$$

~~(3)~~

~~Where,~~

~~D_{he} = hydraulic diameter~~

~~A_{eff} = effective area~~

~~p = permitter of general shape~~

~~Where the enclosure and rectangular extension having an aspect ratio, *R*, of the largest cross section is greater than or equal to 1.2, the perimeter shall be permitted to be determined based on the aspect ratio of the largest cross section, given the following:~~

~~*D he =4 A eff R p=2* R+1 * D 1*~~

$$D_{he} = 4\left(\frac{A_{eff}}{R}\right)_{p=2*(R+1)*D_1} \quad (4)$$

~~Where,~~

~~D_{he} = hydraulic diameter~~

~~A_{eff} = effective area~~

~~R = Aspect ratio~~

~~D_1 = Largest cross section~~

~~p = permitter of general shape~~

~~*L/D* for use in this standard shall be set equal to *H/Dhe*. The vent areas shall be permitted to be reduced from those specified in within NFPA 68, Chapters 7 and 8 if large-scale tests show that the resulting damage is acceptable to the user and the authority having jurisdiction [18].~~

~~The vent flow discharge coefficient (C_d) shall be 0.70 unless the vent occupies an entire wall of the enclosure, in which case a value of 0.80 shall be permitted to be used. The value of P0 shall be greater than or equal to the normal operating pressure and chosen to represent the likely maximum pressure at which a flammable gas mixture can exist at the time of ignition [18].~~

(1)

(a)

i. ~~*Enclosure Internal Surface Area*~~

~~The internal surface area, *A s*, shall include the total area that constitutes the perimeter surfaces of the enclosure that is being protected. Nonstructural internal partitions that cannot withstand the expected pressure shall not be considered to be part of the enclosure surface area The enclosure internal surface area, *A S*, includes the roof, ceiling, walls floors and vent area and shall be based on shall be based on simple geometric figures. Surface corrugations and minor deviations from the simplest shapes shall not be considered [18].~~

~~Regular geometric deviations, such as saw toothed roofs, shall be permitted to be "averaged" by adding the contributed volume to that of the major structure and calculating *A S* for the basic geometry of the major structure. The internal surface of any adjoining rooms shall be included. The surface area of equipment and contained structures shall be neglected when calculating the enclosure internal surface area [18].~~

(1)

(a)

i. ~~*Surface Area of Internal Structures*~~

~~The total external surface area, A_{obs} of the following equipment and internal structures that can be in the enclosure shall be estimated:~~

(1)

(a) ~~Piping, tubing, and conduit with diameters greater than ½ in.~~

(b) Structural columns, beams, and joists

(c) Stairways and railings

(d) Equipment with a characteristic dimension in the range of 2 in. to 20 in. (5.1 cm to 51 cm) - [18]

(2) *Gas/Fuel Properties.*

Any material capable of reacting rapidly and exothermically with an oxidizing medium can be classified as a fuel. The concentration of a gaseous fuel in air is usually expressed as a volume percentage (vol %) or mole percentage (mol %).

Flammable gases are present in air in concentrations below and above which they cannot burn. Such concentrations represent the flammable limits, which consist of the lower flammable limit, *LFL* , and the upper flammable limit, *UFL* . It is possible for ignition and flame propagation to occur between the concentration limits. Ignition of mixtures outside these concentration limits fails because insufficient energy is given off to heat the adjacent unburned gases to their ignition temperatures. Lower and upper flammable limits are determined by test and are test-method dependent. Published flammable limits for numerous fuels are available. For further information, see NFPA 325. (Note: Although NFPA 325 has been officially withdrawn from the *National Fire Codes* , the information is still available in NFPA's *Fire Protection Guide to Hazardous Materials* .)

The mixture compositions that are observed to support the maximum pressure, P_{max} , and the maximum rate of pressure rise, $(dP/dt)max$, for a deflagration are commonly on the fuel-rich side of the stoichiometric mixture. It should be noted that the concentration for the maximum rate of pressure rise and the concentration for $Pmax$ can differ.

(1)

(a)

i.

- - *Flammable gas properties identified in UL 9540A testing*
- - *Composition*

The ability to estimate the toxic hazards of combustion gases in a fire compartment is of great importance to the fire protection engineer. The species of interest to the fire engineer would most often be CO, CO, and O_2 , but concentrations of other combustion products may also be of interest; for example, soot concentration can be directly linked to visibility through a gas mass. To allow an estimation of the hazard, the amount of each toxic product produced per unit fuel burned must be assessed, i.e., the species yield must be estimated. Once the production term is known (the yield), the concentration in the fire gases must be calculated. The products of combustion may be diluted by air entering the hot gas layer through the plume and gases may escape out through an opening, thus influencing the species concentrations in the hot gas layer. The concentration of species must therefore be calculated by considering a mass balance of the region of interest. For example, this region may be the hot gas layer in a room or a fire plume. The generation of combustion products is a very complex issue, and the engineer must rely on measurement and approximate methods for estimating the yield of a product [19].

Understanding the generation of combustion products involves a detailed knowledge of their chemistry. But this is very complex, and the fire protection engineer must rely on measurements, not fundamental theory, to make predictions. For a given product, the nature of the combustion products will depend on the following:

(1) The model of combustion (flaming, smoldering, or thermal degradation, i.e., pyrolysis

(2) or evaporation);

(3) The availability of air; and

(4) The addition of chemical agents to retard.

All of these factors affect the pathway of oxidation to its complete state, or its interruption

(1)

(a)

i.

- - *Stoichiometry*

When chemical reactions occur, they are normally accompanied by the release or absorption of heat. Thermochemistry deals with the quantification of the associated energy changes. This requires a definition of the initial and final states, normally expressed in terms of an appropriate chemical equation, for example,

C 3 H 8 + 5O 2 → 3CO 2 +4 H 2 O

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O \qquad (5)$$

in which the reactants (propane and oxygen) and products (carbon dioxide and water) are specified. This balanced chemical equation defines the *stoichiometry* of the reaction, that is, the exact proportions of the two reactants (propane and oxygen) and products (carbon dioxide and water) are specified. This balanced chemical equation defines the *stoichiometry* of the reaction, that is, the exact proportions of the two reactants (propane and oxygen) for complete conversion to products (no reactants remaining) ([21]. Note that the physical states of the reactants and products should also be specified. In most cases, the initial conditions correspond to ambient (i.e., 25°C and atmospheric pressure) so that there should be no doubt about the state of the reactants. In this case both are gaseous, but it is more common in fires for the "fuel" to be in a condensed state, either liquid or solid.

Given the scenario where it is required to calculate the mass of oxygen or air required for the complete oxidation of a given the NFPA 68 required flammable gas equivalent to mass of propane. It is required to understand that a single mole of propane (44 g) reacts completely with five moles of oxygen (5x32 = 160 g).

Where is it understood that 1 g propane requires 3.64 g oxygen for complete stoichiometry. Given a burning propane-air mixture, the presence of nitrogen needs to be considered although it does not participate to any significant extent in the chemical change. It is known that the oxygen to nitrogen ratio in air is approximately 21:79 (or 1:3.76). Therefore, the reaction in this scenario is rewritten as

C 3 H 8 + 5O 2 +18.8 N 2 → 3CO 2 +4 H 2 O+18.8 N 2

$$C_3H_8 + 5O_2 + 18.8N_2 \rightarrow 3CO_2 + 4H_2O + 18.8N_2 \qquad (5)$$

which shows that 44 g propane requires 686.4 g of "air" for complete combustion, that is, 15.6 g air/g propane[[19].

Calculations of this nature are essential to determining the magnitude of the deflagration pressure transient. In order to calculate yields we must know the exact chemical formula for the reaction. The above equations can then be used to calculate the equivalence ratio, the fuel mixture fraction, and the yield of species i . However, the exact chemical formula for the reaction is hardly ever known in practical applications. It is only in cases where the products composition is directly measured in experiments that we can use the data and the above equations for calculations as typically recorded in the UL 9540A testing [19].

(1)

(a)

i.

- ~~*Fundamental Burning Velocity.*~~

~~Ignition of a gas-air mixture in an unvented enclosure will usually result in a deflagration (i.e., flame propagation at subsonic speed away from the ignition site). The pressure developed in the enclosure is dependent on the extent of flame propagation, and the temperature and composition of the burned gas. If the flame has propagated throughout the enclosure, the ratio of the deflagration pressure to the initial pressure in the enclosure can be obtained from the ideal gas equation as it applies to the post deflagration and pre deflagration gas-air mixtures, both of which occupy the same enclosure volume [21].~~

~~The rate of pressure rise during a deflagration is primarily dependent on the rate of flame propagation and the vessel size, as well as the flame temperature. Theoretical calculations are usually based on the following assumptions. First, it is assumed that the flame speed is small in comparison to sound speed so that the pressures in the enclosure are spatially uniform at any given time during the deflagration. The rate of flame propagation relative to the unburned gas ahead of the flame front is called the burning velocity,~~ ~~S_u~~ ~~[21].~~

~~Flame propagation into a near-stoichiometric gas-air mixture will occur as an expanding spherical flame until the flame approaches the walls of the enclosure. Laminar burning velocities have been measured for worst-case concentrations of many gases and vapors. Representative values for the alkanes and many other hydrocarbons are 40 to 47 cm/s. Expansion of the burned gas, and the corresponding motion of the unburned gas away from the ignition site as the flame propagates, causes the actual flame velocity relative to a fixed observer (i.e., the flame speed) to be significantly larger than the burning velocity. Before any compression occurs, the flame speed is~~ ~~$(T_b / T_0) S_u$~~ ~~, which is equal to 350 to 440 cm/s for many hydrocarbons at near stoichiometric concentrations. Turbulent motion of the unburned gas can further increase the burning velocity and flame speed, as represented either by the augmentation factor~~ ~~χ~~ ~~, or by generating wrinkled or distorted flames with corresponding larger flame surface areas [21].~~

~~Where the hazard within an ESS consists of a flammable gas mixture, the vent size shall be based on the fundamental burning velocity of the mixture. Where the gas mixture composition is not certain, NFPA 68 requires the vent size shall be based on the component having the highest fundamental burning velocity.~~

~~A list of fundamental burning velocities of select gases is presented in NFPA 68:2018, Table D.1(a).~~

(1)

(a)

i.

- ~~*Maximum Pressure Developed in a Contained Deflagration.*~~

~~By definition, the *maximum pressure* (*Pmax*) is the maximum pressure developed in a contained deflagration of an optimum mixture as determined by ISO 6184-2:1985 [22]. A list of select flammable gas maximum pressures is provided in NFPA 68, Table D.2.~~

(1)

(a)

i. ~~*Gas Properties Used in Vent Area Calculation*~~

~~The following variables are required to calculate the minimum vent area:~~

(1) ~~P_0~~ ~~Enclosure pressure (gauge) prior to ignition.~~

(2) ~~P_{max}~~ ~~Maximum pressure developed in a contained deflagration.~~

(3) ~~S_u~~ ~~Fundamental burning velocity.~~

(4) rho_u Unburned gas/air mixture density.

(5) *Gu* Unburned gas/air mixture sonic flow mass flux.

(6) gamma_b Burned gas/air mixture specific heat ratio.

(7) mu_u Unburned gas/air mixture dynamic viscosity

(8) *au* Unburned gas/air mixture sound speed.

(9)

i. *Turbulent Flame Enhancement Factor*

NFPA 68:2018 provides instructions for calculating the baseline value, λ_0, of λ shall be calculated where

$$\varphi_1 = \begin{cases} 1, if\ Re_f \leq 4000 \\ \frac{Re_f}{4000}, if\ Re_f \geq 400 \end{cases} \quad Re_f = \frac{\rho_u S_u \left(\frac{D_{he}}{2}\right)}{\mu_u} \qquad (6)$$

Where,

ρ_u = mass density of unburned gas-air mixture (kg/m^3)

S_u = fundamental burning velocity of gas-air mixture (m/s)

μ_u = the unburned gas-air mixture dynamic velocity (kg/m-s)

D_{he} = the enclosure hydraulic equivalent diameter as determined in NFPA 68:2018, Chapter 6 (m)

$$\varphi_2 = max \left\{ 1, \beta_1 \left(\frac{Re_v}{10^6}\right)^{\left(\frac{\beta_2}{S_u}\right)^{0.5}} \right\} \qquad (7)$$

Where,

β_1 = 1.23

β_2 = fundamental burning velocity of gas-air mixture (m/s)

S_u = fundamental burning velocity of gas-air mixture (m/s)

$$Re_v = \frac{\rho_u u_v \left(\frac{D_v}{2}\right)}{\mu_u} \qquad (8)$$

Where,

ρ_u = mass density of unburned gas-air mixture (kg/m^3)

u_v = maximum velocity through vent (m/s)

D_v = the vent diameter as determined through iterative calculation (m)

μ_u = the unburned gas-air mixture dynamic velocity (kg/m-s)

~~u v =min 2x 10 5 P red ρ u~~ $$u_v = min\left\{\sqrt{\frac{2x10^5 P_{red}}{\rho_u}}\right\}$$ ~~(9)~~

~~Where,~~

~~ρ u~~ ρ_u ~~= mass density of unburned gas-air mixture (kg/m 3)~~

~~P red = maximum pressure developed during venting [bar-g (psig)]~~

~~u v = maximum velocity through vent (m/s)~~

(1)

(a)

i. ~~*Partial Volume Corrections*~~

~~When a documented hazard analysis demonstrates that there is insufficient gas in the enclosure to form a stoichiometric gas-air mixture occupying the entire enclosure volume, the calculated vent area, Av 0 , the shall be permitted. A partial volume fill fraction, Xr , shall be calculated as~~

~~X r = V gas V enc x st~~ $$X_r = \frac{V_{gas}/V_{enc}}{x_{st}}$$ ~~(10)~~

~~Where,~~

~~V gas~~ V_{gas} ~~= maximum volume of gas that can be mixed with air in the enclosure~~

~~V enc~~ V_{enc} ~~= enclosure volume~~

~~x st~~ x_{st} ~~= stoichiometric volume concentration of gas~~

~~If X r < 1, the minimum required vent area, Av 1, shall be calculated from the following equation:~~

~~A v1 = A v0 X r - 1 8 X r Π 1 Π~~

$$A_{v1} = A_{v0} X_r^{-\frac{1}{8}}\sqrt{\frac{X_r - \Pi}{1 - \Pi}}$$ ~~(11)~~

~~Where,~~

~~A v1~~ A_{v1} ~~= vent area for partial volume deflagration~~

~~A v0~~ A_{v0} ~~= vent area for full volume deflagration as determined from NFPA 68: 2018 Equation 7.2.1a or 7.2.2a~~

~~x r~~ x_r ~~= fill fraction > Π~~

~~Π = P red / P max~~

(1)

(a)

i. ~~*Panel Inertia Corrections*~~

~~When the mass of the vent panel ≤40 kg/m2, the following equation shall be used to determine whether an incremental increase in vent area is needed:~~

M T = P red 0.2 n 0.8 V S u λ 0.5 1.67

$$M_T = \left[\frac{P_{red}^{0.2} n^{0.8} V}{(S_u \lambda)^{0.5}}\right]^{1.67} \quad (12)$$

Where,

M T M_T = threshold mass (kg/m 2)

P red = maximum pressure developed during venting [bar-g (psig)]

n n = number for panels

V = Enclosure volume

The determined vent area shall be adjusted for vent mass when the vent mass exceeds M T as calculated in above.

For instances when ESS panel mass M > MT , the required vent area, Av 2, shall be calculated as follows:

A v2 = A v1 F SH 1+ 0.05 M 0.6 * S u λ 0.5 n 0.3 VP red 0.2

$$A_{v2} = A_{v1} F_{SH}\left[1 + \frac{0.05\,(M)^{0.6} * (S_u \lambda)^{0.5}}{n^{0.3} V P_{red}^{0.2}}\right] \quad (13)$$

Where,

A v2 A_{v2} = vent area for panel inertia (m 2)

M = mass of vent panel (kg/m 2)

A v1 A_{v1} = vent area determined in equation 11

F SH = 1 for translating panels or 1.1 for hinged panels

In ESS installations where M < MT, Av 2 shall be set equal to Av 1.

Ignition of a gas-air mixture in an unvented enclosure will usually result in a deflagration (i.e., flame propagation at subsonic speed away from the ignition site). The pressure developed in the enclosure is dependent on the extent of flame propagation, and the temperature and composition of the burned gas. If the flame has propagated throughout the enclosure, the ratio of the deflagration pressure to the initial pressure in the enclosure can be obtained from the ideal gas equation as it applies to the post deflagration and pre deflagration gas air mixtures, both of which occupy the same enclosure volume.

The maximum pressures for each flammable gas occur at fuel equivalence ratios in the range 1.1 to 1.2 (i.e., at slightly richer than stoichiometric concentrations). These worst-case deflagration pressures are in the range 8 to 9.6 atm abs. Theoretical values of Pm at an equivalence ratio of 0.5, which corresponds to the lower flammable limit for methane and propane, are in the range 6 to 6.5 atm abs. Experimental measurements of closed vessel deflagration pressures agree well with the theoretical values of Pm at near-stoichiometric concentrations, but are significantly less than the theoretical values at concentrations near the lower and upper flammable limits. The reasons for the deviation at near-limit concentrations are 1) incomplete combustion due to flame propagation through only a portion of the enclosure and 2) slow flame propagation allowing time for heat losses from the burned gas mixture to the enclosure walls. As an example of the incomplete combustion, extensive deflagration testing of lean hydrogen air mixtures has shown that the fraction of hydrogen burned ranges from zero to one as the hydrogen concentration increases from its lower limit of 4 volume percent to 8 volume percent, and remains equal to approximately one (complete combustion) as the hydrogen concentration ranges from 8 volume percent to about 40 volume percent (equivalence ratio of 1.6).

(1)

(a) *Blast Pressure wave Determination*

Blast wave pressures from the door-vented BESS enclosure gas deflagration have been calculated using three different literature correlations for blast pressure versus distance from the enclosure vent. These are the Palmer and Tonkin correlation, the Hattwig correlation, and the Li and Hao correlation [23-25].

Figure 8 shows the calculated blast wave pressures as a function of distance from a blown-off/open door, using an upper bound 6-psig estimate of the enclosure deflagration pressure as explained above. According to the preliminary site plan drawing you provided, the distance from the BESS enclosure to the fence line is 25 feet. The range of calculated pressures from the three correlations at that distance is 1.5 to 3.5 psig. A pressure of 1.5 psig would break glass windows such as a vehicle window. A pressure of 3.5 psig can damage industrial buildings and storage tanks.

Figure 9 shows the calculated blast wave pressures as a function of distance from a blown-off/open door, using a BESS enclosure P_{red} value of 4 psig. As shown in the figure, the calculated pressure at the 25-ft distant fence line is in the range 0.9 to 2.2 psig. This range of pressures has a slightly reduced damage potential compared to the damage described above. In both cases, there is also a threat of projectiles from objects such as a blown-off door or fastener.

(1)

(a) *Fireball Size Determination*

The requirements for the establishment of an area in the proximity of rated deflagration vents is presented in the National Fire Protection Association (NFPA) Standard 68, *Standard for Explosion Protection by Deflagration Venting* [26]. The specific requirements for the establishment of an area where the intentional exclusion of persons is recommended is presented in Section 7.6, Fireball Dimensions which states "[the] hazard zone from a vented gas deflagration shall be calculated by the following equation:

D=3.1 V n 0.402

$$D = 3.1\left(\frac{V}{n}\right)^{0.402} \quad (14)$$

where:

D = axial distance (front centerline) from vent (m)

V = volume of vented enclosure (m3)

n = number of evenly distributed vents

The hazard zone measured radially (to the sides, measured from the centerline of the vent) shall be calculated as 0.5 D " [26].

The equation governing the calculation of the dimensions of an exclusion zone is based on the work of Bartknecht [27, 28] and Siwek [29] and is bounded by enabling assumptions. Siwek infers the estimation of the maximum flame range *(LF)* " can be made only for nonturbulent gas-air mixtures ignited in a cubic vessel" and is directly proportional to size of the cubic vented vessel [29]. However, Siwek's work does not address the impact of evenly distributed vents. It is inferred the fireball hazard zone can be linearly divided by the number of deflagration vents. Additionally, Siwek's work is based on dated research (1989)[29]. Therefore, it is recommended the engineer analyzing the hazards consider the additional research identified numerous fireball calculations methodologies as a function of fuel [30, 31].

The modelling of fireballs covers the following aspects:

(1) Fireball regime,

(2) Mass of fuel in the fireball,

(3) Fireball development and timescales,

(4) Fireball diameter and duration,

(5) ~~Heat radiated and (6) the view factor.~~

~~The calculation of the heat radiated from a fireball emphasizes the necessity of understanding the different approaches which may be taken to the modelling of fires in process plants. Specifically, there are three different ways of determining the heat radiated. One is to assume that it is a given fraction of the heat released. Another is to assume a given value for the heat radiated from the flame surface, or surface emissive power [31] . The third is to calculate the heat radiated from the flame properties, such as flame temperature and emissivity. Numerical modeling of fireballs can be accomplished through correlations of diameter and duration time, and fundamental models.~~

~~Various engineers have correlated fireball diameter using a relation of the form~~

$$D = K_1 M^{n_1} \qquad (15)$$

~~where D is the diameter of the fireball (m), K_1 is a constant and n_1 is an index [31] .~~

~~Based upon the updated information, the application of the work of A.F. Roberts which is one of the most widely recognized correlation for hydrocarbons and should be considered as part of the analysis and methodologies used to arrive at a conservative hazard zone [30]:~~

$$D = 5.8 m_f^{1/3} \qquad (16)$$

~~where:~~

~~D = axial distance (front-centerline) from vent (m)~~

~~m = mass of propellant (kg)~~

~~Following the principles outlined in NFPA 68, the diameter of the fireball is a function of evenly spaced vents. Therefore, the application of A.F. Roberts and NFPA 68, the equation used for this analysis becomes:~~

$$D = 5.8\left(\frac{m_f}{n}\right)^{\frac{1}{3}} \qquad (16)$$

~~Where,~~

~~D = axial distance (front-centerline) from vent (m)~~

~~m = mass of propellant (kg)~~

~~n = number of evenly distributed vents~~

(1)

(a)

i. ~~*Explosion Mitigation: Flammable Gas Detection and Ventilation*~~

~~The recognized national consensus standard to be used for the design and construction of explosion prevention systems is NFPA 69:2019 and should be used in conjunction with this Chapter [13].~~

~~For effective and efficient mitigation of explosions within energy storage systems, the intentional use of the container ventilation system as a safety barrier to limit or control flammability limits, the following measures can be considered:~~

- ~~External ventilation at nominal rate in case of absence of carbon monoxide (to be measured by local CO detector).~~

- Increase of external ventilation rate to 400 Nm3/h (or more) in case of H2 and/ or CO detection in the container. The high CO content of the flammable gases generated during thermal runaway of batteries allows a rapid detection based on CO concentration.
- Independent power supply to the external ventilation system (to avoid common mode failures in case of fire in the container).

However, it is understood the ESS thermal management system for internal container environmental control does not directly control or impact cell thermal runaway of one or more degraded cells. In the event of such a fire, the intentional operation of the ESS ventilation system may increase the combustion of the flammable gases by the introduction of fresh air into the container. Conversely, the introduction of fresh air may assist in diluting the flammable gases from reaching the lower flammability limit (LFL). Therefore, as part of the engineering controls for mitigating an explosive environment, stakeholders and practitioners should consider adopting a well evaluated risk-reduction and hazard mitigation strategy. This risk-reduction and hazard mitigation strategy should consider the appropriate variables and controls necessary to establish fire scenario metrics, energy storage management system performance permissives, and other administrative controls to determine the appropriate measures of when to stop/de-energize the ventilation in case of a confirmed container compartment fire.

Depending on the complexity of the ESS it is recommended a three-dimensional (3D) computational fluid dynamics (CFD) analysis be performed whereby multivariable attribute analysis can be performed to assist in the engineering risk reduction decision process. Such an analysis was performed in an ongoing Joint Development Project for battery safety led by DNV GL [10, 32]. The influence of external ventilation on the flammable cloud volume in a battery container upon thermal runaway of Li-Ion batteries was investigated in this project. Preliminary results from CFD simulations demonstrate the effect that increased ventilation rates can have on the flammable cloud size. Figure 10 shows how increasing the ventilation rate from 5 to 10 air changes per hour (ACH) reduces the maximum flammable cloud size by more than 20% in case of thermal runaway of a single battery module.

CFD dispersion simulations show that in a typical battery container (without external ventilation), failure of a single battery rack (consisting of about 15 to 20 battery modules) may result in a 50% volume filling of an equivalent stoichiometric gas cloud. This gas cloud contains gradients of gas concentrations and air. If the gas discharge rate is high enough (relative to external ventilation), the atmosphere inside the container will become saturated, reducing the size of the flammable cloud. If ventilation is increased, then the flammable cloud size increases with increasing ventilation rates. This is why ventilation is mainly useful when the thermal runaway can be limited to one of just a few battery modules.

A study was performed by Warner et al. (2018) on explosion and fire risk in ventilated battery rooms. They used experimentally-backed computational fluid dynamics (CFD) simulations of off-gassing and explosion events. In the simulations, the composition of the gases discharged during thermal runaway of Li-ion batteries were obtained experimentally. Based on these experiments, they conclude that the primary gases of interest, in order of descending approximate quantitye2, CH4, ethylene, HCl, ethane, methanol, ethanol, benzene, toluene, HF, HCN. Many of the gases end up in small enough quantities to be discarded, with CO, H2, CH4 and ethylene presenting the bulk of the explosion risk.

The blast panel weight and size are varied to find the combination of parameters that yield sufficient reduction in explosion pressure. The dimensioning event is assumed to be an entire battery rack malfunction (thermal runaway) producing a 50% volume fill of a stoichiometric equivalent mixture. No external air ventilation is present.

CFD simulations indicate that the explosion overpressure in the container exceeds 3 barg if it is a fully enclosed strong room. This pressure is too high to be contained and requires the use of pressure relief panels to lower the internal pressure acceptable levels. Assuming a design load of 1 barg overpressure on the container walls, one can determine the relief panel area and weight required to reduce the overpressure below the design threshold of the container. The explosion pressures are found by modeling the same explosion event several times with varying panel weight and size.

In all modeling and analysis methodologies used, it is recommended that NFPA 69:2019 be relied upon for verification and validation of conclusions and results. The most common use of NFPA 69:2019 for ESS facilities is presented in Chapter 8, *Deflagration Prevention by Combustible Concentration Reduction* [13]. Chapter 8 outlines the requirements and techniques for maintaining the flammable gas concentration below the Lower Flammable Limit (LFL).

The LFL for ESS applications is usually determined by flammability testing on a gas sample obtained during UL 9540A thermal runaway tests. The gas mixture produced during thermal runaways as noted above, often contains carbon monoxide, carbon dioxide, hydrogen, and various hydrocarbons (including electrolyte vapors), with the relative proportions of these components varying widely with the cell state-of-charge at runaway, and the cathode and electrolyte materials [11]. The UL 9540A cell level report includes the gas mixture composition and the measured LFL value for the particular ESS cell application.

NFPA 69:2019 paragraph 8.2.3.2 requires ESS facility owner or operator to provide complete documentation and a detailed description of the protection system to be used for monitoring and controlling flammable gas concentrations. This system usually includes the following components:

- Battery management system (BMS) provisions for detecting and controlling incipient cell anomalies that could lead to a thermal runaway.
- Gas detection provisions designed to sense concentrations of various thermal runaway flammable gases produced in the early stages of a runaway and send an alarm to the BMS and external system monitors.
- Normal and emergency ventilation and ESS enclosure exhaust provisions designed to dilute and expel flammable vapors [13].

NFPA 69 paragraph 8.2.3.4 requires the protection system design be reviewed by a qualified person acceptable to the facility's authority having jurisdiction. Other paragraphs require the ESS owner or operator to provide maintenance of the system after installation and acceptance, and to arrange for periodic inspection by personnel trained by the protection system manufacturer(s). There is one important new provision in NFPA 69-2019 applicable to an instrumented explosion prevention control system, also known as a safety instrumented system (SIS).) [13]. In order to achieve a minimum documented level of system reliability, section 15.5.5 requires an SIS installed after November 5, 2021 to be either listed for explosion prevention service or evaluated to demonstrate a safety integrity level 2 rating in accordance with ANSI/ISA 84.000.01. Therefore, the review of all ESS instrumented explosion prevention systems should include a careful assessment of component and system reliability.

NFPA 69 paragraph 8.3.1 requires the flammable gas concentration to be maintained at or below 25 percent of the LFL. There is an exception for installations that have continuous monitoring of combustible gas concentration and associated safety interlocks to control flammable gas concentrations. Such explosion prevention systems are allowed to maintain flammable gas concentrations at or below 60 percent of the LFL. This is an important provision for BESS explosion prevention systems that can be shown to have reliable continuous monitoring of incipient thermal runaway flammable gases, and the combination of ventilation provisions to cope with UL 9540A data on gas generation rates and quantities, so as to limit gas concentrations to 60% of the LFL.

NFPA 69-2019 section 8.3.3 contains some straightforward requirements for ventilation and air intakes and exhausts. These requirements include locating air intakes and exhausts such that flammable gas discharged from one enclosure will not enter the air intake o f an a d j a c e n t enc l o s u re.

NFPA 69 Annex D describes ventilation calc u lat i on me th o d s t o est i mate t h e c on c e ntration of a f lammable gas released into a ventilated enclosure such as a BESS container. Equations are given for simple applications including calculating the number of enclosure air changes per minute required to limit the average gas concentration to some fraction of the LFL. These equations are special case solutions to the following equation for gas concentration, C, as a function of time, t.

V dC dt +QC=G

$$V\frac{dC}{dt} + QC = G \qquad (17)$$

where: V is t h e en c l o s u re vol u me, Q is the en c l o s u re ve n tilation rate, and

G is the gas vol u metric rel e a s e rate. In order to account for ventilation mixing issues, i.e. non-uniform concentrations, the value of Q in Equation 1 is replaced by KQ, where K is an empirically determined mixing efficiency factor for the specific ventilation arrangement. The solution of Eqn 1 for the case of constant gas release rate starting at t=0, is

C= G Q 1 e KN

$$C = \frac{G}{Q}(1 - e^{-KN}) \qquad (18)$$

Where the required number of air changes for dilution, N, resulting in a given concentration. is introduced implicitly as being equal to N = Qt/V. . Figure 11 is a graph showing C calculated from and Figure 12 shows the solution for dilution after the release rate is terminated

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Statement of Problem and Substantiation for Public Input

Annex G chapter 6 guidance LIB gas production for was a reserve chapter last cycle due to limited information available at the time of committee review. The data provides the necessary information to the industry for guidance on how to evaluate the explosion control as required under section 9.6.5.6

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 65-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 66-NFPA 855-2023 [New Section after 3.3.27]	855 Explosion Task Group
Public Input No. 67-NFPA 855-2023 [Section No. 4.2.1.3]	855 Explosion Task Group
Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	855 Explosion Task Group
Public Input No. 71-NFPA 855-2023 [Section No. 9.6.5.6.1.1]	855 Explosion Task Group
Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	855 Explosion Task Group
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	855 Explosion Task Group
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	855 Explosion Task Group
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	855 Explosion Task Group
Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]	855 Explosion Task Group
Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]	855 Explosion Task Group
Public Input No. 78-NFPA 855-2023 [Section No. 9.6.5.6.9]	855 Explosion Task Group
Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]	855 Explosion Task Group
Public Input No. 80-NFPA 855-2023 [Section No. 9.6.5.6.8]	855 Explosion Task Group
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Public Input No. 83-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Explosion Task Group
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Public Input No. 70-NFPA 855-2023 [New Section after 9.1.5.1.2]	
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Public Input No. 72-NFPA 855-2023 [Section No. 9.6.5.6.1.2]	
Public Input No. 73-NFPA 855-2023 [Section No. 9.6.5.6.3]	
Public Input No. 74-NFPA 855-2023 [Section No. A.9.6.5.6.3]	
Public Input No. 75-NFPA 855-2023 [Section No. 9.6.5.6.4]	

Public Input No. 76-NFPA 855-2023 [Section No. 9.6.5.6.5]

Public Input No. 77-NFPA 855-2023 [Section No. 9.6.5.6.6]

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Public Input No. 79-NFPA 855-2023 [Section No. 9.6.5.6.7]

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Public Input No. 81-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

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Statement: This addition provides necessary information to the industry for guidance on how to evaluate the explosion control as required under Section 9.6.5.6.

Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]

G.11.3 Guidelines.

Battery ESS based on electrochemical technologies represent the majority of ESS being designed and installed. The safe operation of electrochemical ESS is critical—especially when installed inside occupied structures. The primary concerns of the fire service with this type of installation would include the implications of overheating via internal or external heat source, thermal runaway, potential deflagration event in enclosed spaces, and the effective operation of fire detection, suppression, and smoke exhaust systems. There are additional concerns to be considered where assessing firefighter responses to electrochemical ESS.

Handover procedures for potentially damaged systems should be developed for fire departments to ensure the timely response of a qualified person as a technical representatives to manage safety issues. These procedures would also cover issues such as the removal or recycling of damaged equipment. Another procedural component is the realization that damaged ESS system components could include significant stored or stranded energy with no known method for safe dissipation. Stored or stranded energy could be defined as energy that remains in a battery after the system has been shut down.

Statement of Problem and Substantiation for Public Input

"Qualified" is used in different configurations thru out the standard. Updating the definition to align with the use in the standard. Additional updating the usage to be consistently applied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
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Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]

G.11.4 Suppression Systems.

Some ESS design validations have included pre-engineered inert or clean-agent fire suppression systems for fire protection. These system installations were often approved without validation based on fire and explosion testing in accordance with 9.1.5 by nationally recognized testing laboratories. Evidence-based data is needed to ensure ESS designers specify appropriate fire protection systems based on the material involved and physical design characteristics. Several early research papers from multiple organizations, including NFPA's Fire Protection Research Foundation, and third-party engineering groups have shown that fires involving lithium-ion cells must be cooled to terminate the thermal runaway process. Water is the agent of choice, yet system cabinet design could pose a significant barrier to the efficient application of water while simultaneously allowing the free movement of fire and combustion gases.

One of the more challenging types of incidents will be one where no signs of overheating are visible, and no information is available via integral displays. This places the responding firefighter in the challenging position of determining what is safe or not with very little information. Integrated energy management systems (EMS) are designed to monitor and manage critical safety parameters of the battery such as cell temperature, voltage, and available current. While this data might prove valuable to responders to best understand the current state of the battery, there is no standard for manufacturers to provide a user interface to access the state of these parameters or a method to interface with to monitored alarm systems within the building. Responders should attempt to gather any visible information prior to shutting down the system unless there is clear evidence of imminent danger. Additionally, the response of a qualified ~~and trained individual in~~ person in ESS should be made available to assist the firefighters in the event of damage to an installed system.

Statement of Problem and Substantiation for Public Input

"Qualified" is used in different configurations thru out the standard. Updating the definition to align with the use in the standard. Additional updating the usage to be consistently applied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
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Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

G.11.5 Overheated Batteries.

The process of charging/discharging results in heat dissipation from cells. An optimum overall system design should include cascading layers of hardware and software protection, including at the battery cell, module or pod, and rack levels. Should a fault occur and over-heating of a cell continues, damage could occur resulting in swelling, off-gassing, fire, or explosion. Proper response to an overheated battery is needed.

Fires in electrochemical ESS are often a result of a failure mode called *thermal runaway.* Thermal runaway can simply be defined as the process in which a battery creates heat within an individual cell but cannot dissipate that heat, resulting in dynamic temperature increase. Initial signs of thermal runaway might include pressure increase at the cell level, temperature increase, and off-gassing. As the process continues, additional signs might include vent gas ignition, exploding cells, projectile release, heat propagation, and flame propagation.

As the failure cascades, responders should also be prepared for toxic and highly toxic emission and potentially explosive gas release. Though fire and explosion testing in accordance with 9.5.3.2 to determine battery burn outcomes remains incomplete, including toxic ~~gas release calculations~~ and highly toxic emissions calculations , responders should treat them as highly dangerous ECE hazardous materials and use their full suite of PPE and breathing apparatus when responding.

Proper response to electrochemical ESS fires should include the following procedures and steps:

(1) System isolation and shutdown

(2) Hazard confinement and exposure protection

(3) Fire suppression

(4) Controlled ventilation

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

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Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
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Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
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Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]

Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]
Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Committee Statement

Resolution: FR-178-NFPA 855-2023

Statement: The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. The annex is updated to reflect these requirements.

Public Input No. 63-NFPA 855-2023 [Section No. G.11.7.3]

G.11.7.3 Suppression Tactics.

As previously mentioned, battery components are often housed in cabinets or other configurations that can serve to protect the components and thus limit the ability of fire stream penetration. Firefighters should never use piercing nozzles and long penetrating irons. It is recommended that firefighters use the reach of the water stream instead but should never be up close to these installations. Mechanically damaged cells or puncturing unburned or undamaged cells can result in the immediate ignition of those cells. In addition, internal shorting within the cabinets could create an electrocution risk. The use of salt water on a damaged system will cause more electrical leakage back to the water appliance. Only unadulterated fresh water should be used on ECE hazardous materials.

Movement of damaged cells might result in arcing or reignition if active material or cells remain in the modules. Modules should not be moved without consultation from a qualified ~~personnel~~ person . Firefighter should never attempt to “overhaul” a damaged ECE hazardous material.

Ventilation during suppression is critical. Research has shown that Li-ion batteries might continue to generate flammable gases during and after extinguishing. In addition, testing has shown that during sprinkler suppression, removal of combustion and flammable gases emitted from the battery significantly improves the effectiveness of the suppression. Ventilation of an enclosure does not remove the potential of explosion. Ventilation manual activation devices that can be used in enclosure to exhaust flammable and toxic gases from within the enclosure must be remote from the installation and marked for fire department use. This option of ventilation of an enclosure should be in consultation with the system SME. No ventilation should be attempted by the fire service until more information is gathered and the area around the installation is secured.

Testing has shown that electrical current leakage back through hose streams using unadulterated fresh water will not be a shock hazard when appropriate streams are used and distances maintained. Firefighters that use tower ladders (i.e., buckets) should be aware of explosion hazards and should not be in the explosion area when operating a water source from these types of apparatus. In cases where systems are destroyed and electric potential is shown to be minimal, close-range engagement with hoses for drowning modules can be performed to provide more direct cooling. During postfire operations, SCBA should continue to be worn by all persons near the damaged ESS, especially where systems are in confined or poorly ventilated spaces or have not been sufficiently cooled yet. There is a concern that the buildup of these gases can cause an explosion even after the fire has been put under control. Gases, and CO in particular, should be monitored during this period, as dangerous buildups have been observed during postfire testing. If possible, batteries should be monitored for residual heat and temperature, as reignition is a possibility in cells that are not sufficiently cooled.

Care should be taken to secure the area where the batteries are located and ensure that the heat has been removed and that the batteries are not at risk of being electrically shorted or mechanically damaged. This should be done at the guidance of a qualified ~~technician~~ person . At this point, the fire scene should be handed over to the owner, operator, or responsible party appointed by the site owner. Though trace amounts of heavy metals such as nickel and cobalt can be deposited from combustion of the batteries, these elements are not expected to be present in large quantities or in quantities larger than any other similar fire. In most instances, water exposed to the batteries shows very mild acidity, with an approximate pH of 6. Runoff-water pH can be monitored during firefighting operations but should not pose a greater risk than normal firefighting runoff. In unique cases where a system on fire poses little or no risk to the surrounding uninvolved equipment or the environment, it is reasonable to assume a defensive posture and allow the system to burn itself out. Some typical steps for this approach include local municipal firefighters responding to the scene to make sure that the flames do not spread beyond the property perimeter, having ESS operations personnel arriving at the scene to review the situation and conditions, and then allowing the fire to burn out. This option should only be considered when no risks are posed to the environment and the risk to firefighting operations is great or unknown. It is up to the site owner/operator to communicate with fire services in the event of an emergency to relay vital system information to fire services.

Statement of Problem and Substantiation for Public Input

"Qualified" is used in different configurations thru out the standard. Updating the definition to align with the use in the standard. Additional updating the usage to be consistently applied.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	Qualified Persons
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	Qualified Persons
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	Qualified Persons
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	Qualified Persons
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	Qualified Persons
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	Qualified Persons
Public Input No. 57-NFPA 855-2023 [Section No. 3.3.20]	
Public Input No. 58-NFPA 855-2023 [New Section after 3.3.27]	
Public Input No. 59-NFPA 855-2023 [Section No. G.3.1.1]	
Public Input No. 60-NFPA 855-2023 [Section No. 4.3.2.1.4]	
Public Input No. 61-NFPA 855-2023 [Section No. G.11.3]	
Public Input No. 62-NFPA 855-2023 [Section No. G.11.4]	

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Submittal Date: Sun Apr 23 12:20:06 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-179-NFPA 855-2023

Statement: "Qualified" is used in different configurations thru out the standard. This updates the usage to be consistently applied throughout the standard.

Public Input No. 52-NFPA 855-2023 [Section No. G.11.8.5]

G.11.8.5 Types of Hazards Once a Fire has Started.

Fire, explosions, toxic ~~gases~~ and highly toxic emissions , chemical hazards, CO, CO_2, hydrocarbons (i.e., typically propane and methane, but this depends on the chemistry of the specific battery), and H_2.

Statement of Problem and Substantiation for Public Input

Toxic emissions are not adequately addressed in the current addition of 855. A NFPA 855 Task Group was formed for the evaluation of current toxic code requirements and to provide recommendations for changes to the code. Information on the generation and emission of gases is still limited. The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. Information will be amended based on current research on toxics.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]	855 Toxics task group
Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]	855 Toxics task group
Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]	855 Toxics task group
Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]	855 Toxics task group
Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]	855 Toxics task group
Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]	855 Toxics task group
Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group

Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]	855 Toxics task group
Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]	855 Toxics task group
Public Input No. 48-NFPA 855-2023 [Section No. 15.10]	855 Toxics task group
Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]	855 Toxics task group
Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]	855 Toxics task group
Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]	855 Toxics task group
Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]	855 Toxics task group
Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]	855 Toxics task group

Public Input No. 31-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 32-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 33-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 34-NFPA 855-2023 [New Section after 3.3.27]

Public Input No. 35-NFPA 855-2023 [Section No. 4.6.11]

Public Input No. 36-NFPA 855-2023 [Section No. A.4.6.11]

Public Input No. 37-NFPA 855-2023 [Section No. A.9.1.5.1]

Public Input No. 38-NFPA 855-2023 [Section No. A.9.6.5.1]

Public Input No. 39-NFPA 855-2023 [Section No. 9.6.5.1.2]

Public Input No. 40-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 41-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 42-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 43-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 44-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 45-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 46-NFPA 855-2023 [New Section after 9.6.6.2.5]

Public Input No. 47-NFPA 855-2023 [Section No. G.2.3.3]

Public Input No. 48-NFPA 855-2023 [Section No. 15.10]

Public Input No. 49-NFPA 855-2023 [Section No. C.4.2]

Public Input No. 50-NFPA 855-2023 [Section No. G.7.3.7.2]

Public Input No. 51-NFPA 855-2023 [Section No. G.11.5]

Public Input No. 53-NFPA 855-2023 [Section No. 9.5.1 [Excluding any Sub-Sections]]

Public Input No. 54-NFPA 855-2023 [Section No. 9.5.2 [Excluding any Sub-Sections]]

Public Input No. 55-NFPA 855-2023 [Section No. 9.5.3.1 [Excluding any Sub-Sections]]

Public Input No. 56-NFPA 855-2023 [Section No. 9.6.5 [Excluding any Sub-Sections]]

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Committee: ESS-AAA

Committee Statement

Resolution: FR-180-NFPA 855-2023

Statement: The addition of a new section addresses a path to evaluate toxic and highly toxic gas and requirements to mitigate potential emission of gases during failure conditions. The annex is updated to reflect these requirements.

Public Input No. 211-NFPA 855-2023 [Section No. H.1]

H.1 Referenced Publications.

The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

H.1.1 NFPA Publications.

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

NFPA 1, *Fire Code*, 2021 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition.

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

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2022 edition.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

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

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2021 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2018 edition.

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

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2023 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 70B, *Recommended Practice for Electrical Equipment Maintenance*, 2022 edition.

NFPA *70E®, Standard for Electrical Safety in the Workplace®*, 2021 edition.

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

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

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2022 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2021 edition.

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

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2022 edition.

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

NFPA 204, *Standard for Smoke and Heat Venting,* 2021 edition.

NFPA 400, *Hazardous Materials Code*, 2022 edition.

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

NFPA 550, *Guide to the Fire Safety Concepts Tree,* 2022 edition.

NFPA 551, *Guide for the Evaluation of Fire Risk Assessments*, 2022 edition.

NFPA 652, *Standard on the Fundamentals of Combustible Dust*, 2019 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition.

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

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants,* 2020 edition.

NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*, 2020 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2021 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2019 edition.

NFPA 1620, *Standard for Pre-Incident Planning*, 2020 edition.

NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*, 2018 edition.

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

NFPA 2010, *Standard for Fixed Aerosol Fire-Extinguishing Systems*, 2020 edition.

Fire Protection Handbook, ~~20th~~ 21st edition, ~~2008~~ 2023 .

H.1.2 Other Publications.

H.1.2.1 CENELEC Publications.

CENELEC, European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Rue de la Science 23, B - 1040 Brussels, Belgium.

EN 15276-1, *Fixed firefighting systems — Condensed aerosol extinguishing systems — Part 1: Requirements and test methods for components*, 2019.

EN 15276-2, *Fixed firefighting systems — Condensed aerosol extinguishing systems — Part 2: Design, installation and maintenance*, 2019.

H.1.2.2 CSA Group Publications.

CSA Group, 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada.

CAN/CSA C22.2 No. 107.1, Power conversion equipment, 2016, reaffirmed 2021.

CAN/CSA C22.2 No. 62109-1, *Safety of power converters for use in photovoltaic power systems — Part 1: General requirements*, 2016, reaffirmed 2021.

H.1.2.3 FPRF Publications.

Fire Protection Research Foundation, 1 Batterymarch Park, Quincy, MA 02169-7471.

Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results, July 2013.

H.1.2.4 ICC Publications.

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

Uniform Fire Code, 1997.

H.1.2.5 IEC Publications.

International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60812, *Analysis techniques for system reliability — Procedure for failure mode and effects analysis (FMEA)*, 2006.

IEC 61025, *Fault tree analysis (FTA)*, 2006.

H.1.2.6 IEEE Publications.

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

IEEE 450, *Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*, 2010.

IEEE 484, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*, 2019.

IEEE 1187, *Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*, 2013.

IEEE 1188, *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications*, 2005.

IEEE 1547, *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, 2018.

IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications,* 2018.

IEEE 3007.1, *Recommended Practice for the Operation and Management of Industrial and Commercial Power Systems*, 2010.

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

H.1.2.7 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401 - 1214 Vernier, Geneva, Switzerland.

ISO 9001, *Quality management systems — Requirements*, 2015.

H.1.2.8 Military Specifications.

Department of Defense Single Stock Point, Document Automation and Production Service, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-1629A, *Procedures for Performing a Failure Mode, Effects and Criticality Analysis,* 1980.

H.1.2.9 NECA Publications.

National Electrical Contractors Association, 3 Bethesda Metro Center, Suite 1100, Bethesda, MD 20814.

NECA 416, *Recommended Practice for Installing Energy Storage Systems (ESS)*, 2017.

H.1.2.10 SFPE Publications.

Society of Fire Protection Engineers, 9711 Washingtonian Blvd., Suite 380, Gaithersburg, MD 20878.

SFPE Engineering Guide to Fire Risk Assessment, 2006.

SFPE Handbook of Fire Protection Engineering, 2016.

H.1.2.11 UL Publications.

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

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

UL 1642, *Lithium Batteries*, 2020.

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2018.

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 2436, *Outline of Investigation for Spill Containment for Stationary Acid and Alkaline Electrolyte Battery Systems,* 2020.

ANSI/UL 2775, *Standard for Fixed Condensed Aerosol Extinguishing System Units,* 2019.

UL 62109-1, *Safety of Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements*, 2019.

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

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

H.1.2.12 UN Publications.

United Nations Headquarters, 760 United Nations Plaza, New York, NY 10017.

UN 38.3, *Recommendations on the Transport of Dangerous Goods: Lithium Metal and Lithium Ion Batteries*, 2015.

UN 2800, *Batteries, wet, non-spillable, electric storage*, 2017.

H.1.2.13 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.38, “Emergency Action Plans.”

Title 29, Code of Federal Regulations, Part 1910.39 “Fire Prevention Plans.”

Title 29, Code of Federal Regulations, Part 1910.120(q)(6), “Hazardous Waste Operations and Emergency Response—Emergency Response to Hazardous Substance Releases—Training.”

Title 29, Code of Federal Regulations, Part 1910.147, “The Control of Hazardous Energy (Lockout/Tagout).”

Title 29, Code of Federal Regulations, Part 1910.269(d), “Electric Power Generation, Transmission, and Distribution — Hazardous Energy Control (Lockout/Tagout) Procedures.”

H.1.2.14 Other Publications.

H.1.2.14.1 References for Annex D.

1. International Electrotechnical Commission (IEC), "Electrical Energy Storage," White Paper, Geneva/Switzerland, pp. 17–34, December 2011.

2. Rastler, D., "Electricity Energy Storage Technology Option," Electric Power Research Institute, December 2010.

3. Doetsch, C., "Electrical energy storage from 100 kW—State of the art technologies, fields of use," 2nd International Renewable Energy Storage Conference, Bonn, Germany, November 2007.

4. Xie, S., and L. S. Wang, "Industry Trends — Issue 9," China Energy Storage Alliance, January 2012.

5. The ADELE project in Germany uses adiabatic compression, while the SustainX, General Compression, and LightSail projects in the US use isothermal compression. See "ADELE — Adiabatic Compressed-Air Energy Storage (CAES) for Electricity Supply," RWE; "SustainX's ICAES," SustainX; and "General Compression, Who We Are," General Compression.

6. Nakhamkin, M., "Novel Compressed Air Energy Storage Concepts," developed by Energy Storage and Power Consultants (ESPC) and presented to EESAT, May 2007.

7. Inage, Shin-ichi, "Prospects for Large-Scale Energy Storage in Decarbonised Grids," International Energy Agency, Report, 2009.

8. Schossig, P., "Thermal Energy Storage," 3rd International Renewable Energy Storage Conference, Berlin, Germany, November 2012.

9. Fairley, P., http://spectrum.ieee.org/energy/environment/largest-solar-thermal-storage-plant-to-start-up, Article 2008, Accessed July 2011.

10. Jahnig D. et al., "Thermo-chemical storage for solar space heating in a single-family house," 10th International Conference on Thermal Energy Storage, Ecostock 2006, New Jersey, May/June 2006.

11. Tamme, R., "Development of Storage Systems for SP Plants," DG TREN—DG RTD Consultative Seminar on Concentrating Solar Power, Brussels, Belgium, June 2006.

12. Bullough, C., "Advanced Adiabatic Compressed Air Energy Storage for the Integration of Wind Energy," European Wind Energy Conference and Exhibition, London, GB, November 2004.

H.1.2.14.2 References for Annex F.

H.1.2.14.2.1 NFPA Publications.

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

NFPA 1, *Fire Code*, 2000, 2003, 2006, 2009, 2012, 2015, and 2018 editions.

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

"Lithium Ion Batteries Hazard and Use Assessment," Fire Protection Research Foundation, July 2011.

"Lithium Ion Batteries Hazard and Use Assessment — Phase IIB — Flammability Characterization of Li-ion Batteries for Storage Protection," Fire Protection Research Foundation, April 2013.

"Lithium Ion Batteries Hazard and Use Assessment — Phase III," Fire Protection Research Foundation, November 2016.

H.1.2.14.2.2 ICC Publications.

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

International Building Code (IBC), 2000, 2003, 2009, 2012, and 2015.

International Fire Code (IFC), 2000, 2003, 2006, 2009, 2012, 2015, and 2018.

International Residential Code, 2018.

Uniform Fire Code (UFC), 1994 and 1997.

H.1.2.14.2.3 UL Publications.

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

UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, 2021.

H.1.2.14.3 Other Publications.

DNVGL Battery Safety Joint Development Project Report, "Technical Reference for Li-ion Battery Explosion Risk and Fire Suppression," January 7, 2020.

Marioff Corporation—Fire Test Summary #57/BR/AUG15, "HI-FOG® Systems for Protection of Li-ion Rooms," August 2015.

"Fire Safety Testing Data Analysis Supplement for NYC Outdoor ESS," NY Solar Map, City University of New York (CUNY). https://nysolarmap.com/media/2041/fire-safety-testing-data-analysis-supplement-for-nyc-outdoor-ess_v1.pdf

Statement of Problem and Substantiation for Public Input

This updates the Fire Protection Handbook to the most recent version (21st edition, published in 2023). The other publications should be updated to include the most recent versions.

Submitter Information Verification

Submitter Full Name: Kevin Fok
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Submittal Date: Wed May 31 11:24:24 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: Public inputs referencing encapsulating agents were rejected. See Public Inputs 269, 330,331 and 349 for technical substantiation for rejecting inclusion of encapsulating agents. Therefore, this document should not reference NFPA 18A.

Public Input No. 369-NFPA 855-2023 [Section No. H.1.1]

H.1.1 NFPA Publications.

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

NFPA 1, *Fire Code*, 2021 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 edition.

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

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2022 edition.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2019 edition.

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

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2021 edition.

NFPA 18A, Standard on Water Additives for Fire Control and Vapor Mitigation, 2022 Edition

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2018 edition.

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

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2023 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 70B, *Recommended Practice for Electrical Equipment Maintenance*, 2022 edition.

NFPA *70E®, Standard for Electrical Safety in the Workplace®*, 2021 edition.

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

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

NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, 2022 edition.

NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, 2021 edition.

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

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2022 edition.

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

NFPA 204, *Standard for Smoke and Heat Venting,* 2021 edition.

NFPA 400, *Hazardous Materials Code*, 2022 edition.

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

NFPA 499, *Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2021 edition.

NFPA 550, *Guide to the Fire Safety Concepts Tree,* 2022 edition.

NFPA 551, *Guide for the Evaluation of Fire Risk Assessments*, 2022 edition.

NFPA 652, *Standard on the Fundamentals of Combustible Dust*, 2019 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition.

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

NFPA 805, *Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants,* 2020 edition.

NFPA 850, *Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations*, 2020 edition.

NFPA 921, *Guide for Fire and Explosion Investigations*, 2021 edition.

NFPA 1221, *Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems*, 2019 edition.

NFPA 1620, *Standard for Pre-Incident Planning*, 2020 edition.

NFPA 1962, *Standard for the Care, Use, Inspection, Service Testing, and Replacement of Fire Hose, Couplings, Nozzles, and Fire Hose Appliances*, 2018 edition.

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

NFPA 2010, *Standard for Fixed Aerosol Fire-Extinguishing Systems*, 2020 edition.

Fire Protection Handbook, 20th edition, 2008.

Statement of Problem and Substantiation for Public Input

Added NFPA 18A as a needed NFPA reference.

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
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Submittal Date: Thu Jun 01 17:42:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-56-NFPA 855-2023

Statement: This updates the publications to the current revision date of publication. Standards newly referenced in NFPA 855 are added.

Public Input No. 370-NFPA 855-2023 [Section No. H.1.2]

H.1.2 Other Publications.

H.1.2.1 CENELEC Publications.

CENELEC, European Committee for Electrotechnical Standardization, CEN-CENELEC Management Centre, Rue de la Science 23, B - 1040 Brussels, Belgium.

EN 15276-1, *Fixed firefighting systems — Condensed aerosol extinguishing systems — Part 1: Requirements and test methods for components*, 2019.

EN 15276-2, *Fixed firefighting systems — Condensed aerosol extinguishing systems — Part 2: Design, installation and maintenance*, 2019.

H.1.2.2 CSA Group Publications.

CSA Group, 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada.

CAN/CSA C22.2 No. 107.1, Power conversion equipment, 2016, reaffirmed 2021.

CAN/CSA C22.2 No. 62109-1, *Safety of power converters for use in photovoltaic power systems — Part 1: General requirements*, 2016, reaffirmed 2021.

H.1.2.3 FPRF Publications.

Fire Protection Research Foundation, 1 Batterymarch Park, Quincy, MA 02169-7471.

Best Practices for Emergency Response to Incidents Involving Electric Vehicles Battery Hazards: A Report on Full-Scale Testing Results, July 2013.

H.1.2.4 ICC Publications.

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

Uniform Fire Code, 1997.

H.1.2.5 IEC Publications.

International Electrotechnical Commission, 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland.

IEC 60812, *Analysis techniques for system reliability — Procedure for failure mode and effects analysis (FMEA)*, 2006.

IEC 61025, *Fault tree analysis (FTA)*, 2006.

H.1.2.6 IEEE Publications.

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

IEEE 450, *Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications*, 2010.

IEEE 484, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*, 2019.

IEEE 1187, *Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications*, 2013.

IEEE 1188, *IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications*, 2005.

IEEE 1547, *Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces*, 2018.

IEEE 1635/ASHRAE 21, *Guide for the Ventilation and Thermal Management of Batteries for Stationary Applications,* 2018.

IEEE 3007.1, *Recommended Practice for the Operation and Management of Industrial and Commercial Power Systems*, 2010.

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

H.1.2.7 ISO Publications.

International Organization for Standardization, ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401 - 1214 Vernier, Geneva, Switzerland.

ISO 9001, *Quality management systems — Requirements*, 2015.

H.1.2.8 Military Specifications.

Department of Defense Single Stock Point, Document Automation and Production Service, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-1629A, *Procedures for Performing a Failure Mode, Effects and Criticality Analysis,* 1980.

H.1.2.9 NECA Publications.

National Electrical Contractors Association, 3 Bethesda Metro Center, Suite 1100, Bethesda, MD 20814.

NECA 416, *Recommended Practice for Installing Energy Storage Systems (ESS)*, 2017.

H.1.2.10 SFPE Publications.

Society of Fire Protection Engineers, 9711 Washingtonian Blvd., Suite 380, Gaithersburg, MD 20878.

SFPE Engineering Guide to Fire Risk Assessment, 2006.

SFPE Handbook of Fire Protection Engineering, 2016.

H.1.2.11 UL Publications.

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

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

UL 1642, *Lithium Batteries*, 2020.

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, 2018.

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 2436, *Outline of Investigation for Spill Containment for Stationary Acid and Alkaline Electrolyte Battery Systems,* 2020.

ANSI/UL 2775, *Standard for Fixed Condensed Aerosol Extinguishing System Units,* 2019.

UL 62109-1, *Safety of Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements*, 2019.

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

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

H.1.2.12 UN Publications.

United Nations Headquarters, 760 United Nations Plaza, New York, NY 10017.

UN 38.3, *Recommendations on the Transport of Dangerous Goods: Lithium Metal and Lithium Ion Batteries*, 2015.

UN 2800, *Batteries, wet, non-spillable, electric storage*, 2017.

H.1.2.13 US Government Publications.

US Government Publishing Office, 732 North Capitol Street, NW, Washington, DC 20401-0001.

Title 29, Code of Federal Regulations, Part 1910.38, “Emergency Action Plans.”

Title 29, Code of Federal Regulations, Part 1910.39 “Fire Prevention Plans.”

Title 29, Code of Federal Regulations, Part 1910.120(q)(6), “Hazardous Waste Operations and Emergency Response—Emergency Response to Hazardous Substance Releases—Training.”

Title 29, Code of Federal Regulations, Part 1910.147, “The Control of Hazardous Energy (Lockout/Tagout).”

Title 29, Code of Federal Regulations, Part 1910.269(d), “Electric Power Generation, Transmission, and Distribution — Hazardous Energy Control (Lockout/Tagout) Procedures.”

H.1.2.14 Other Publications.

H.1.2.14.1 References for Annex D.

1. International Electrotechnical Commission (IEC), “Electrical Energy Storage,” White Paper, Geneva/Switzerland, pp. 17–34, December 2011.

2. Rastler, D., “Electricity Energy Storage Technology Option,” Electric Power Research Institute, December 2010.

3. Doetsch, C., “Electrical energy storage from 100 kW—State of the art technologies, fields of use,” 2nd International Renewable Energy Storage Conference, Bonn, Germany, November 2007.

4. Xie, S., and L. S. Wang, “Industry Trends — Issue 9,” China Energy Storage Alliance, January 2012.

5. The ADELE project in Germany uses adiabatic compression, while the SustainX, General Compression, and LightSail projects in the US use isothermal compression. See “ADELE — Adiabatic Compressed-Air Energy Storage (CAES) for Electricity Supply,” RWE; “SustainX's ICAES,” SustainX; and “General Compression, Who We Are,” General Compression.

6. Nakhamkin, M., “Novel Compressed Air Energy Storage Concepts,” developed by Energy Storage and Power Consultants (ESPC) and presented to EESAT, May 2007.

7. Inage, Shin-ichi, “Prospects for Large-Scale Energy Storage in Decarbonised Grids,” International Energy Agency, Report, 2009.

8. Schossig, P., “Thermal Energy Storage,” 3rd International Renewable Energy Storage Conference, Berlin, Germany, November 2012.

9. Fairley, P., http://spectrum.ieee.org/energy/environment/largest-solar-thermal-storage-plant-to-start-up, Article 2008, Accessed July 2011.

10. Jahnig D. et al., “Thermo-chemical storage for solar space heating in a single-family house,” 10th International Conference on Thermal Energy Storage, Ecostock 2006, New Jersey, May/June 2006.

11. Tamme, R., “Development of Storage Systems for SP Plants,” DG TREN—DG RTD Consultative Seminar on Concentrating Solar Power, Brussels, Belgium, June 2006.

12. Bullough, C., “Advanced Adiabatic Compressed Air Energy Storage for the Integration of Wind Energy,” European Wind Energy Conference and Exhibition, London, GB, November 2004.

H.1.2.14.2 References for Annex F.

H.1.2.14.2.1 NFPA Publications.

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

NFPA 1, *Fire Code*, 2000, 2003, 2006, 2009, 2012, 2015, and 2018 editions.

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

"Lithium Ion Batteries Hazard and Use Assessment," Fire Protection Research Foundation, July 2011.

"Lithium Ion Batteries Hazard and Use Assessment — Phase IIB — Flammability Characterization of Li-ion Batteries for Storage Protection," Fire Protection Research Foundation, April 2013.

"Lithium Ion Batteries Hazard and Use Assessment — Phase III," Fire Protection Research Foundation, November 2016.

H.1.2.14.2.2 ICC Publications.

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

International Building Code (IBC), 2000, 2003, 2009, 2012, and 2015.

International Fire Code (IFC), 2000, 2003, 2006, 2009, 2012, 2015, and 2018.

International Residential Code, 2018.

Uniform Fire Code (UFC), 1994 and 1997.

H.1.2.14.2.3 UL Publications.

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

UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, 2021.

H.1.2.14.3 Other Publications.

DNVGL Battery Safety Joint Development Project Report, "Technical Reference for Li-ion Battery Explosion Risk and Fire Suppression," January 7, 2020.

Marioff Corporation—Fire Test Summary #57/BR/AUG15, "HI-FOG® Systems for Protection of Li-ion Rooms," August 2015.

"Fire Safety Testing Data Analysis Supplement for NYC Outdoor ESS," NY Solar Map, City University of New York (CUNY). https://nysolarmap.com/media/2041/fire-safety-testing-data-analysis-supplement-for-nyc-outdoor-ess_v1.pdf

H1.2.14.2.4 NIOSH- Comparison of Fire Suppression Techniques on Lithium-Ion Battery Pack Fires

Statement of Problem and Substantiation for Public Input

NIOSH report supports the use of an Encapsulator Agent (EA) in fighting Lithium-ion battery fires.

Submitter Information Verification

Submitter Full Name: Craig Leadbetter
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Submittal Date: Thu Jun 01 17:45:30 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: The NIOSH report is not referenced within the standard.

Public Input No. 304-NFPA 855-2023 [Section No. H.1.2.11]

H.1.2.11 UL Publications.

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

UL 1012, *Power Units Other Than Class 2*, 2010, revised 2021.

UL 1642, *Lithium Batteries*, 2020, revised 2022 .

UL 1741, *Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources*, ~~2018~~ 2023 .

UL 1778, *Uninterruptible Power Systems*, ~~2017~~ 2014, revised 2023 .

CAN/ UL 1973, *Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications,* ~~2018~~ 2022 .

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

UL 2436, *Outline of Investigation for Spill Containment for Stationary Acid and Alkaline Electrolyte Battery Systems,* 2020.

ANSI/UL 2775, *Standard for Fixed Condensed Aerosol Extinguishing System Units,* 2019.

UL 62109-1, *Safety of Power Converters for Use in Photovoltaic Power Systems — Part 1: General Requirements*, 2014, revised 2019.

UL 9540, *Energy Storage Systems and Equipment*, ~~2020~~ 2021 .

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

Statement of Problem and Substantiation for Public Input

Update UL standards to the current edition and revision.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 302-NFPA 855-2023 [Section No. 2.3.7]	
Public Input No. 306-NFPA 855-2023 [Section No. H.1.2.14.2.3]	

Submitter Information Verification

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Submittal Date: Thu Jun 01 11:40:57 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-57-NFPA 855-2023

Statement: This updates the publications to the current revision date of publication. Standards newly referenced in NFPA 855 have been added.

Public Input No. 131-NFPA 855-2023 [Section No. H.1.2.14.1]

H.1.2.14.1 References for Annex D.

1. International Electrotechnical Commission (IEC), "Electrical Energy Storage," White Paper, Geneva/Switzerland, pp. 17–34, December 2011.

2. Rastler, D., "Electricity Energy Storage Technology Option," Electric Power Research Institute, December 2010.

3. Doetsch, C., "Electrical energy storage from 100 kW—State of the art technologies, fields of use," 2nd International Renewable Energy Storage Conference, Bonn, Germany, November 2007.

4. Xie, S., and L. S. Wang, "Industry Trends — Issue 9," China Energy Storage Alliance, January 2012.

5. The ADELE project in Germany uses adiabatic compression, while the SustainX, General Compression, and LightSail projects in the US use isothermal compression. See "ADELE — Adiabatic Compressed-Air Energy Storage (CAES) for Electricity Supply," RWE; "SustainX's ICAES," SustainX; and "General Compression, Who We Are," General Compression.

6. Nakhamkin, M., "Novel Compressed Air Energy Storage Concepts," developed by Energy Storage and Power Consultants (ESPC) and presented to EESAT, May 2007.

7. Inage, Shin-ichi, "Prospects for Large-Scale Energy Storage in Decarbonised Grids," International Energy Agency, Report, 2009.

8. Schossig, P., "Thermal Energy Storage," 3rd International Renewable Energy Storage Conference, Berlin, Germany, November 2012.

9. Fairley, P., http://spectrum.ieee.org/energy/environment/largest-solar-thermal-storage-plant-to-start-up, Article 2008, Accessed ~~July 2011~~ May 2023 .

10. Jahnig D. et al., "Thermo-chemical storage for solar space heating in a single-family house," 10th International Conference on Thermal Energy Storage, Ecostock 2006, New Jersey, May/June 2006.

11. Tamme, R., "Development of Storage Systems for SP Plants," DG TREN—DG RTD Consultative Seminar on Concentrating Solar Power, Brussels, Belgium, June 2006.

12. Bullough, C., "Advanced Adiabatic Compressed Air Energy Storage for the Integration of Wind Energy," European Wind Energy Conference and Exhibition, London, GB, November 2004.

Statement of Problem and Substantiation for Public Input

Accessed link and verified that it is active. Accessed date was updated to show that the link is active and was verified.

Submitter Information Verification

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Submittal Date: Thu May 18 08:41:15 EDT 2023

Committee: ESS-AAA

Committee Statement

Resolution: FR-58-NFPA 855-2023

Statement: It is not customary or necessary to show that the paper was accessed on any given date (H.1.2.14.1.9) and corrects H.1.2.14.1.5 to be consistent with all the other references.

Public Input No. 306-NFPA 855-2023 [Section No. H.1.2.14.2.3]

H.1.2.14.2.3 UL Publications.

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

CAN/ UL 9540A, *Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems*, ~~2021~~ 2019 .

Statement of Problem and Substantiation for Public Input

Update UL standards to the current edition and revision.

Related Public Inputs for This Document

Related Input	Relationship
Public Input No. 302-NFPA 855-2023 [Section No. 2.3.7]	
Public Input No. 304-NFPA 855-2023 [Section No. H.1.2.11]	

Submitter Information Verification

Submitter Full Name: Kelly Nicolello
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Submittal Date: Thu Jun 01 11:44:43 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: FR-59-NFPA 855-2023

Statement: Revises CAN/UL 9540A heading to reflect correct co-sponsorship of this testing document.

Public Input No. 130-NFPA 855-2023 [Section No. H.1.2.14.3]

H.1.2.14.3 Other Publications.

DNVGL Battery Safety Joint Development Project Report, “Technical Reference for Li-ion Battery Explosion Risk and Fire Suppression,” January 7, 2020.

Marioff Corporation—Fire Test Summary #57/BR/AUG15, “HI-FOG® Systems for Protection of Li-ion Rooms,” August 2015.

“Fire Safety Testing Data Analysis Supplement for NYC Outdoor ESS,” NY Solar Map, City University of New York (CUNY). https://nysolarmap.com/media/2041/fire-safety-testing-data-analysis-supplement-for-nyc-outdoor-ess_v1.pdf, Accessed May 2023.

Statement of Problem and Substantiation for Public Input

This includes a description of when the link was accessed to show that the link was actually verified and is active.

Submitter Information Verification

Submitter Full Name: Kevin Fok
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Submittal Date: Thu May 18 07:36:02 EDT 2023
Committee: ESS-AAA

Committee Statement

Resolution: It is not necessary to show a particular paper or publication was accessed.