FIRE DEPARTMENT • CITY OF NEW YORK

CERTIFICATE OF FITNESS

STUDY MATERIAL

FOR

B-28 Supervision of Stationary Energy Storage Systems (ESS)

W-28 Supervision of Mobile Energy Storage Systems (ESS) (Citywide)

This book is provided to the public for free by the FDNY.

TO HELP YOU UNDERSTAND WHICH CERTIFICATE OF FITNESS YOU SHOULD APPLY FOR, PLEASE NOTE THE FOLLOWING:

ALSO INCLUDED IN THIS BOOKLET YOU WILL FIND THE FOLLOWING:
NOTICE OF EXAMINATION (NOE)

ATTENTION: The material presented in this booklet is highly comprehensive; it provides information for applicants taking the above Certificate of Fitness examination. As the scope of Energy Storage Systems is highly technical, FDNY recommends that applicants devote sufficient amount of time and effort in preparation before taking the B-28/W-28 Certificate of Fitness examination.

Specially designed Reference Material WILL BE provided to applicants during the exam. This study material will NOT be provided to applicants during the exam. It is critical that applicant understands the information presented in this booklet.

Contents

EXAM SPECIFIC INFORMATION FOR B-28/W-28 CERTIFICATE OF FITNESS

Save time and submit application online!

Applicants who submitted and paid online for an exam before arriving at the FDNY will not need to wait in line to enter the FDNY.

It can take about 30 minutes to complete. Completing application and paying online will eliminate waiting outside in the long lines.

Simplified instructions for online application and payment can be found here:
http://www1.nyc.gov/assets/fdny/downloads/pdf/business/fdny-business-cof-individuals-short.pdf

Create an Account and Log in to:
https://fires.fdnycloud.org/CitizenAccess/SAML/NYCIDLogin.aspx

REQUIREMENTS FOR CERTIFICATE OF FITNESS APPLICATION

General requirements:
Review the General Notice of Exam:

https://www1.nyc.gov/assets/fdny/downloads/pdf/business/general-notice-of-exam-cof.pdf

Special requirements for B-28/W-28 Certificate of Fitness:

(1) B-28/W-28 COF applicants need to submit the Battery System Training Verification Letter. Applicant must present an affidavit from the battery system owner, manufacturer or the installer of the battery system stating that this applicant has been trained and is knowledgeable with the battery system he/she will supervise. The sample of this verification letter is provided on the following pages or the following link:
https://www1.nyc.gov/assets/fdny/downloads/pdf/business/b28-w28-verification-letter.pdf

(2) B-28/W-28 COF applicants need to submit the Employer Recommendation Letter. Sample recommendation letter is provided on the following pages or the following link:
https://www1.nyc.gov/assets/fdny/downloads/pdf/business/b28-w28-sample-letter.pdf

(3) W-28 and B-28 COF holders can obtain W-27 COF without taking the W-27 exam but only pay the $25 application fee.

(4) W-28 COF holder is only authorized to supervise the mobile battery system. W-28 COF is citywide.

(5) B-28 COF is premises related, the B-28 COF authorizes the holder to supervise any indoor and outdoor stationary battery system that is NOT designated as a mobile system.

Application fee (Cash is NO LONGER ACCEPTED):

Pay the **$25** application fee online or in person by one of the following methods:

- Credit card (*American Express, Discover, MasterCard, or Visa*)
- Debit card (*MasterCard or Visa*)
- In person: Personal or company check or money order (*made payable to the New York City Fire Department)*

A convenience fee of 2% will be applied to all credit card payments.

For fee waivers submit: ***(Only government employees who will use their COF for their work- related responsibilities are eligible for fee waivers.)***

- A letter requesting fee waiver on the Agency's official letterhead stating applicant full name, exam type and address of premises; ***AND***
- Copy of identification card issued by the agency

REQUIREMENTS FOR ALTERNATIVE ISSUANCE PROCEDURE (AIP)

No AIP available. This certificate of fitness can only be obtained by passing the computer exam at the FDNY Headquarters.

EXAM INFORMATION

The **B-28/W-28** exam will consist of **75** multiple-choice questions, administered on a "touch screen" computer monitor. It is a time-limited exam. A passing score of at least 70% is required in order to secure a Certificate of Fitness.

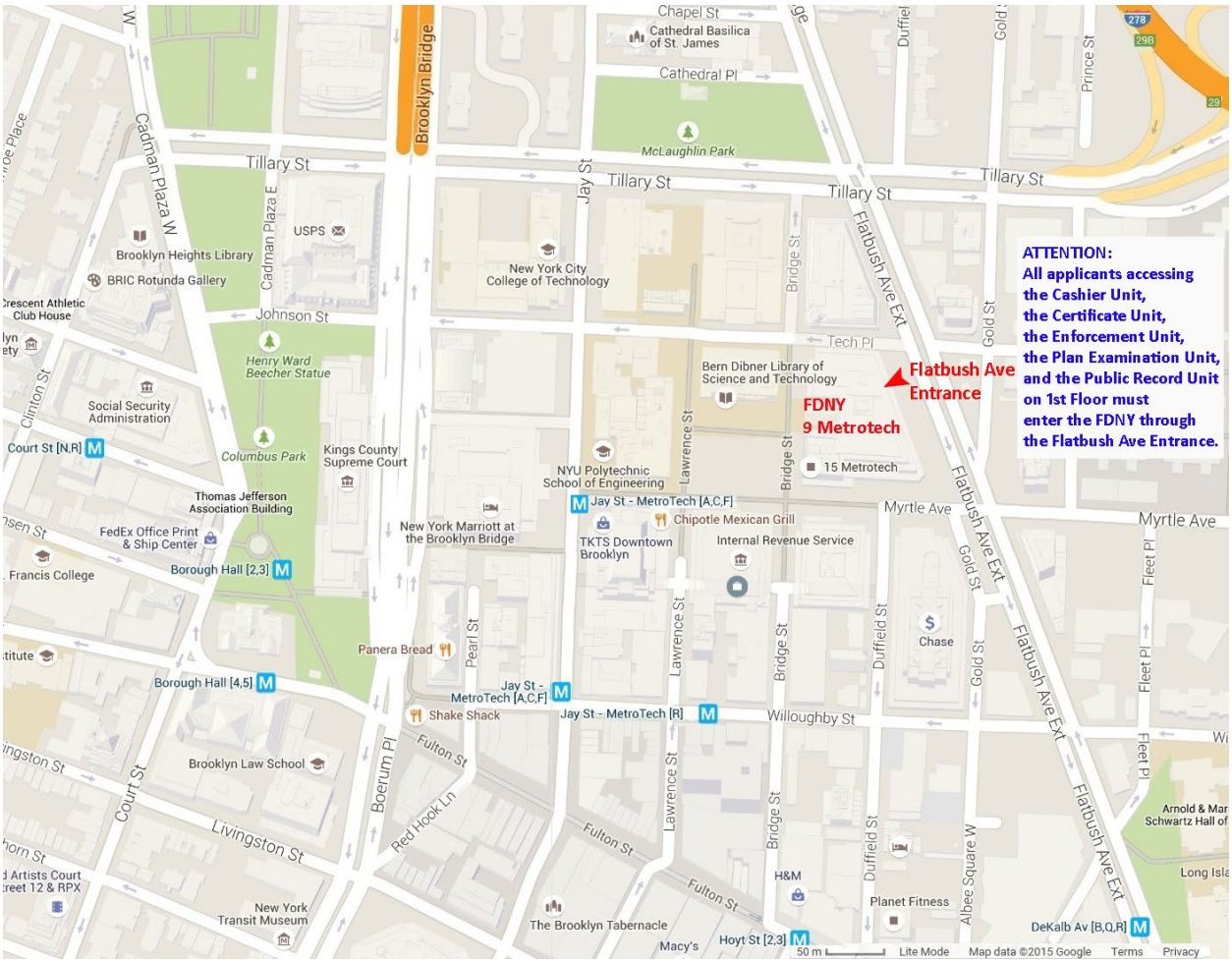
Special material provided during the test:

The reference material in Appendix A will be provided when you take the test at Metro Tech. However, the booklet will not be provided to you during the test.

Call (718) 999-1988 for additional information and forms.

Please always check for the latest revised booklet at FDNY website before you take the exam.
http://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-b28-w28-study-material.pdf

Exam site: **FDNY Headquarters,** 9 MetroTech Center, Brooklyn, NY. Enter through the **Flatbush Avenue entrance (between Myrtle Avenue and Tech Place)**.



RENEWAL REQUIREMENTS

General renewal requirements:

Review the General Notice of Exam:
https://www1.nyc.gov/assets/fdny/downloads/pdf/business/general-notice-of-exam-cof.pdf

Special renewal requirements.

B-28/W-28 Certificate of Fitness must be renewed every **3** ***YEAR***. The renewal fee is **$15**. FDNY also reserves the right to require the applicants to take a re-examination upon submission of renewal applications.

You will receive a courtesy notice of renewal 90 days before the expiration date. However, it is your responsibility to renew your Certificate. It is very important to renew your COF before it expires. Renewals submitted 90 days (up to one year) after the expiration date will incur a $25 penalty in

addition to the renewal fee. Certificates expired over one year past expiration date will not be renewed. New exams will be required.

The FDNY strongly recommends the B-28/W-28 COF holders to renew the COF on-line. To learn the simplified on-line renewal:

https://www1.nyc.gov/assets/fdny/downloads/pdf/business/cof-simplified-renewal-short.pdf

QUESTIONS?

FDNY Business Support Team: For questions, call 311 and ask for the FDNY Customer Service Center or send an email to FDNY.BusinessSupport@fdny.nyc.gov.

Energy Storage System (ESS) Training Verification Letter

Please **print** or **type** the information below. **This form must be NOTARIZED.**

This verification letter is to verify that _____(Name of Applicant) has been trained in the energy storage system that the applicant will supervise.

I am ☐ the owner of the battery system
☐ the manufacturer of the battery system
☐ the installer of the battery system

I affirm that I have the comprehensive knowledge and required material to administer the training for the applicant that listed in this letter.

The size of the energy storage system (ESS) is _____ kWh and the type of the energy storage system (ESS) is (check the one that applies)

☐ Lithium-ion
☐ Flow
☐ Nickel cadmium
☐ Nickel metal hydride
☐ Flooded (Vented) Lead acid
☐ Valve-Regulated Lead Acid (VRLA)
☐ Other: _____ (please specify)

The remote monitoring company of this energy storage system's Energy Storage Management System (ESMS) is _____ (company name) and its contact phone number is: _____.

Section A - Premises Verification

☐ This system is a mobile energy storage system, list the addresses of all locations that are approved by the FDNY (add another sheet if needed):

_____
_____
_____

☐ This system is a stationary storage battery system, the energy storage system located at:

_____

(address of the energy storage system, if it is on rooftop, it should also be specified)

Section B - Energy Storage System (ESS) Training Verification

I, _____, hereby certify that the applicant has been trained and obtained the following information related to the energy storage system that he/she will supervise. (All items below must be marked "Yes" or "N/A" to proceed)

Information	
The type, size of the battery systems	☐ Yes
The possible hazards of the energy storage system	☐ Yes
The area that the energy storage system serves and the impact of shutting down the entire system	☐ Yes
Safety Data Sheets (SDS) of the energy storage system	☐ Yes
The Emergency Management Plan	☐ Yes
Commissioning plan	☐ Yes
Decommissioning plan (end-of-life decommissioning plan and emergency decommissioning plan)	☐ Yes
The type of fire extinguishing systems will be installed and designed hold time (if applicable, refer to the section 5.1 of this booklet)	☐ Yes ☐ N/A, there is no fire extinguishing systems.
Procedures for safe shutdown, de-energizing, or isolation of equipment and systems under emergency conditions	☐ Yes
Procedure for notification in need of maintenance or service	☐ Yes
Procedure for notifications in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions	☐ Yes
Contact information of the ESMS monitoring facility and the SMEs	☐ Yes
The general function of the ESMS including how this system monitors or manages the energy storage performance and status of health, safe operation, notifications, etc.	☐ Yes
Standoff distances for electrical hazards and explosion hazards	☐ Yes
Procedures for annual inspection	☐ Yes
The planned/actual location of:	
Required signs	☐ Yes
E-stops	☐ Yes
Disconnect switches (i.e. "lock-out, tag-out")	☐ Yes
The vent and the manual activation switch of the smoke/gas purge system	☐ Yes ☐ N/A, there is no smoke/gas purge system.
The deflagration vents and/or exhaust outlets	☐ Yes ☐ N/A, there is no deflagration venting/explosion prevention system.

On this _____ day of _____, in the year _____, I have hereunto affixed my signature and I affirm that all statements made on this application are true under the penalties of perjury. I understand that:

- any intentional falsification of this letter can be grounds for the denial, non-renewal, suspension or revocation of the Certificate of Fitness as applies to the applicant;
- all statements made in connection with the application are subject to investigation and verification;
- the FDNY representative may ask the B-28/W-28 Certificate of Fitness holder without prior notice to demonstrate the required knowledge listed in this verification letter to verify his/her proficiency in supervising the energy storage system upon inspection.

_____ _____

Printed Name of owner, manufacturer or installer | Job Title

_____ Signature of owner, manufacture or installer (**Sign only before a Notary**)	_____ Signature of Notary	**NOTARY PUBLIC: [Notary Seal]** **My commission expires: ___/___/____**

B-28/W-28 Sample Recommendation Letter

COMPANY NAME
BUSINESS ADDRESS

Fire Department
Bureau of Fire Prevention
9 Metro Tech Center
Brooklyn, NY 11201-3857

Date: _____

Dear Sir/Madam:

I am pleased to recommend _____ (Name of Applicant) to apply for the:

☐ B-28 Certificate of Fitness to supervise the stationary energy storage system (ESS) located at:

_____

☐ W-28 Certificate of Fitness to supervise the mobile energy storage system (approved locations are listed in the Energy Storage System Training Verification Letter)

He/she has _____ (Years/Months) of relevant experience and has obtained all required training regarding the energy storage system mentioned in the Training Verification Letter from the qualified personnel. I confirm that this candidate has been trained and is capable in supervising the energy storage system and providing required information to the first responders during a fire or non-fire emergency incident. This candidate is of good character and is physically able to perform the functions required by this Certificate of Fitness.

I affirm that the candidate has also been trained and is knowledgeable about the

☐ the operational purpose of this system and ☐ the area(s) served by this system

and the locations of

☐ the Fire Department Connection ☐ N/A; ☐ the manual pull stations ☐ N/A

☐ the hydrants ☐ N/A; ☐ the standpipe systems ☐ N/A

☐ This energy storage system (ESS) is an indoor system. ☐ N/A

I affirm that the candidate has also been trained and is knowledgeable about the

☐ the location(s) and types of the portable fire extinguishers (the candidate knows whether or not the portable fire extinguishers can be used on the energy storage system)

☐ Building Information Card (BIC) ☐ N/A

☐ Fire and Emergency Preparedness Plans ☐ N/A

On this _____ day of _____, in the year _____, I have hereunto affixed my signature and I affirm that all statements made on this form are true under the penalties of perjury. I understand that

- all statements made in connection with the application are subject to investigation and verification
- any intentional falsification of this letter can be grounds for the denial, non-renewal, suspension or revocation of the B-28/W-28 Certificate of Fitness as applies to the candidate
- FDNY representative may question the B-28/W-28 Certificate of Fitness holder as to the required building or site information listed above to verify their knowledge during inspection.

_____ _____ _____

(Printed name of Employer) (Employer's title) (Signature of Employer)

NOTE: ***The recommendation letter should be on employer's letterhead. If not on employer's letterhead, signature must be notarized.***

STUDY MATERIAL AND TEST DESCRIPTION

About the Study Material

This material will help you prepare for the examination for the Certificate of Fitness for Supervision of Stationary Energy Storage System. The exam covers this entire booklet, but not the appendix. **It will not be provided to you during the test. It is critical that you read and understand this booklet to help increase your chance of passing this exam. The reference material will be provided to you during exam.** The study material does not contain all of the information you need to know to supervise the energy storage system (ESS). It is your responsibility to become familiar with all applicable rules and regulations of the City of New York, even if they are not covered in this study material. In order to properly prepare for this exam, you need to be familiar with the 2022 New York City Fire Code sections FC608, FC901.6, and FC907, Fire Department Rules 3RCNY 608-01 and 3RCNY 907-01, and NFPA 855 (2022 Ed.).

About the Test

The B-28/W-28 exam will consist of 75 multiple choice questions, administered on a "touch screen" computer monitor. It is a time-limited test. Only one answer is correct for each question. If you **DO NOT** answer a question or mark more than one alternative, your answer will be scored as incorrect. A score of 70% correct is required on the examination in order to secure a Certificate of Fitness. Read each question carefully before marking your answer. There is no penalty for guessing.

Sample Questions

The following questions represent the "format" of the exam questions, not the content of the real exam.

1. Which of the following are allowed to be used/displayed while taking a Certificate of Fitness examination at 9 Metro Tech Center?

I. cellular phone
II. Study material booklet
III. Reference material provided by the FDNY
IV. Mp3 player

A. III only
B. I, II, and III
C. II and IV
D. I only

Only reference material provided by the FDNY is allowed to be used during Certificate of Fitness examinations. Therefore, the correct answer would be A. You would touch "A" on the computer terminal screen.

2. If you do not know the answer to a question while taking an examination, whom should you ask for help?

A. the person next to you
B. the firefighters
C. the examiner in the testing room
D. you should not ask about test questions since FDNY staff cannot assist applicants

You should not ask about examination questions or answers since FDNY staff cannot assist applicants with their tests. Therefore, the correct answer would be D. You would touch "D" on the computer terminal screen.

3. If the screen on your computer terminal freezes during your examination, whom should you ask for help?

A. the person next to you
B. the firefighters
C. the examiner in the testing room
D. the computer help desk

If you have a computer related question, you should ask the examiner in the testing room. Therefore, the correct answer would be C. You would touch C. You would touch "C" on the computer terminal screen.

INTRODUCTION

This study material will help you prepare for the written examination for the B-28/W-28 Certificate of Fitness (COF) for Supervision of Energy Storage Systems (ESS).

B-28/W-28 Certificate of Fitness holders should be aware that they may be required to demonstrate their knowledge and proficiency in their duties related to their Certificate at the time of original and renewal applications, and at any time Fire Department representatives are conducting an inspection of a premises. The Fire Department (FDNY) can deny, not renew, suspend or revoke a Certificate of Fitness for misconduct, which would include the failure of the Certificate of Fitness holder to properly fulfill their duty for any reason.

The Certificate of Fitness holder must keep the Certificate of Fitness readily available for inspection by any representative of the Fire Department and at all times while operating or supervising an energy storage system (ESS) facility for which the Certificate of Fitness is required.

In addition to any other penalties provided by law, misconduct on the part of an applicant or holder of a Certificate of Fitness shall be grounds for denial, non-renewal, suspension or revocation of a certificate, and denial of an application for a certificate or the opportunity to take a certificate examination. Such misconduct includes, but is not limited to:

- The failure of Certificate of Fitness holders to properly fulfill their duties
    - i.e. COF holders will be held accountable when they fail to report a spill, fire, excessive smoking/vaporizing or smoldering, or any other hazardous condition, and they may have their Certificate of Fitness revoked for such failure.
- Any false and fraudulent conduct in connection with an application for a certificate or the duties of a certificate holder, including:
    - False or fraudulent statements or submissions
    - Unauthorized changes or use of a Certificate of Fitness or possession of a fraudulent Certificate of Fitness
    - Cheating on Certificate of Fitness examination
    - Impersonating another person or allowing oneself to be impersonated
- The failure of Certificate of Fitness holders to promptly notify the Fire Department of any change in the applicant’s or Certificate of Fitness holder’s residence address, or work location
- Any other conduct that decreases the integrity or reliability of an applicant or Certificate of Fitness holder
- Compromising the integrity or confidentiality of a Fire Department examination

PURPOSE OF FIRE CODE Section 608

The Fire Code Section 608 govern all energy storage systems, including emergency power, standby power, uninterruptible power and mobile systems.

PURPOSE OF RULE 3 RCNY 608-01

The rule 3 RCNY 608-01 was adopted to establish standards, requirements and procedures for the design, installation, operation, inspection, maintenance, and decommissioning of outdoor/rooftop stationary storage energy storage systems and mobile energy storage systems. All outdoor/rooftop stationary energy storage systems or mobile energy storage systems shall additionally comply with this Rule requirements.

PURPOSE OF THE STUDY MATERIAL

The study material includes information taken from the 2022 NYC Fire Code, NYC Fire Department Rules, and various NFPA standards.

Unless otherwise specified, all requirements apply to the outdoor stationary energy storage system should also apply to the rooftop stationary energy storage system or mobile energy storage system.

This study material covers:

(1) Indoor/outdoor/rooftop stationary storage systems that use various types of new energy storage technologies, including lithium-ion, flow, lead acid, nickel-cadmium and nickel metal hydride batteries.
(2) All energy storage uses, including stationary energy storage systems installed on a mobile trailer (or other form of mobile installation).

This study material does NOT cover:

Outdoor stationary energy storage systems with an aggregate rated energy capacity of not more than 250 kWh that are a component of individual electric motor vehicle (EV) charging stations and used for the purpose of EV charging.

DEFINITIONS

Abnormal Conditions. When one or more parameters that govern the operation of a system are outside their control limits.

Alarm Signal. A signal indicating an emergency requiring immediate action, such as a signal indicative of fire.

Ampere-Hour (Ah). Ah is an abbreviation for ampere-hour, or amp-hour. This describes the charge capacity of a battery, or how much current can be delivered at a constant rate as the battery is depleted over the course of one hour.

Approved. Acceptable to the Fire Commissioner. In reference to construction documents, the determination by the Fire Department after full examination that submitted construction documents comply with NYC Fire Code and other applicable laws and rules. In reference to materials, the determination by the commissioner that material is acceptable for its intended use.

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

Automatic. As applied to fire protection devices, any device, equipment or system that initiates system function as a result of a predetermined temperature rise, rate of temperature rise, or combustion products, without the necessity for human intervention.

Battery Module. A module consists of number of cells generally connected in either series or parallel.

Battery String. A battery string or bank comprises a number of cells/batteries connected in. series to produce a battery or battery string with the required usable voltage/potential e.g. 6V, 12V, 24V, 48V, 110V. Ah.

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

Battery Rack. A device used to vertically store battery modules.

Cell. A single connection between the plates and electrolyte which produces a specific voltage (i.e. one AA battery has one cell). In battery systems there are multiple cells in order to provide enough voltage and energy for the entire load.

Central Station. A facility that receives alarm signals from a protected premises and re-transmits or otherwise reports such alarm signals to the Fire Department.

Certificate of Approval. A written statement issued by the FDNY commissioner, certifying that an article, device or equipment, or type, class or kind thereof, has been examined, tested and approved for a specific purpose or use in conformity with the requirements of the construction codes, the Fire Code or the Fire Department Rules.

Commissioning of the System. A systematic process that provides documented confirmation that the stationary energy storage system and all associated fire protection systems function according to the intended design criteria set forth in the project documents and satisfy the operator and/or owner's operational needs, including compliance with applicable laws, regulations, codes, and standards. This process should also include verification that the energy storage system has been installed and activated in accordance with manufacturer's specifications.

Converters. Convert the voltage of an electric device, usually alternating current (AC) to direct current (DC).

Decommissioning of the System. A process that verifies and documents that the energy storage system has been completely and safely removed from service and the hazardous components properly disposed of in accordance with minimum code requirements, applicable regulations and manufacturer's instructions. Decommissioning can be Emergency Decommissioning; required when the ESS suffers a thermal runaway or other failure or Planned Decommissioning; which occurs at the expected termination of the ESS when it reaches the end of its useful life.

Dedicated Use Building. A building housing a stationary energy storage system that 44 allows human entry (walk-in) but is not designed or used for human occupancy.

Deflagration. Propagation of a rapid combustion zone creating over-pressure at a velocity that is less than the speed of sound in the unreacted medium, which may be caused by a thermal runaway condition. (NFPA 68-2018: Standard on explosion Protection by Deflagration Venting.)

Disconnect Switch. The purpose of this switch is to electrically isolate the ESS from the utility grid and provide a physical break in the electrical circuit. *(See e-stop).*

Direct Current. As opposed to alternating current or AC which is commonly found in homes and business batteries produce direct current or DC. Note: Non-contact voltage testers will NOT detect direct current. These devices were designed to detect alternating current as the devices can see the alternating wave form of AC.

E-Stop. An emergency device used to stop an energy storage system from charging. ***Note:*** It will NOT deplete the energy already stored within the batteries associated with the system. (*See disconnect switch*).

Energy Storage Systems (ESS), Stationary.

A rechargeable system for the storage of electrochemical energy, designed as a stationary installation (including mobile systems) and consisting of one or more interconnected storage batteries, capacitors, inverters and other electrical equipment. A stationary energy storage system is typically used to provide electrical power and includes associated fire protection, explosion mitigation, ventilation and/or exhaust systems. Stationary energy storage systems include the following types of systems:

- **Indoor System.** A stationary energy storage system installed inside a building.
- **Mobile System.** A stationary energy storage system mounted on a trailer or otherwise installed for mobile use.

- **Outdoor System.** A stationary energy storage system installed outdoors, including mobile systems and systems installed on a rooftop.

One or more devices, assembled together, capable of storing energy in order to supply electrical energy at a future time to the local power loads, to the utility grid, or for grid support.

Fire Alarm Control Panel. FACP is a system component that monitors inputs and control outputs through various circuits. The primary purpose of the fire alarm control panel is to process signals received from initiating devices and to activate appropriate signals and outputs.

Fire Alarm Box, Manual. A manually operated device used to initiate an alarm signal.

Fire Alarm Signal. A signal initiated by a fire alarm-initiating device such as a manual fire alarm box, automatic fire detector, water-flow switch, or other device whose activation is indicative of the presence of a fire or fire signature.

Fire Alarm System. Any system, including any interconnected fire alarm sub-system, of components and circuits arranged to monitor and annunciate the status of fire alarm or supervisory signal-initiating devices.

Fire Apparatus Access Road. A road that serves to provide access for fire apparatus from a public street to the frontage space of one or more buildings not directly fronting on a public street. A fire apparatus access road includes any road that serves such purpose whether denominated as a driveway, parking lot lane, private road or private street.

Fire Department Connections (FDC). A connection, normally on the exterior of the building, through which the Fire Department can pump supplemental water into the sprinkler system, standpipe, or other system furnishing water for fire extinguishment to supplement existing water supplies (**formerly known as a Siamese connection).**

Fire Detector, Automatic. A device designed to detect the presence of a fire signature and to initiate action.

Fire Extinguishing System. An approved system of devices and equipment which detects a fire and discharges an approved fire extinguishing agent onto or in the area of a fire. Such term includes automatic systems and, where such systems are authorized by this code or the Building Code, manually activated systems.

Fire Protection System. Approved devices, equipment and systems or combinations of systems used to detect a fire, activate an alarm, extinguish or control a fire, control or manage smoke and products of a fire or any combination thereof, including fire extinguishing systems, fire alarm systems, sprinkler systems and standpipe systems.

Gas Detection System. A system or portion of a combination system that utilizes one or more stationary sensors to detect the presence of a specified gas at a specified concentration and initiate one or more responses required by this code, such as notifying a responsible person, activating an alarm signal, or activating or deactivating equipment. A self-contained gas detection and alarm device is not classified as a gas detection system.

Initiating Device. A system component that originates transmission of a change-of-state condition, such as in a smoke detector, manual fire alarm box, or supervisory switch.

Inverters. Convert direct current (DC) to alternating current (AC).

Immediately. Without any delay, but up to a maximum of 15 minutes.

Kilowatt-Hour (kWh). A measurement of electrical energy. KWh is an abbreviation for kilowatt hour. If energy is transmitted or used at a constant rate (power) over a period of time, the total energy in kilowatt hours is equal to the power in kilowatts multiplied by the time in hours. The kilowatt hour is commonly used as a billing unit for energy delivered to consumers by electric utilities.

Listed. A material, device, equipment or system included on a list published by a nationally recognized testing laboratory or other approved organization performing product evaluations that maintains periodic inspection of production of such listed material, device, equipment or system, and whose listing indicates compliance with nationally recognized standards and designates suitable usage.

Megawatt Hours (MWh). A measurement of electrical energy.

Out-of-Service System. A fire protection system that is not fully functional; or whose operation is impaired or is otherwise not in good working order.

One-Way Emergency Communications System. One-way emergency communications systems are intended to broadcast information, in an emergency, to people in one or more specified indoor or outdoor areas. It is intended that emergency messages be conveyed either by audible, visible, or textual means, or by any combination thereof.

Pre-Signal System. A fire alarm system having a feature that allows initial fire alarm signals to sound in a constantly attended central location and for which a human action is subsequently required to achieve a general alarm, or a feature that allows the control equipment to delay the general alarm by more than one minute (but not more than 3 minutes) after the start of the alarm processing.

Recommissioning of an Existing System. A process that verifies and documents that a repaired or reconditioned energy storage system functions in accordance with its initial commissioning and according to minimum code requirements, listing requirements and manufacturer's published instructions.

Residential Group R Occupancies.

Group R-1 occupancies containing sleeping units where the occupants are primarily transient in nature, including:

Boarding houses (transient) with more than 10 occupants

Congregate living facilities (transient) with more than 10 occupants

Hotels/Motels (transient)

Group R-2 occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, including:

Apartment houses

Congregate living facilities (non-transient) with more than 16 occupants, including boarding houses (non-transient), convents, dormitories, fraternities and sororities, monasteries

Hotels/Motels (non-transient)

Vacation timeshare properties

Group R-3 occupancies where the occupants are primarily permanent in nature and not classified as R-1, R-2, R-4 or I, including:

Buildings that do not contain more than two dwelling units

Care facilities that provide accommodations for five or fewer persons receiving care

Congregate living facilities (non-transient) with 16 or fewer occupants, including boarding houses (non-transient), convents, dormitories, fraternities and sororities, monasteries.

Lodging houses (transient) with 5 or fewer guest rooms and 10 or fewer occupants

Safety Data Sheet (SDS). A document prepared in accordance with the regulations of the United States Department of Labor, as set forth in 29 CFR Part 1910.1200 or a federally approved state OSHA plan which sets forth information concerning a hazardous material. An SDS is a standardized document that contains important occupational safety and health hazard data for workers and emergency first responders.

Smoke Detector. A listed device that senses visible or invisible particles of combustion.

Standpipe System. Piping installed in a building or structure that serves to transfer water from a water supply to hose connections at one or more locations in a building or structure for fire-fighting purposes.

Storage Battery. An electrochemical device, equipment or system designed to store and generate electrical energy.

Storage Battery Types

Flow battery. A storage battery that stores and generates an electrical current by ion exchange through a membrane separating liquid electrolytes.

Lead acid battery. A storage battery that is comprised of lead electrodes immersed in sulfuric acid electrolyte, including vented (flooded) or valve regulated lead acid (VRLA) batteries.

Valve-regulated lead-acid (VRLA) battery. A lead-acid battery consisting of sealed cells furnished with a valve that opens to vent the battery whenever the internal pressure of the battery exceeds the ambient pressure by a set amount. In VRLA batteries, the liquid electrolyte in the cells is immobilized in an absorptive glass mat (AGM cells or batteries) or by the addition of a gelling agent (gel cells or gelled batteries).

Vented (flooded) lead-acid battery. A lead-acid battery consisting of cells that have electrodes immersed in liquid electrolyte. Flooded lead-acid batteries have a provision for the user to add water to the cell and are equipped with a flame-arresting vent that permits the escape of hydrogen and oxygen gas from the cell in a diffused manner such that a spark, or

other ignition source, outside the cell will not ignite the gases inside the cell.

Lithium-ion (Li-ion) battery. A storage battery in which an electrical current is generated by lithium ions embedded in a carbon graphite or nickel metal-oxide substrate placed in a high-viscosity carbonate mixture or gelled polymer electrolyte.

Lithium Metal Polymer Battery. A storage battery in which an electrical current is generated by the interaction between lithiated positive active material electrically separated from metallic lithium or lithiated negative active material, and nonaqueous liquid or polymerized electrolytes.

Nickel Cadmium (Ni-Cd) Battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative active material contains cadmium, and the electrolyte is potassium hydroxide.

Nickel Metal Hydride (NiMH) Battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative active material is a hydrogen- absorbing alloy, and the electrolyte is potassium hydroxide.

Nonrecombinant Battery. A storage battery in which, under conditions of normal use, 26 hydrogen and oxygen gases created by electrolysis are vented into the air outside of the battery.

Recombinant Battery. A storage battery in which, under conditions of normal use, hydrogen 29 and oxygen gases created by electrolysis are converted into water inside the battery instead of 30 venting into the air outside of the battery.

Stationary storage battery. A storage battery designed for use in a stationary installation, in which electrochemical cells are interconnected to supply a nominal voltage of direct current power. The nominal voltage rating of a stationary storage battery is a function of the number of cells connected in a series, and the discharge capacity is a function of the size of the cells. Stationary storage batteries are characterized by their ability to be restored to a fully charged condition by reversing the flow of the electric current after discharge.

Storage Battery Unit. A storage battery system in the configuration in which it was tested and listed to Underwriters Laboratories Standard 9540 (UL Standard 9540), including any cabinet or other enclosure.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Supervisory Signal. A signal indicating the need for action in connection with the supervision of guard tours, fire extinguishing systems or equipment, fire alarm systems or the maintenance features of related systems.

Thermal Imaging Camera. (TIC) is a thermographic camera that converts infrared light emitted from surfaces to visible light, displayed by the camera's viewing screen. Such cameras allow firefighters to see areas of heat or thermal energy through smoke, darkness, or heat-permeable barriers. Thermal imagers also enable the inspection of equipment for abnormal operation (e.g., loose connections, overloaded components, loss of coolant, moisture intrusion, etc.)

Thermal runway. The condition when an electrochemical battery cell increases its temperature

through self-heating in an uncontrollable fashion. The thermal runaway progresses when the cells generation of heat is at a higher rate than the heat it can dissipate. Thermal runaway may lead to off-gassing, fire and deflagration.

Trouble Signal. A signal initiated by the fire alarm system or device indicative of a fault in a monitored circuit or component.

Two-Way Emergency Communications System. Two-way emergency communications systems are divided into two categories, those systems that are anticipated to be used by building occupants and those systems that are to be used by fire fighters, police, and other emergency services personnel. Two-way emergency communications systems are used to both exchange information and to communicate information such as, but not limited to, instructions, acknowledgement of receipt of messages, condition of local environment, and condition of persons, and to give assurance that help is on the way.

Unnecessary Alarm. An alarm signal transmitted by a fire alarm system which functioned as designed, but for which a Fire Department response proved unnecessary. An example of an unnecessary alarm is an alarm triggered by smoke from a lit cigarette in a non-smoking area, when the presence of such smoke does not implicate fire safety concerns.

Unwarranted Alarm. An alarm signal transmitted by a fire alarm system which failed to function as designed because of improper installation, improper maintenance, malfunction, or other factor. Examples of unwarranted alarms are alarms resulting from improper smoke detector placement, improper detector setting for installed location, lack of system maintenance, and control panel malfunction.

CHAPTER 1. CASE STUDIES

The case studies mentioned below are for illustrative purposes to address some issues that may be involved in energy storage system accidents. The case studies do not necessarily reflect the overall incidents.

Sodium-Sulfur Battery Fire (Japan, 2011)

A 2 MW (i.e. 2000 KW) NAS (sodium-sulfur) energy storage system caught fire at the Mitsubishi Materials Corporation plant in Tsukuba, Japan. It took firefighters more than eight hours to control the blaze, and more than 2 weeks to extinguish it.

One faulty cell leaked electrolyte, which created an electrical short path that subsequently destroyed other cells and lead to further heating. Heating was sufficient to cause a release of molten material, which developed into a spreading fire.

Lesson learned:

The manufacturer identified the need for rapid detection of abnormal conditions in the monitoring systems and physical barriers within the product design that limit fire spread and heat transfer during failure events (compartmentalization).

Lead Acid Battery Fire (Oahu, Hawaii, USA, 2012)

The 10 MWh (i.e. 10000 kWh) lead acid battery system was used to buffer electricity smoothing out spikes and low spots in wind power production. The blaze sparked in a metal warehouse with 12,000 lead acid batteries mounted in racks towering more than 6 feet high. An alarm sensor showed a buildup of heat, and video cameras recorded a fire starting in the battery banks. Capacitors in the power electronics are reported to be associated with the failure.

The risks from scalding heat, poisonous fumes, a collapsing structure and the potential for battery explosions kept firefighters outside the warehouse.

The on-site supervisors from the facility suggested the firefighters to wait the fire extinguish itself. However, the stubborn blaze burned for more than 13 hours and continued to smolder after 36 hours.

The response team decided to use a defensive fire attack by focusing on keeping the blaze from spreading to other buildings at the site.

The team used water to cool parts of the building but avoided using it to extinguish the fire out of concerns for electric shock and risks of creating toxic chemical runoff. Instead, they waited for a carbon dioxide extinguishing system to arrive on the scene, but that proved ineffective at quenching the inferno.

Lesson learned:

There should be representative(s) who is/are knowledgeable to provide the information of the battery system and suggest the effective extinguishing methods. So that the firefighters will not have to extinguish a blaze without knowing what chemicals are in play, where the electrical shutoffs are or what kind of fire retardant to use.

Developers and responders need to take proactive steps to ensure they know what they are dealing with when an accident occurs.

Lithium-ion batteries fire (PORT ANGELES, WA, USA, 2013)

The 50kWh batteries system caught fire at The Landing mall, triggering an evacuation of between 50 and 100 people from the waterfront landmark and closures of surrounding streets and City Pier. The batteries are part of a “green energy” system that stores excess power to the building during low power usage, and feeds it back into the system during times of high usage. An electrical fault in the battery system was thought to have caused the fire.

The fire was announced to be extinguished after 2.5 hours.

After the incident, the system was isolated from rest of The Landing mall. However, few days later, the batteries caught fire again. The Fire Department found a single battery that had survived the first fire holding enough to ignite and melt plastic around it.

Lesson learned:

The post-fire battery may re-ignite. The isolation and monitoring of the damaged battery system is critical. There should be at least one watchperson to supervise the site 24/7. If the watchperson becomes aware of a fire or other emergency at the site, he could immediately call 911 and report the emergency. This watchperson should also ensure all entries and exits on the ground level to the site are properly secured. It can reduce the chance of entry by unauthorized persons.

Lithium-ion batteries fire (Franklin, WI, USA, 2016)

The fire began in a utility-scale energy storage system that was still under construction. These batteries were not being charged or discharged and were not connected to a power source or load. The fire started in one of that battery manufacturer's DC power and control compartments of a battery rack within the energy storage system, and once the fire was started in the battery rack DC Power and control compartment it spread to the adjacent batteries.

The fire departments found that the fire was still contained to the single container, but the batteries were indeed releasing their stored energy, which resulted in a lot of smoke and a lot of heat. The reality is that lithium-ion batteries are very energy dense, and once they start releasing their energy, the priority is controlling the pace at which they release that energy. After reading the SDS, the first step the fire department took was to use foam as a precautionary measure. Once the foam was applied, the local fire departments used 500 gallons per minute of water to cool the batteries. Water was appropriately used on these lithium-ion batteries, as listed on the SDS. The water didn't put out the fire, but it did control the spread of heat from the fire.

After few hours, there was no fuel remaining and the fire extinguished.

Lesson learned:

The facility staff is on-site to provide advice to the first responders. Water is considered the best possible extinguishment for lithium ion battery fires to keep the batteries cool in order to keep the fire localized to the container.

Compartmentalization (limiting the amount of material in a space and providing physical barriers between equipment areas) was critical in limiting the extent of the fire spread. Safety data sheets do not contain sufficient information for emergency response to battery system fires. Manufacturers, installers, and fire protection professionals must provide fire mitigation strategies (e.g., containment and suppression) and collaborate with the fire department to develop a thorough emergency response plan.

Lithium Ion Battery Fire (Belgium, 2017)

The fire occurred during the commissioning phase at the battery container at the utility company's test site. The 6MW project was the first time an ESS was to be used for grid Frequency Containment Reserve services in Belgium.

The firefighters arrived rapidly at the site and took several hours for firefighters to control the fire. The fire did not extend to the other containers or other parts of the site. The firefighters have continued to water the containers in order to cool them down.

Lesson learned:

Compartmentalization is critical. Water is considered the best possible extinguishment for lithium ion battery fires to keep the batteries cool.

Twenty-three Fires at different Lithium-ion stationary storage battery systems (South Korea, 2017-2018)

Twenty-three energy storage system fires that have occurred in South Korea since August of 2017. The lithium-ion battery fires resulted in system losses valued at over $32M USD. In January, the government requested to stop operation of existing systems, which resulted the shutdown of 522 ESS units – approximately 35% of the budding market.

Lesson learned:

The government formed an investigation committee of academics, research institutions, laboratories and ESS industry experts to investigate the causes of the fires. Their report was released in 2019 and included four causes for the fires:

1. Insufficient battery protection systems against electric shock.

Systems were not able to properly protect against electrical hazards due to ground faults or short circuits.

2. Inadequate management of operating environment.

Of the 23 fire incidents that occurred, 18 were installed in the mountains or coastal areas. It was concluded that these environments resulted in harsh conditions including large temperature swings, high humidity and elevated levels of dust and particulates which ultimately led to failure modes resulting in fires.

3. Faulty Installations.

It was determined that human error during installations can also lead to system faults resulting in ESS fires. There are some cases include faulty wiring or mechanical damage to the batteries during installation were cited.

4. ESS System Integration.

The integrated protection and management systems were found to be insufficient with the ESS. It was confirmed by the committee that gaps in the integration of the energy storage management system (ESMS), energy management system (EMS), and power management system (PMS) can result in conditions that lead to fire.

Lithium-Ion Batteries Fire/Explosion (Arizona, USA 2019)

The Fire Department responded to an incident at a utility owned ESS used for storing power collected from solar panels. The site was equipped with a clean agent suppression system but not outfitted with a smoke purge system. The Fire Department monitored the building for several hours after their arrival. Although there were no significant heat blooms indicating active fire, a dense smoke appeared at ground level and began to expand horizontally and vent out the door of the ESS. As a standard tactic, the fire department continued to vent the space by leaving the door open. During the ventilation process the firefighters remained in close proximity to the ESS container. Shortly after beginning the ventilation process an explosion occurred seriously injuring two firefighters that were outside the ESS building.

After the incident, the site was secured to prevent any unauthorized entry.

Lesson learned:

The fire department was not sure how to handle Lithium-ion batteries that were contained inside a structure. The only way for them to cool the batteries was to get water inside the structure or container. Having fire department enter into a location that is filled smoke and has no life in danger is an unreasonable risk. There is a tremendous amount of stored electrical energy that is hazardous to the responder. Putting water on these systems in such a close proximity is also a major concern because of the electrical leakage going back to the firefighter holding the hose line. The facility should install proper fire extinguishing system for the first responders to put water to cool down the battery system in a safe distance.

The utility company should provide real-time information for the first responders regarding the status of the battery systems inside the facility. **During the ventilation of a cabinet or container a delayed explosion can take place even if there is no visible fire from the enclosure or structure.**

Conducting ventilation without knowledge of the potential flammable gas concentration contained therein can result in an explosion. Clean agent fire extinguishing systems are not always effective at extinguishing these types of fires. Lithium-ion battery fires produce a high temperature flame front. If the clean agent is not successful in extinguishing this fire, these elevated temperatures have the potential to thermally decompose the clean agent resulting in the production of Hydrogen Fluoride; a toxic gas. When the risk of the flammable atmosphere has been mitigated, the recommended suppression agent is water.

CHAPTER 2. STATIONARY ENERGY STORAGE SYSTEMS

Stationary energy storage systems are commonly used in office buildings and other commercial buildings to provide power for various **NON-EMERGENCY** uses for business operations. The movement to replace fossil fuels with alternative energy sources to address global environmental concerns has prompted the rapid development of new energy storage technologies. In recent years, new energy storage technology has been developed for large-scale power uses, such as storing electrical power for general building use. The batteries can be charged overnight or during other low-demand periods, and provide building electrical power during the daytime when power demand is typically high. Additionally, stationary storage batteries can be used to store power generated by solar panel installations and other local, distributed and renewable energy generating systems. The electrical power stored by these systems, when not needed on-site, can supply power to the public utility's power grid. Examples of this power use include: peak shaving, demand response, grid support and so forth.

Peak Load Shaving: Peak load shaving occurs when customers reduce their energy consumption during times of utility high demand to avoid a spike in consumption. This is possible by temporarily scaling down electrical consumption, activating an on-site power generation system, or relying on a energy storage system.

Demand Response: Demand response (DR) programs offer payments to large electrical energy users that agree to reduce their demand at times when the grid is under stress. These programs help to keep the lights on and energy prices low in the community, while providing utility customers with regular payments for participating. Demand Response is a type of Demand Management.

Grid Support: An electrical grid or power grid, is an interconnected network for delivering electricity from producers to consumers. Grid energy storage is a collection of methods used to store electrical energy on a large scale within an electrical power grid system. Electrical energy is stored during times when production (generation) exceeds consumption and returned to the grid when production falls below consumption. A battery ESS may be strategically located within a geographical area for grid support. Energy storage systems used in grid support scenarios rely on batteries to relieve the load of feeders within a network during peak demand periods in the summer months. If the battery energy storage system is connected to the electrical grid, shutting the entire energy storage system down (e.g. using E-stop) could disrupt public utility operations, potential impacting a large geographic area. For this reason, activating the E-Stop must be carefully considered for potential consequences and is typically done only when necessary for fire or life safety.

During an emergency at an Energy Storage Systems (ESS) site used for Grid Support, mutual consideration between the SME and fire department should consider the impact on the network prior to engaging a full shut down of the facility. During a peak load period, the loss of the full ESS supporting the grid can cause instability resulting low power conditions, loss of customers or a full network blackout based upon existing conditions. Consideration should be given to isolating the affected container as opposed to the whole site. However, Fire Department has full authorization over SME, fire and public safety is the first priority.

Because of their energy density (high-energy generation considering the battery's size and weight), batteries, especially lithium-ion batteries, are increasingly being used in a wide range of applications, including consumer products. However, some batteries are subject to thermal runaway, which occurs when the heat generated by a malfunctioning battery cell or module causes others to fail, potentially generating intense fires and a deflagration hazard and fires that may reignite after being extinguished. Stranded or stored energy is also the potential hazard present in most type of battery energy storage systems. Various highly-publicized incidents have illustrated the fire safety concerns associated with batteries that undergo thermal runaway.

2.1 Five Types of Energy Storage Technologies

This study material focuses on the stationary energy storage systems that uses the following types of new energy storage technologies:

- Lithium-ion batteries
- Lithium metal polymer
- Flow batteries
- Nickel cadmium
- Nickel metal hydride
- Lead acid (Flooded and VRLA)

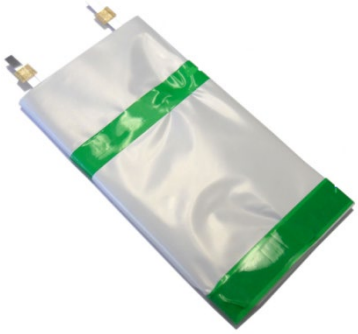
In the future, the study material may be updated with the new technologies or battery chemistries that may become available.

2.1.1 Lithium-ion (Li-ion) batteries

LITHIUM-ION PRISMATIC

LITHIUM-ION PRISMATIC

LITHIUM-ION POUCH



LITHIUM-ION POUCH

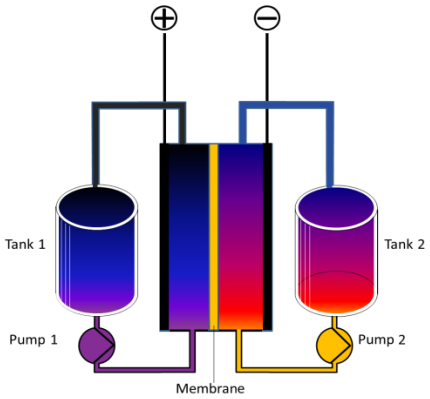
LITHIUM-ION CELL (18650)
CYLINDRICAL

LITHIUM-ION CELL
CYLINDRICAL

LITHIUM-ION RACK
(MULTIPLE MODULES)

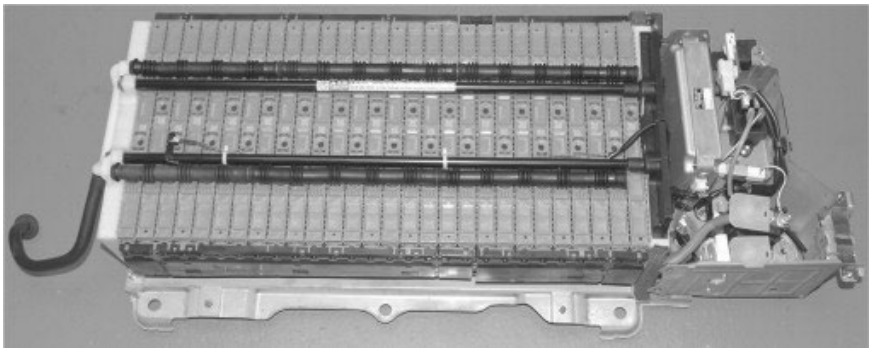
2.1.2 Lithium Metal Polymer batteries

2.1.3 Flow batteries



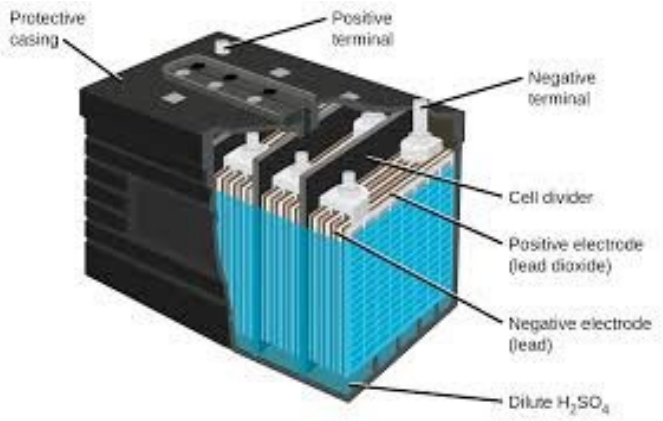
2.1.4 Nickel cadmium batteries

2.1.5 Nickel metal hydride (Ni-MH) batteries



2.1.6 Lead acid batteries

(a) Flooded



(b) VRLA

2.2 Multiple Layers of Stationary Energy storage Systems

Multiple Container/Enclosure System	
Single Container/Enclosure System	
Racks	
Module	
Cell	

2.3 Different Battery Energy Storage Systems Benefits and Hazards

2.3.1 Benefits of different Battery Energy Storage Systems

Technology	Benefits
Lithium Ion **(most commonly used)**	• Low maintenance • high cycle life • Due to popular demand, this technology is continually evolving • Fast power response rate
Flow	• Long life, deep discharge, • Can be replenished at end of life by replacement of electrolytes
Nickel Cadmium (Ni-Cad)	• Good load performance • Forgiving if abused
Nickel-Metal Hydride	• Memory degradation but less prone to memory than Ni-Cad, can be long usage life • More environmentally friendly
Flooded (Vented) Lead Acid	• Require a refill with distilled water • Low risk of thermal runaway • Well understood causes and remedies for thermal runaway
Valve-Regulated Lead-Acid (VRLA)	• No electrolyte to fill • Low risk of thermal runaway • Well understood causes and remedies for thermal runaway

2.3.2 Hazards of different Battery Energy Storage Systems

(For detailed information, refer to NFPA 855, Annex B. Battery Energy Storage System Hazards)

Technology	Potential Hazards	Potential Hazards Under Normal Conditions	Potential Hazards Under Emergency/Abnormal Conditions
Lithium Ion (Li-ion)	Fire/explosion hazards	Latent defects within the cells or design issues: • Flammable gas concentrations • Thermal runaway	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A.	• Off-gassing of flammable or toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance	• Stranded energy may present electric shock hazards during disassembly
	Physical hazards	• Lifting hazards due to the weight of the battery	• Overheating • Heavy system components • The guards of moving hazardous parts (e.g. fans) might be missing

Flow	Fire hazards	N/A	• Flammable gas concentrations
	Chemical hazards	• Corrosive liquid	• Corrosive liquid • Toxic Vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting
	Stranded or stored energy hazards	N/A	• N/A
	Physical hazards	N/A	• Overheating • Overpressure gas if sufficient pressure relief is not provided • The guards of moving hazardous parts (e.g. fans) might be missing
Nickel Cadmium (Ni-Cad)	Fire hazards	If not properly vented: • Flammable gas concentrations	• Flammable gas concentrations
	Chemical hazards	• Corrosive/caustic potassium hydroxide electrolyte	• Corrosive/caustic potassium hydroxide electrolyte • Toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance	• Stranded energy may present electric shock hazards during disassembly
	Physical hazards	• Lifting hazards due to the weight of the battery	• Overheating • Heavy system components
Nickel-Metal Hydride (Ni-MH)	Fire hazards	N/A	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A	• Corrosive electrolyte • Off-gassing of toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Electric shock
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance	• Stranded energy may present electric shock hazards during disassembly
	Physical hazards	N/A	• Overheating • The guards of moving hazardous parts (e.g. fans) might be missing

Flooded (Vented) Lead-Acid	Fire hazards	If not properly vented: • Flammable gas concentrations	• Flammable gas concentrations
	Chemical hazards	• Sulfuric acid electrolyte	• Corrosive sulfuric acid electrolyte
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly
	Physical hazards	• Lifting hazards due to the weight of the battery	• Overheating • Heavy system components
Valve-Regulated Lead-Acid (VRLA)	Fire hazards	N/A	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A.	• Corrosive electrolyte (minor)
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance	• Stranded energy may present electric shock hazards during disassembly
	Physical hazards	• Lifting hazards due to the weight of the battery	• Overheating • Heavy system components

2.4 Battery Systems Size Thresholds (only applies to outdoor/rooftop stationary or mobile energy storage systems)

Outdoor/rooftop stationary and mobile energy storage systems are classified by size - small, medium or large, as set forth in Table 1 of this booklet. The size of the stationary energy storage system is based on the energy storage/generating capacity of such system, as rated by the manufacturer, and includes all energy storage units operating as a single system. Table 1 is not applicable to multiple battery systems operating independently at a single premise, which are subject to the Section 2.4 “Multiple battery system” of this booklet.

Table 1. Stationary Energy storage System Size Thresholds

Battery Technology	**Aggregate Rated Energy Capacity**		
	Small	**Medium**	**Large**
Lead Acid Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Ni-Cd Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
NiMH Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Li-ion Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 250 kWh	> 250 kWh
Flow Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 500 kWh	> 500 kWh

Ampere-Hour Conversion:

If the energy capacity is rated in amp-hours, the B-28/W-28 COF holder should know how to convert the rating to kWh:

kWh shall equal rated voltage times amp-hour rating divided by 1000:

(voltage x amp-hours)/1000 = kWh

Calculation Example:

The size of a battery system is labeled as 2500 amp-hours at 12 volts. To convert it to kWh:

(12*2500)/1000=30 kwh

Stationary energy storage systems shall comply with all requirements applicable to the type of installation as specified in the Appendix A.

2.5 Multiple Battery Systems

(may not apply to small outdoor/rooftop stationary energy storage systems, see below for details)

More than one energy storage system may be installed on a single site or premises. These sites will be subject to additional or alternative requirements.

Multiple small outdoor/rooftop stationary energy storage systems are not subject to this requirement if they:

- are not part of a single installation or installed in a single enclosure; and
- operate independently of each other and are not interconnected with other small, medium or large battery systems.

If there are multiple battery systems installed on a single site or premises, it is important for the COF holder to know how many battery systems are co-located on the site, how they are separated, how they are electrically interconnected, and their total size.

2.6 Mobile energy storage Systems

Battery storage systems that can be relocated on trailers or other moveable bases are considered Mobile energy storage Systems. Like air compressors, diesel-fueled emergency generators, and other mobile power and heating trailers, Mobile energy storage Systems can be moved and temporarily installed at different locations. It is important for the COF holder to know if the ESS is mobile or permanently installed.

Mobile energy storage systems shall be designed, installed, operated and maintained in compliance with the same requirements as the non-mobile energy storage systems, except as follows:

(1) Installation approval is not required. The design of the trailer and the installation of the battery systems or any limitations on the use of mobile energy storage energy storage systems shall be addressed in the equipment approval.

(2) Compliance with commissioning and decommissioning requirements is <u>not required</u>. However, the safe decommissioning of a malfunctioning mobile energy storage system must be coordinated with the Fire Department.

Few examples of mobile energy storage systems

CHAPTER 3. PERMITS, ROLES AND RESPONSIBILITIES

3.1 Permits

3.1.1 DOB work permit

The work permits issued by the Department of Buildings (DOB) are issued to authorize construction work. It is the owner's responsibility to contact the Department of Building to comply with the DOB work permit requirements. The information regarding application process can be obtained from the following document:

https://www1.nyc.gov/assets/buildings/bldgs_bulletins/bb_2019-002.pdf

3.1.2 FDNY permit

An FDNY permit is required to install and operate a stationary energy storage system.

The following stationary energy storage systems do not require a Fire Department permit:

- Indoor/outdoor systems in Group R-3 occupancies, including an energy storage system installed in a Group R-3 dwelling or in an attached or detached garage serving such a dwelling, or mounted on an exterior wall of such a dwelling or garage.
- Outdoor/rooftop/mobile systems with an aggregate rated energy capacity listed below:

Battery Technology	**Small**
Lead Acid; Ni-Cd; NiMH	70 kWh or less
Others (e.g. Li-ion, Flow, etc.)	20 kWh or less

FDNY permit is issued to authorize the operation of a stationary energy storage system after the system has been designed, installed and, if applicable, passed an acceptance inspection (commissioning). Fire Department permits are designed to inform the Fire Department's firefighting force of the presence of a hazard at a premise and are typically associated with a periodic inspection by the Fire Department of the permitted installation.

3.2 Obligations of Owner and Operator

(applies to all battery storage systems)

Both the owner of the premises at which the stationary energy storage system has been installed, and the business responsible for the battery system's operation, if any, is responsible for compliance with all battery system installation, operational and maintenance requirements, including the lawful and proper removal and disposal of the battery system (decommissioning).

3.3 B-28/W-28 Certificate of Fitness Holder's General Duties

3.3.1 Outdoor/mobile/rooftop systems

(applies to all battery storage systems)

All outdoor stationary energy storage systems must be under the general supervision of a trained and knowledgeable person holding a Fire Department Certificate of Fitness.

3.3.2 Indoor systems

Except as may be otherwise provided in the Fire Department Rules, indoor systems shall be operated and maintained under the general supervision of such certificate of fitness holder, provided, however, that an FLS director, FEP coordinator, certificate of qualification holder or other responsible person with approved qualifications shall be on the premises during the regular business hours in any building with an indoor system with an aggregate rated energy capacity of one megawatt (1 MWh) or more. Such person shall be responsible for assisting emergency responders, including coordinating with such certificate of fitness holder and the remote monitoring facility in accordance with the emergency management plan.

"General supervision" is a defined term in the Fire Code (see FC202). In the present context, it refers to the person holding a Fire Department B-28/W-28 Certificate of Fitness who is responsible for the safe operation and maintenance of an ESS at a specific site location. A person providing general supervision does not have to be present on the premises when the ESS is in operation, but is responsible for ensuring that it is installed, operated and maintained in accordance with the NYC Fire Code and other applicable laws, rules and regulations.

A Certificate of Fitness requirement helps ensure that installers and other businesses involved in stationary energy storage systems – who may be new to New York City – are familiar with New York City regulatory requirements, and the B-28/W-28 Certificate of Fitness holder can serve as a point of contact with the Fire Department. The FDNY anticipates that the required emergency management plan would be developed by manufacturers, installers and, in some cases, by property owners, to address how such situations would be handled.

B-28/W-28 COF holder must:

- be trained and knowledgeable in the installation and operation of the battery system;
- possess the manufacturer's installation and operating specifications for each battery system and any associated fire protection and deflagration mitigations systems present;
- ensures that installers and other businesses involved in stationary energy storage systems are familiar with regulatory requirements;
- ensure the fire and gas detection systems, fire extinguishing systems and smoke/gas purge systems are approved by the FDNY;

- be present during commissioning of the system and authorize the activity after confirming that the battery system is in good working order and operating in accordance with manufacturer's specifications;
- inspect the battery system as often as necessary (at least once annually) to ensure that it is continuing to operate in a safe and lawful manner;
- ensure that all associated systems on site (e.g. fire detection systems, ventilation systems, fire extinguishing, deflagration mitigation, ventilation and smoke/gas purge system, etc.) are properly maintained by certified and licensed personnel;
- be familiar with the required procedures for impairment situations with any associated systems on site;
- be familiar with the notification procedures for different conditions (e.g. maintenance issue, emergency, etc);
- coordinate communication between ESMS monitor facility staff, SME and FDNY during any emergency condition;
- be reachable by the Fire Department to provide technical support immediately (via phone is acceptable), and physically present on scene within 2 hours for any emergency condition affecting a battery system;
- provide technical assistance to the Fire Department about the stationary energy storage system installation in coordination with the energy storage management system (ESMS) monitoring facility, SMEs who can provide technical assistance about the battery's design and performance in the event of an emergency condition affecting the battery system;
- understand how other systems on premises affect the ESS and their sequences in case of emergency (other COF holders have to be available for specific systems that are on the premises);
- be familiar with the emergency standardized operating procedures, which may include assigned actions (alarming neighboring tenants, securing the area, etc.);
- ensure continuous watchperson is provided post emergency;
- be present during all decommissioning to ensure the decommissioning is conducted in accordance with manufacturer's specifications and the system is lawfully transported and disposed of in accordance with *USDOT* hazardous materials regulations and other applicable laws, rules and regulations;
- maintain logbooks, emergency contacts, as well as list of all system personnel. Ensure that information is updated when necessary and it is current and up to date.

3.4 Subject Matter Experts (SMEs)

The SMEs shall be completely knowledgeable and proficient on the specific battery system, know how this system works and how the system will likely behave under normal and emergency conditions. SMEs work with the B-28/W-28 COF holders to provide system/site specific technical information to the Fire Department during an emergency situation involving the ESS. They are representative of the

manufacturer and/or installer. The SMEs understand the specific chemistry of the battery system and they are fully trained by the manufacturer of the system.

The SME must:

- have technical understanding of the system and be knowledgeable and proficient on reading and understanding the system ESMS signals and indicators.
- know how to remotely monitor, interpret and explain ESS system performance data as provided by the ESMS.
  - Interpret location and timing of detection signals (smoke (photo/ion), CO, H_2, VOC, THC, VESDA, etc.)
  - Identify the condition of the fire suppression system(s), if applicable (clean agent, inert gas, water, etc. (discharged/not discharge, malfunctions, etc.))
  - Understand the condition of any other fire/deflagration mitigation systems (deflagration vents,
  - Identify the condition of existing system(s) (e.g. the HVAC system or any mechanical/exhaust ventilation system.)
  - Estimate the quantity of system involved in thermal runaway.
- be familiar with the Emergency Management Plan of the battery system.
- be reachable for technical support immediately (via phone is acceptable).
- work with the B-28/W-28 COF holder to assist first responders.
- understand the specific chemistry of the battery system and be fully trained by the manufacturer of the system.
- deal directly with battery manufacturer on emergency operation and decommissioning of the system.
  - Knowledgeable in arc flash hazards and PPE
  - Identify potential ground paths
  - Develop work plan to account for voltage hazards
- have access to real-time ESMS data and work with COF holder to assist first responders as needed.
- at the site or has remote access to the site.

The SME's knowledge plays an important role in helping the first responders to correctly understand the nature and severity of the emergency and provide technical information essential for making correct decisions regarding the safe mitigation of the emergency. If the SME is knowledgeable to provide the technical support and suggestions for the emergency operation, the first responders will not only be able to control and extinguish the fire but also mitigate the damages to the entire battery system. However, if the SME cannot provide the sufficient information, the first responders will focus on controlling the fire/deflagration and protecting public safety but not on reducing any potential damage to the ESS.

3.5 ESMS monitoring facility staff

The designated ESMS monitoring facility staff shall be trained and knowledgeable persons retained by the manufacturer or installer of the battery system. The ESMS monitoring facility personnel may also be the SMEs or they may be different personnel. In order to address any potential emergency, the ESMS monitoring facility staff shall either be personally present in the monitoring facility to constantly monitor the ESMS or be able to receive the immediate notifications from the ESMS device constantly monitored. In the event the battery system exceeds or appears likely to exceed operating conditions at which fire, deflagration or other serious adverse consequences may result, the staff must immediately make the required notifications to the FDNY, Certificate of Fitness holder and SME(s) representing the manufacturer.

3.6 Other possible related systems and the related license holders

The B-28/W-28 COF holder may not be the person authorized to inspect, maintain and test the following systems, but he/she should ensure that these systems are inspected/maintained/tested by qualified personnel. He/she should also be aware of all testing/maintenance and should ensure that he/she will be notified if any of the following systems is out of service. The COF holder also must ensure all records are well-maintained and readily available for inspection by any FDNY representative.

Systems	**Who is authorized to install this system**	**Who is authorized to inspect, maintain and test this system**
Dry-type, manual water-spray fixed systems	Master Fire Suppression Piping Contractor (MFSPC) License	*B-28/S-12/S-15 COF holder*: visual inspections only, proper notification and record inspection results for examination *MFSPC or Plumber license*: perform all inspection, maintenance or testing duties.
Automatic water spray fixed systems including sprinkler systems	S-12/S-15 COF with Master Fire Suppression Piping Contractor (MFSPC) License (Class A or B)	S-12/S-15 COF holder: perform visual inspections only. S-12/S-15 COF holder with Q-99/Q-01/High pressure operating Engineer license: perform visual inspections and additional daily and weekly routine maintenance. S-12/S-15 COF holder with MFSPC license: perform all inspection, maintenance or testing duties S-12/S-15 COF holder with Master Plumber license: perform all inspection, maintenance or testing duties, but only limited to residential occupancies 30 sprinkler heads or less without a booster pump. Review the S-12/S-15 booklet for detail.
Standpipe systems	S-13/S-14 COF with Master Fire Suppression Piping Contractor	S-13/S-14 COF holder: perform visual inspections only.

Systems	**Who is authorized to install this system**	**Who is authorized to inspect, maintain and test this system**
	(MFSPC) License or Master Plumber License	S-13/S-14 COF holder with Q-99/Q-01/High pressure operating Engineer license: perform visual inspections and additional daily and weekly routine maintenance. S-13/S-14 COF holder with MFSPC license: perform all inspection, maintenance or testing duties S-13/S-14 COF holder with Master Plumber license: perform all inspection, maintenance or testing duties, but only limited to standpipe systems not combined with sprinkler systems. Review the S-13/S-14 booklet for detail.
Non-sprinkler (alternate agent) fire extinguishing systems*	Master Fire Suppression Piping Contractor (MFSPC) License (Class A or C)	Effect on April 15, 2023: S-16 COF will be required to inspect/maintain/test the non-sprinkler fire extinguishing systems. (The S-16 COF is still under development.)
Fire alarm systems	S-97/S-98 COF holder employed by an FDNY approved fire alarm company. DOB Master/Special Electrician License.	*B-28 COF holder:* visual inspection of the stand-alone fire alarm system. *S-95/F-53/T-89/F-89 COF holder*: visual inspection of the fire alarm system linked to a building fire alarm system. *S-78/F-78/S-97/S-98 COF holder*: clean, inspect and test smoke detectors. *S-97/S-98 COF holder:* maintain and test all components of the fire alarm systems.
Flammable /combustible gas detection system	S-97/S-98 COF holder employed by an FDNY approved fire alarm company. DOB Master/Special Electrician License. ESS system installer (if the detectors are NOT system type)	*B-28 COF holder*: visual inspection of the detectors if the detector(s) are NOT system type. *S-95/F-53/T-89/F-89 COF holder*: visual inspection of the detectors if they are linked to a building fire alarm system. *S-97/S-98 COF holder*: maintain and test gas detectors.
Exhaust ventilation system	Design Professional with DOB-issued license	*B-28/W-28 COF holder*: make sure the exhaust ventilation system is operating. (The testing and maintenance shall be performed by a trained and knowledgeable person or a person qualified and approved by the DOB.)
Emergency power	Design Professional with DOB-issued license	*DOB licenses*:

Systems	Who is authorized to install this system	Who is authorized to inspect, maintain and test this system
		• Electrician license; Stationary engineer license; High-pressure boiling operating engineer license or *FDNY license:* • Q-01/F-89/T-89/F-80 *Registered design professional* Inspection, testing or other maintenance must be conducted under the personal supervision of a person who possesses any licenses listed above.
Smoke purge system	Design Professional with DOB-issued license	*B-28/W-28 COF holder:* ensure that the system is in a good working order by periodical inspection and testing.

*Non-sprinkler (alternate agent) fire extinguishing systems include aerosol, carbon dioxide, clean agent, dry chemical, expansion foam, water mist, wet chemical fire extinguishing systems.

CHAPTER 4. GENERAL DESIGN AND INSTALLATION REQUIREMENTS

4.1 Listing and Full-scale testing standards

(applies to all stationary energy storage systems)

All stationary energy storage systems must be tested and listed by a nationally recognized testing laboratory to the standards provided in FC 608.4.1 (Refer to the appendix B) and FC 608.13 (Refer to the Appendix B).

Stationary energy storage systems must be subjected to full-scale testing (referred to as "large-scale testing" in NFPA 855).

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 Certificate of Fitness holder must verify if all components of the systems are approved for use in NYC.

4.2 Equipment Approval (Certificate of Approval)

(Applies to all battery storage systems.)

The manufacturer of the energy storage unit shall obtain a Certificate of Approval issued from the FDNY prior to installation.

Special requirements for any energy storage systems will be listed on the Certificate of Approval. The COF holder must ensure the installation, operation and maintenance of the system also comply with the Certificate of Approval.

➢ B-28/W-28 COF holder's responsibilities

Before commissioning, B-28/W-28 Certificate of Fitness holder must verify if the Certificate of Approval has been issued to the energy storage system and all requirements listed on the Certificate of Approval are met.

4.3 Maximum Aggregate Rated Energy Capacity

4.3.1 Outdoor/rooftop/mobile systems

The aggregate rated energy capacity of outdoor/rooftop stationary energy storage systems (including mobile systems) shall be as approved by the FDNY, unless the FDNY prescribes by Fire Department Rule a maximum aggregate rated energy capacity for such systems.

4.3.2 Indoor systems

The aggregate rated energy capacity per control area of indoor systems shall not exceed the limitations set forth in the following table.

TYPE OF STORAGE BATTERY	MAXIMUM AGGREGATE RATED ENERGY

	CAPACITY (kWh) PER CONTROL AREA
Lead-acid, all types	600
Nickel, all types except sodium nickel chloride	600
Lithium-ion, all types	400
Sodium nickel chloride	400
Flow	400
Other	As prescribed by rules or approved by the FDNY

4.3.3 Special requirements for Group R-3 occupancies:

The maximum rated energy capacity of any storage battery in an energy storage system installed in such a dwelling, attached garage or detached garage or mounted outdoors on an exterior wall thereof, shall not exceed 20 kWh, and the maximum aggregate rated energy capacity of such energy storage system shall not exceed the following amounts:

- in any such dwelling, 20 kWh per dwelling unit, except as may be approved by the department; or
- in any such attached garage, or when mounted outdoors on an exterior wall of such a dwelling or attached garage, 40 kWh, provided that there is an approved two-hour fire barrier separating such indoor system or wall mounted installation from the dwelling, or other approved measure based on the testing results of the energy storage systems; or
- in any such detached garage, or mounted on an exterior wall thereof, 40 kWh.

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 Certificate of Fitness holder must ensure that the maximum rated energy capacity of the ESS does not exceed the approved capacity.

4.4 Installation Approval (Site Approval)

4.4.1 Outdoor/rooftop/mobile systems

(Pre-installation approval is required for large stationary energy storage systems; however, medium stationary energy storage systems are subject to limited post-installation review by FDNY inspection unit.)

The design and installation of any ESS shall comply with the requirements of the Department of Buildings and Fire Department. The design of large outdoor systems must also be approved by the FDNY. The owner must obtain the FDNY approval of the design and installation documents. The installation application must include the FDNY equipment approval for each battery system unit proposed.

Although the mobile energy storage system is not required to obtain the installation approval, the Certificate of Fitness holder must ensure the FDNY equipment approval is issued for the mobile system.

4.4.2 Indoor systems

The design and installation of any ESS shall comply with the requirements of the Department of Buildings and Fire Department. Detail can be referred to FC 608.6 (See Appendix C)

➢ B-28/W-28 COF holder's responsibilities

- Ensure the DOB work permits/approval are obtained.
- Large outdoor stationary energy storage systems: ensure that the pre-installation approval and the FDNY permit are obtained.
- Medium outdoor stationary ESS, mobile ESS, indoor ESS: ensure that the FDNY permit is obtained.
- Small outdoor ESS, or Group R-3 ESS: ensure that the Certificate of Approval (equipment approval) is obtained from the FDNY.

4.5 Location and Construction

4.5.1 Outdoor/rooftop/mobile systems

(Applies to all outdoor stationary energy storage systems.)

1. Outdoor location (including rooftop when authorized)

Stationary energy storage systems shall be located outdoors, which includes, when authorized by the Fire Department rules for rooftop installations. This includes rooftops when authorized by this section. Medium and large battery systems shall not be installed in enclosed areas without direct access from a public street, or fire apparatus access road, unless full-scale testing data demonstrates intrinsic safety, or hazard mitigation measures that the Fire Department determines to be appropriate for the particular location are provided.

2. Fire Department access and Fire Protection System water supply

Where feasible, a direct, unobstructed pathway shall be provided from the battery system installation to the public street or fire apparatus access road on which the premises fronts. Stationary energy storage systems located more than 250 feet from a fire hydrant shall be provided with a private hydrant or other approved water supply for firefighting operations.

3. Separation distances

Stationary energy storage systems shall be located a minimum of 10 feet from the following exposures, except where lesser or greater distances are required by the equipment approval or installation approval based on full-scale testing data that indicate that a battery system fire will or will not adversely impact one or more of the following exposures:

(1) Lot lines;

(2) Public streets, fire apparatus access road, public walkways and other public ways;

(3) Any vehicle parking;

(4) Any building entrance door, openable window, or ventilation intake;

(5) Any exit discharge opening or other means of egress opening from a building or outdoor area;

(6) Any outdoor hazardous materials or combustible materials storage facility or area;

(7) Any outdoor storage facility or area for high-piled combustible materials or other combustible items;

(8) Overhead power lines or other aboveground electrical installation, measured from the boundary of the utility easement or, if there is no easement, from the vertical plane of the installation at its widest point; and

(9) Any adjacent or overhead public utility or transportation infrastructure.

4. Rooftop locations

Where Stationary energy storage systems are proposed to be located on a building rooftop, the systems are subject to the NYC Fire Department Rule requirements and must be approved by the NYC DOB (Certificate of compliance). B-28/W-28 COF holder must ensure the Certificate of Compliance is obtained from the DOB before installation. Although the original installation will be performed by the manufacture and approved by the FDNY, the COF holder must ensure any modification or renovation of the rooftop must also comply with the Fire Department Rule requirements, such as:

(1) Proper clearances and no obstructions:

a. Rooftop battery system installations, including structural support, enclosures/roof covering the ESS, electrical or other associated equipment, shall not obstruct the rooftop access and clear path for buildings (required by the Fire Code Chapter 5).

b. There shall be access to the rooftop from a building stairway, or other means of rooftop access authorized by the NYC Building Code. A safe, unobstructed path must be provided and maintained from the bulkhead door or other point of rooftop access to the entrance(s) to the battery system enclosure or to the service/access panel (if any).

c. Rooftop installations shall be located at a safe distance (not less than 10 feet) from the bulkhead entrance door or other rooftop access location.

d. Rooftop installations shall maintain the separation distances (a minimum of 10 feet or greater distances are required by the FDNY) for means of egress; hazardous materials or combustible materials storage facility or area; overhead power lines or other aboveground electrical installation; public utility or transportation infrastructure; and other stationary energy storage system installations.

(2) Standpipe outlet:

a. On rooftops of buildings provided with a standpipe for firefighting operations, a minimum of two (2) standpipe hose outlets shall be provided and maintained within the

building bulkhead at an approved distance from the stationary energy storage system installation. If a standpipe is provided for the battery system installation, the fire department connections shall be identified by durable signage or markings conspicuously posted at street level. The B-28/W-28 COF holder shall ensure the required signage is maintained or replaced when necessary.

b. On rooftops of buildings that do not have a standpipe, an approved water supply source shall be provided for firefighting operations.

(3) Valve-regulated lead-acid (VRLA) and flow batteries may not be installed on rooftops unless the applicant demonstrates to the satisfaction of the Department that the hazardous materials used in such systems can be safely stored and used on a rooftop, and the application adequately addresses leak detection, spill containment and the movement of such hazardous materials into and out of the building.

(4) Any dunnage or other structural support for the battery system installation shall have a proper fire rating, based on the size of the system.

(5) The building roof covering or roofing system, or other approved material placed underneath the rooftop battery system installation, shall be noncombustible for a distance of five (5) feet from such installation.

5. Physical Protection

Stationary energy storage system installations shall be protected from damage in accordance with the following requirements:

(1) **Temperature.** The storage battery or battery system shall be designed for operation throughout the entire expected range of ambient temperature, in accordance with manufacturers' specifications, or provided with appropriate protection from damage from extreme ambient temperatures.

(2) **Vehicle impact protection**. Where the battery system is subject to impact by a motor vehicle or other motorized equipment, such as a fork lift or other powered industrial trucks, vehicle impact protection shall be provided.

(3) **Security**. The battery system installation shall be secured against unauthorized entry. All battery system enclosures shall be securely locked and, where appropriate, safeguarded by a chain link fence or other approved barrier.

➢ B-28/W-28 COF holder's responsibilities

- Ensure that the ESS protected by the approved functional fire protection systems.
- Ensure that the ESS protected from any damage listed above.
- Ensure that proper clearances and "no obstruction" are maintained.

4.5.2 Indoor systems

The indoor systems must be installed in accordance with the location requirements set forth in FC 608.9.4.1 (See Appendix C).

➢ B-28 COF holder's responsibilities

- Ensure that the ESS is properly protected by the approved functional fire protection systems required by the Certificate of Approval and the Fire Code FC608.

4.6 Remote monitoring

All stationary energy storage systems shall be designed to transmit ESMS data regarding battery system status and temperature to a remote monitoring facility.

4.7 Electrical components

The electrical components of stationary energy storage systems shall comply with UL Standards 9540, be designed to operate safely during normal operating conditions, and installed in accordance with the Fire Department rule requirements.

4.7.1 Secondary stand-by power

A separate source of electrical power shall be provided for battery system controls and safety functions, unless the battery system is designed to power such systems for at least 30 minutes after battery system shutdown.

A separate source of electrical power shall be provided for all external battery safety systems, including detection, ventilation and smoke/gas purge systems. Such secondary power can be supplied from any independent power source. If the secondary power supply is an emergency power system designed in accordance with the *Building Code*, it shall be capable of supplying secondary stand-by power for duration of two (2) hours.

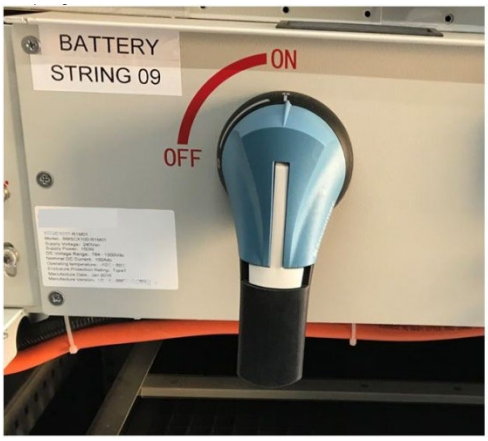
4.7.2 Disconnect switch and Lockout/Tagout Procedure

A disconnect switch (or "load break switch") serves multiple purposes, but its primary uses are to function as a disconnect means for a service entrance, and disconnect switch and fault protection for motors (heavy machinery). To summarize, the switch is used to disconnect manufacturing equipment and heavy machinery from its power source. It may need to be used for a variety of reasons, including:

- Repairs
- Maintenance
- Emergency stoppage (E-stop)

Fused disconnect switch

Unfused disconnect switch



Battery string disconnect switch

Battery container disconnect switch

Disconnect switches are reliable and provide safety to the battery system and personnel in addition to providing:

- Protection against overcurrent
- Protection against circuit overloads
- Protection against short circuiting
- Protection against heat-generated damage

Safety switches are designed to interrupt the power in the event of a single fault in the circuit.

Disconnect switch may also shut off secondary power to other systems, such as the gas purge system. As a COF holder, you must know what system(s) will be disconnected from its electrical supply when you open the disconnect switch.

Lockout-Tagout refers to the OSHA recognized safety procedure used in industry and research settings to ensure that dangerous machines have been properly shutdown and is incapable of being started up

again prior to the completion of maintenance or servicing work. It requires that all hazardous energy sources have been (1) identified; (2) isolated; and (3) rendered inoperative to prevent the release of potentially hazardous energy prior to the start of any repair or maintenance procedure. This is accomplished through the locking and tagging of all energy sources and their control devices. Some common forms of energy isolation include electrical circuit breakers, disconnect switches, ball or gate valves, blind flanges, and blocks. Lockout/Tagout procedures are required for ensuring that electrical or mechanical equipment is rendered safe by placing switches or controls in the "off" position and using approved measures to physically prevent the switches from operation while in "lockout" mode.

Push buttons, e-stops, selector switches and control panels are not considered proper points for energy isolation.

Lockout is the placement of a lockout device on an energy isolation apparatus (circuit breaker, slide gate, line valve, disconnect switch, etc.) to ensure that the energy isolating device and equipment being controlled cannot be operated until the lockout device is removed. A lockout device utilizes a positive means such as a lock (key or combination type) to hold an energy-isolating device in a safe position and prevent the energization of a machine or equipment. The lockout device must be substantial enough to prevent removal without use of excessive force or unusual techniques.

Tagout is the placement a tag or other prominent warning device and a means of attachment on an energy isolation device to indicate that the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed.

In general, Lockout/Tagout typically involves signage ("tagout") at the control switches and includes employee procedures about how, when and who can remove such signage; locking devices and return switches to the "on" position.

➢ B-28/W-28 COF holder's responsibilities

- Must know the location of the disconnect switch, and when the disconnect switch should be used.
- Must know how to open the disconnect switch.
- Must know how the disconnect switch functions and how it may affect the ESS and other related systems. For example, the COF holder must know what system(s) will be disconnected from its electrical supply when the disconnect switch is opened.
- Must know the lockout/tagout procedure.
- Must ensure that the proper PPE are provided.

4.7.3 Emergency shut down (e-stop)

An emergency stop (e-stop) and as an emergency power off switch or device, is a safety mechanism used to shut off machinery in an emergency, when it cannot be shut down in the usual manner. A normal disconnect switch or shut-down procedure shuts down all systems in specific order, without machinery damage. An e-stop is designed and configured to abort the operation as quickly as possible and to be operated simply and quickly (so that even a panicked operator with impaired executive functions or a by-stander can activate it). E-stops are usually designed to be noticeable, even to an untrained operator or a bystander.

The intent of the E-Stop function is to:

1) Stop the ESS (no charging / discharging)

2) Isolate hazardous voltages from as many surfaces as possible

   a. Batteries cannot be discharged to 0 Volts without permanently damaging them.

   b. Battery modules are inside battery racks (IP20 touch-safe enclosures)

It is recommended to post a sign that indicates how this emergency stop will affect the system.

The Fire Department rule requires an emergency shut down control (e-stop), in the form of a red button or other approved design that is designed to shut down all stationary energy storage system operations (without affecting the fire protection systems and other safety measures required by the Fire Department Rule). It shall be provided at the Fire Department Connection, if any, utility connection or other approved, conspicuous location on the premises that is accessible to emergency response personnel and is a reasonable distance (but not less than 10 feet) from the stationary energy storage system installation. The shutdown control shall be secured in a lock box operable by a citywide standard key (2642 key).

When the E-Stop button is pressed:

1) The inverter will stop charging / discharging, and will open its AC breaker and DC contactor;

2) All battery racks will open their separate DC contactors;

3) ESMS will report the alarm to the monitoring station;

4) The batteries inside their racks will still have a stored/stranded energy hazard;

5) The site's switchgear, and transformers may still be energized

Emergency shutdown procedures for the energy storage system shall be posted at the energy storage system emergency shutdown (e-stop) control and at any attended on-site location. The emergency shutdown instructions shall clearly indicate "**GRID SUPPORT SYSTEM**" in large letters (not less than 2 inches high) if immediate shut down of the ESS could disrupt public utility operations.

➢ B-28/W-28 COF holder's responsibilities

- Must know the location of the e-stop
- Must ensure that the emergency shutdown procedure for the energy storage system is posted at required on-site location(s)
- Must ensure that the required signs are posted
- Must know how to operate the e-stop
- Must know the scope of what the e-stop will affect and the associated consequences: what the e-stop will or will not affect when it is pressed (e.g., Fire Alarm system, other aux distributions, building lights, etc.)

4.8 Special Requirements for the Battery Systems Installed in Group R-3 Occupancies

Stationary energy storage systems installed in or on the premises of Group R-3 occupancies (indoor and outdoor systems) shall comply with some special requirements. Refer to FC 608.13 and the Certificate of Approval of the ESS installed in Group R-3 occupancies.

CHAPTER 5. ENCLOSURE DESIGN AND INSTALLATION REQUIREMENTS

5.1 Enclosure designs for the outdoor systems

When required by the Fire Department rule requirements, outdoor stationary energy storage systems housed in a shipping container or other type of outdoor enclosure (but not energy storage system housing) shall be designed and installed in accordance with the following requirements.

No medium and large stationary outdoor energy storage system shall be housed in an enclosure used for human occupancy. Access to such an enclosure (whether walk-in or reach-in) shall be provided solely for maintenance purposes, including inspection, testing, servicing and repair of the battery system.

Outdoor stationary energy storage systems may be installed on open racks within enclosures if approved water-based fire extinguishing, explosion mitigation, ventilation and smoke/gas purge systems are installed.

➢ B-28/W-28 COF holder's responsibilities

- Ensure that the enclosure is not used for human occupancy.
- No combustible materials stored in the enclosure.

5.2 Fire Protection Systems

➢ B-28/W-28 COF holder's responsibilities

The Certificate of Fitness holder must be aware what kinds of the fire extinguishing systems, fire and gas detection systems, ventilation system and smoke/gas purge system are provided within the battery system enclosure and must be knowledgeable regarding how those systems coordinate with each other.

5.2.1 Outdoor/rooftop systems

An approved water spray fixed fire extinguishing system (NFPA 15 Water Spray Fixed System) shall be provided in large outdoor stationary energy storage system enclosures, and may be required as a condition of the equipment approval for small and medium outdoor systems. For large battery storage systems located in outdoor cabinets or other battery system housing, the same type of fire extinguishing system shall be provided for exterior exposure protection. The fire department connections shall be located at an approved distance from the outdoor stationary energy storage system enclosure to ensure the safety of firefighting operations.

In this type of system, all pipes are normally dry. Water is supplied when needed by pumping water into the system through the Fire Department connection. Some of these systems are supplied by manual operation of a water control valve and may be equipped with nozzles with or without fusible links.

	
Water spray heads inside a container	Fire Department Connection for the manual water spray system

Although some non-water based fire extinguishing systems can eliminate visible flame from some types of battery systems, they may 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. The B-28/W-28 COF holder must provide the information regarding designed hold time from the manufacturer to the first responders if specified. Hold time refers to the amount of time it takes for the concentration of the agent-air mixture to drop below a specified concentration at a designated height within the protected enclosure. Manufacturer-recommended times should be made clear. These non-water based fire-extinguishing systems reduce flammability by inhibiting combustion and/or suppressing oxygen levels. The flammable gases will continue to be produced due to the continued heating and could create an environment ripe for flashover or backdraft or deflagration when oxygen is reintroduced into the system.

Consideration would be given to approve the use of non-water based fire extinguishing systems if such use of systems is acceptable by the battery system listing. The listing would be based on approved full scale fire testing results demonstrating the efficiency of a non-water system in suppressing or extinguishing a battery system fire. The FDNY must review and approve the use of any non-water based fire extinguishing system.

B-28/S-12/S-15 Certificate of Fitness holders are authorized to visually inspect this dry-type, manual water-spray fixed system (refer to Section 3.6 of this booklet). The B-28 COF holder must ensure the following items are inspected at the frequency specified in the table below:

ITEM	FREQUENCY
Control valves (sealed)	Weekly
Control valves (locked or electrically supervised)	Monthly
Drainage	Quarterly
Fittings	Annually
Fittings (rubber-gasketed)	Annually and after each system activation
Hangers, braces and supports	Annually and after each system activation
Nozzles	Annually and after each system activation
Pipe	Annually and after each system activation
Strainers	Manufacturer's instruction
Fire Department connections	Quarterly

The inspection procedure for each component:

COMPONENT	INSPECTION
All components	Inspected and maintained as per NFPA 15/NFPA 25/ and manufacturer's instructions.
Valves	Valves secured with locks are locked in correct position (Open/Closed).
Piping and fittings	• Inspect for mechanical damage (broken piping or cracked fittings) • External conditions (missing or damaged paint or coatings, rust, corrosion) • Misalignment or trapped sections • Conditions of low point drains • Protection for rubber-gasketed fittings
Hangers, braces and supports	• Inspect for condition (missing or damaged paint or coating, rust, and corrosion • Secure attachment to structural supports and piping • Damaged or missing hangars, braces, supports
Nozzles	• Inspect nozzles to ensure they are in place, free from external loading, corrosion, and aimed or pointed in direction intended. • Confirm caps/plugs (if provided) are in place and free to operate as intended
Strainers (if provided)	Inspect strainers to ensure they are clean. Damaged or corroded parts replaced or repaired.
Fire department connections	• Fire Department Connections are visible and accessible. • Couplings or swivels are not damaged and rotate smoothly. • Plugs or caps are in place and undamaged. • Gaskets are in place. • Identification signs are in place and legible. • Visible piping supplying the fire department connection is undamaged. • Fire department connection clapper is in place and operating properly. • Check valve is not leaking. • Automatic drain valve is in place and operating properly.

➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 Certificate of Fitness holder must ensure that the fire extinguishing system is periodically inspected, maintained and tested by a qualified license holder (as listed in the Section 3.6 of this booklet). The COF holder must be notified if there is any issue related to the system and ensure the issue has been resolved by a qualified license holder.

The COF holder must be familiar with the location of Fire Department Connection. They must be aware of what types of fire extinguishing systems are installed within the stationary battery system enclosures and inform the FDNY first responders the requested information.

5.2.2 Indoor systems

Indoor systems may be installed only in buildings fully protected throughout by a sprinkler system. The detail requirements should be referred to FC 608.9.4.1.2 and FC 608.9.4.1.9 (See Appendix B).

➢ B-28/W-28 COF holder's responsibilities

The B-28Certificate of Fitness holder must ensure that the water-based fire extinguishing system (or the FDNY approved alternate agent fire extinguishing system) is inspected/maintained/tested by a qualified license holder (refer to the Section 3.6 of this book). The COF holder must be notified if there is any issue related to the system and ensure the issue has been resolved by a qualified license holder

The COF holder must be familiar with the location of Fire Department Connection. They must be aware of what types of fire extinguishing systems are installed to protect the ESS and inform the FDNY first responders the requested information.

5.3 Fire Detection Systems and Gas Detection Systems

5.3.1 Outdoor/rooftop systems

An approved automatic fire alarm system shall be installed in medium and large outdoor stationary energy storage system enclosures. Enclosure for small outdoor ESSs are not subject to this requirement unless required as a condition of equipment approval based on full-scale testing.

Note: Mobile system must comply with the COA regarding the fire/gas detection system.

Approved gas detection system shall be installed in the battery system enclosures for the following types of battery systems:

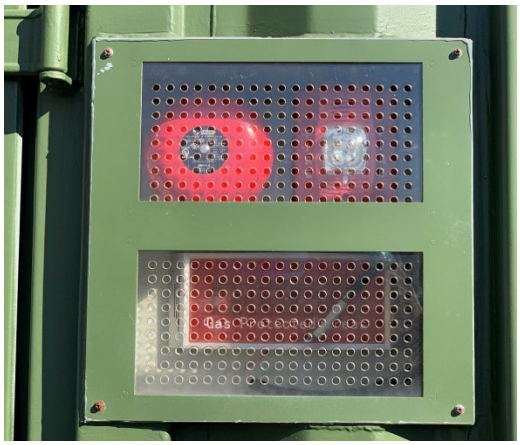
Battery Type	Small Size	Medium Size	Large Size
Lead Acid	Yes[1]	Yes	Yes
Ni-Cad and Ni-MH	Yes[1]	Yes	Yes
Li-Ion Battery	No	No[2]	No[2]
Flow	Yes[1]	Yes	Yes

1. Required for equipment approval, as an element of the storage battery unit design, not as part of a battery system enclosure.
2. Unless required as a condition of equipment approval based on full-scale testing

The placement of gas detectors must be in accordance with manufacture's specifications. When the level of flammable gas inside the battery system enclosure exceed 25% of the lower flammability limit (LFL), the gas detection system shall be activated.

If applicable, activation of a fire or gas detector in a battery system enclosure shall initiate the following notifications and other actions:

(A) Activate a distinct audible and visible alarm signal at the battery system installation or an approved constantly attended on-site location.



(B) Transmit an alarm signal to the fire alarm system and thereby to an approved central station.

(C) Shut down the battery system, if warranted.

(D) Activate all necessary shut down and hazard mitigation measures of the ventilation system.

It should NOT be assumed that an alarm generated at the site was successfully communicated to the central station company. Notification of a fire or an emergency should not be delayed in calling 911.

5.3.2 Indoor systems

Control areas housing stationary energy storage systems shall be protected by a fire alarm system or, if a fire alarm system is not otherwise required in the building or occupancy, by a dedicated smoke detection system. The additional requirements will be listed on the Certificate of Approval.

5.3.3 Special requirements for the ESS systems in Group R-3 occupancies

(from NFPA 855 section 15.9)
Interconnected smoke alarm must be installed throughout the dwelling, including in rooms, attached garages, and areas in which ESS are installed in compliance with the Building Code.
If smoke alarms cannot be installed, an interconnected listed heat detector must be installed and be connected to the alarm system required by the Building Code. The requirements will be listed on the Certificate of Approval.

➢ B-28/W-28 COF holder's responsibilities

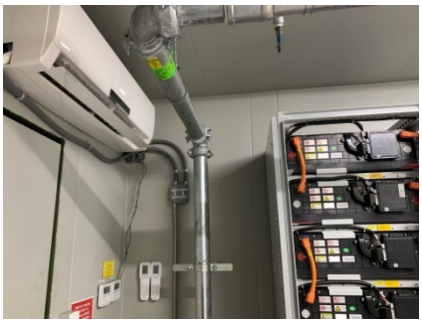
- Know what fire detection system or smoke detection system is installed.
- Know if the fire/smoke detection system has been monitored by a Central Station.
- Ensure that the fire/smoke detection system is supervised/inspected/maintained/tested by a qualified Certificate of Fitness holder. (Refer to Section 3.6 of this booklet)
- Ensure that the fire/smoke detection system is functional.
- If the system is impaired, ensure all required out-of-service procedures are implemented. (Refer to Section 7.5.3 and Section 7.5.4 of this book)

5.4 Exhaust ventilation system

5.4.1 Outdoor/rooftop systems

An approved exhaust ventilation system shall be provided for the space within the battery system enclosure for large systems. Enclosure for small and medium battery systems are not subject to this requirement unless required as a condition of equipment approval based on full-scale testing.

The ventilation system shall be designed to maintain optimal operating conditions for the stationary energy storage system in accordance with manufacturer's specifications or Institute of Electrical and Electronics Engineers (IEEE) Standard 1635/ASHRAE Standard 21 (2012 edition), whichever requires a higher level of protection.



The ventilation system shall be intrinsically safe for, and/or explosion protected from, any toxic and flammable gases generated by the battery system during normal operating conditions, and shall be designed to limit the maximum concentration of toxic gases inside the battery enclosure to 25 percent of the permissible exposure limit (PEL) for such gases, unless full-scale testing demonstrates that the storage battery unit does not generate toxic gas concentrations in excess of 25 percent of PEL.

5.4.2 Indoor systems

Control areas housing stationary energy storage systems shall be equipped with ventilation systems designed for high-hazard occupancies in accordance with the construction codes. Such ventilation systems shall be adequate to exhaust any flammable or other gases generated during the normal operation and/or failure of the stationary energy storage system.

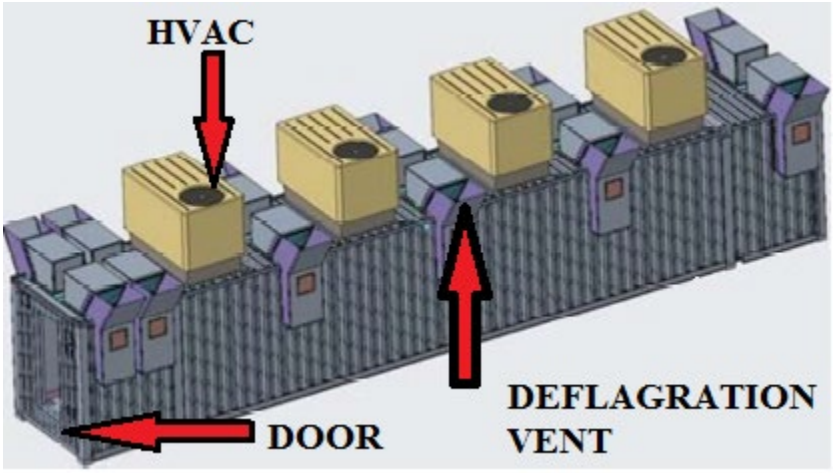
➢ B-28/W-28 COF holder's responsibilities

- Ensure that the ventilation system is functional to maintain optimal operating conditions for the ESS.
- Ensure that the ventilation system can prevent the accumulation of flammable/ toxic gases.

5.5 Explosion mitigation

5.5.1 Outdoor/rooftop systems

Explosion mitigation must be provided for large outdoor stationary energy storage system enclosures in accordance with the Fire Department rule requirements. Enclosures for small and medium systems are not required to provide explosion mitigation unless required as a condition of equipment approval based on full-scale testing.



Once explosion mitigation is required, deflagration venting in accordance with NFPA 68 (2018 Edition) must be provided. Deflagration venting is a passive system that will vent flammable gases at a pre-determined pressure in order to relieve pressure build up in a container. Such venting must be provided and designed to vent upwards or other safe location. Vents must not face toward any exit discharge path from a nearby building or other pedestrian walkway, or any other location from which first response personnel may access the enclosure.

If a hazard mitigation analysis (based on full-scale testing or other approved test data) indicates that explosion prevention system is effective for the type of battery system (e.g. Lead-Acid systems), the owner of the facility may install explosion prevention systems voluntarily. Explosion prevention system is an automatic and active system that relies upon detection and inherently safe exhaust fans to limit the buildup of flammable gasses to below 25% of the lower flammability limit (LFL). This system must be provided in accordance with NFPA 69 (2014 Edition).

5.5.2 Indoor systems

Indoor systems shall be provided with the hazard mitigation systems and measures required by the conditions of the system's listing and equipment approval and the Building Code.

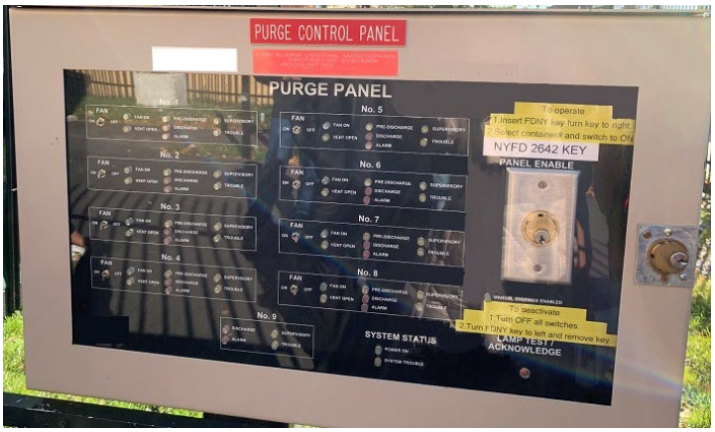
➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 Certificate of Fitness holder must be familiar with the location of deflagration vents and/or exhaust outlets, location of control switches and ensure the vents or outlets are clear from any obstructions (e.g. ice, snow or debris buildup). Further, they need to inform the FDNY of the recommended standoff distances from these hazardous locations.

5.6 Smoke/gas purge system

5.6.1 Outdoor/rooftop systems

A manually-operated purge system designed to exhaust heat, smoke and toxic gases generated by the stationary energy storage system during abnormal operating conditions, for use by firefighting personnel, shall be provided for a ESS enclosure for large systems. Enclosure for small and medium ESSs are not subject to this requirement unless required as a condition of equipment approval based on full-scale testing.



The smoke/gas purge system shall be intrinsically safe and/or explosion protected for any such toxic gases and be designed in accordance with the following requirements:

(A) **Manual operation.** The smoke/gas purge system shall be designed to be manually activated. A manual activation switch shall be installed at the Fire Department connection, if any; otherwise, near the utility connection or other approved location on the premises. The activation switch shall be identified by a conspicuously posted and durable sign that reads: "Energy Storage System Emergency Smoke/Gas Purge." The activation switch shall be secured in a lock box operable by a citywide standard key (2642 key).

(B) **Exhaust venting.** The smoke/gas purge system shall vent in a manner that will minimize the risk to surrounding buildings and building occupants, pedestrians, and emergency response personnel. Exhaust vents shall not face toward any exit discharge path from a nearby building or other pedestrian walkway, or any location adjacent to the enclosure access.

		
smoke purge exhaust vent (outside container)	smoke purge fan (inside container)	smoke purge exhaust vent (inside container)

5.6.2 Indoor systems

Indoor systems shall be provided with the smoke/gas purge systems required by the conditions of the system's listing and equipment approval and the Building Code.

➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 COF holder must know where the manual activation is located for the smoke purge system. The COF holder also needs to ensure the smoke purge system is maintained in good working order.

The B-28/W-28 COF holder must know the location of vent and switch, ensure they are clear from obstructions (e.g. ice, snow or debris buildup), and inform the FDNY of the recommended standoff distances from these hazardous locations.

CHAPTER 6. COMMISSIONING AND DECOMMISSIONING

6.1 Commissioning

Stationary energy storage systems shall be installed by trained and knowledgeable persons in accordance with manufacturer's specifications.

Once an Energy Storage System (ESS) has been installed and all fire protection systems related to the system are approved and operational, the commissioning process can begin. Commissioning ensures that the Energy Storage System (ESS) is evaluated for proper operation by the system owner or their designated agent.
All fire protection, smoke control and smoke purge, and hazard mitigation systems and measures installed to protect the system must also be inspected and tested by a person holding the qualifications required by the Fire Codes or Fire Department Rules, the construction codes and/or the Electrical Code, and any required acceptance testing conducted, prior to activation of the system.

Notification
For all ESSs, notice must be given to the Fire Department, so Fire Department firefighters or other representatives can, if they wish, attend the commissioning to familiarize themselves with these installations. The required notification procedures are detailed in Section 10.1 of this booklet.

➢ B-28/W-28 COF holder's responsibilities

Upon completion of the installation, the COF holder assuming responsibility for supervision of the ESS shall authorize it to be activated, after confirming that the ESS is in good working order and operating in accordance with manufacturer's specifications.

6.1.1 Commissioning Plan

The system owner or their designated agent shall prepare a written commissioning plan that details the commissioning process developed specifically for the ESS to be installed and a description of the activities to be conducted. The plan must be submitted with the FDNY permit application. The small outdoor ESS and Group R-3 must follow the COA requirement to develop the plan.

NFPA 855 and the Fire Code indicate that 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 installation and 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) Guidelines and format for a commissioning checklist and relevant operational testing forms and necessary commissioning logs and progress reports;

(9) Means and methods whereby facility operating and maintenance staff will be trained on the system;

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

(11) A decommissioning plan (refer to section 6.2 of this booklet) 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

6.2 Decommissioning

6.2.1 Decommissioning plan

Prior to decommissioning, the owner, or their designated agent(s) (e.g. manufacturer, installer, hazardous materials carrier or other party responsible for removal, transportation and/or disposal of the stationary energy storage system) shall prepare a written decommissioning plan that provides the organization, documentation requirements and methods and tools necessary to indicate how the safety systems are required by this standard and the ESS and its components will be decommissioned and the ESS removed from the site. The plan must be submitted with the FDNY permit application. The small outdoor ESS and Group R-3 must follow the COA requirement to develop the plan.

A decommissioning plan will vary depending on the system size, manufacturer, and intended use. The NFPA 855 and the Fire Code indicate that the decommissioning plan shall include the following information:

(1) An overview of the decommissioning process developed specifically for the ESS that are 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 whereby the decommissioning plan will 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, such as 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.

Additional Information that must be included in the decommissioning plan would include, but not be limited to the following:

(1) An identification of all energy sources (batteries, connected batteries in other enclosures or structures), inverters [also known as power conversion systems (PCS)], DC bus pre-charge power supplies, UPS, support equipment with batteries, and AC or DC auxiliary power equipment and distribution systems;
(2) Information about personal protection equipment (PPE) and requirements for use as needed (site dependent), noting that each electrical equipment cabinet should already have shock and arc flash warning labels applied as per NFPA 70E;
(3) A notification that the ESS should be discharged to its safe state of charge (SOC) prior to removal or transport;
(4) Assurance that during the decommissioning process, critical support equipment such as, but not limited to, fire detection and suppression equipment, emergency lighting, electrical circuits to facilitate decommissioning, and so forth, remain operational to the extent possible;
(5) A warning not to disconnect any ESS grounding until all energy sources are isolated and follow locked out/tag out safety procedures;
(6) A warning notification to disconnect and shut down all batteries and support or auxiliary equipment associated with the system or its component parts;
(7) Isolation of all energy sources, starting with those with highest fault energy, by isolating the ac point of interconnection, then isolating strings, then isolating the individual battery modules;
(8) The need to mechanically uninstall battery trays and place them into original or equivalent packing materials or protect terminals;
(9) Information on disposal material associated with each ESS.

In addition, the owner, manufacturer or installer of stationary energy storage systems shall have an emergency management plan or protocol that includes procedures for notifications and technical assistance (refer to section 10.1 and 10.3 of this booklet) and all other actions necessary for mitigation and decommissioning (or restoration to normal operation). The procedures of decommissioning vary, and instructions of decommissioning are to be followed from the manufacturer.

6.2.2 Decommissioning Process

For all ESSs, notification of decommissioning to the FDNY must be made. The notification requirement for decommissioning should be referred to Section 10.1 of this booklet.

➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 COF holder supervising a stationary energy storage system shall be responsible for its decommissioning. The deactivation, de-energizing, dismantling and removal of the stationary energy storage system shall be conducted by trained and knowledgeable persons in accordance with manufacturer's specifications. The owner, manufacturer, installer, hazardous materials carrier or other party responsible for removal, transportation and/or disposal of the stationary energy storage system shall ensure that the energy storage system is lawfully decommissioned, transported and disposed of in accordance with DOTn hazardous materials regulations and other applicable laws, rules and regulations.

The decommissioning process must be in accordance with the decommissioning plan (for medium and large systems, the decommissioning plan must be approved by the FDNY). In general, the Certificate of Fitness holder should the ensure:

1. **Proper Isolation**
   ESS remains electrically and mechanically isolated through the use of the E-Stop and disconnect switches until the affected batteries have been removed.
2. **Removal of all damaged/end of useful life batteries**

   All the damaged batteries and any battery that reaches end of life have been removed the ESS.

   Heat compromises the performance virtually all electronics, and can be particularly harmful to battery electrolyte operation. If any battery that was/is exposed to the temperature that exceeds the normal temperature setting, the battery should be removed from service and disposed of.

3. **Qualified Hazardous Waste Management Company will handle the disposal and transportation of the battery waste properly**

   Specific management standards for batteries include containing any battery that shows evidence of leakage, spillage, or damage that could cause leakage. The container must be closed, structurally sound, and compatible with the batteries. Batteries or battery packs may be sorted, mixed, discharged, regenerated, disassembled into individual batteries, or removed from products as long as the individual battery cell is not breached. Cells may be opened to remove electrolyte from the battery, but must be closed again immediately. Electrolyte or any other material generated by the handler must be evaluated to determine if it is a hazardous waste and, if so, managed appropriately under 40 CFR part 262 and/or 40 CFR part 273 regulations.

   The person transporting the waste must comply with the transportation standards in 40 CFR part 273 subpart D of the universal waste regulations. These standards prohibit disposal or treatment of the universal wastes and cover management standards, complying with DOT regulations, storage time limits, responding to releases, and exports.

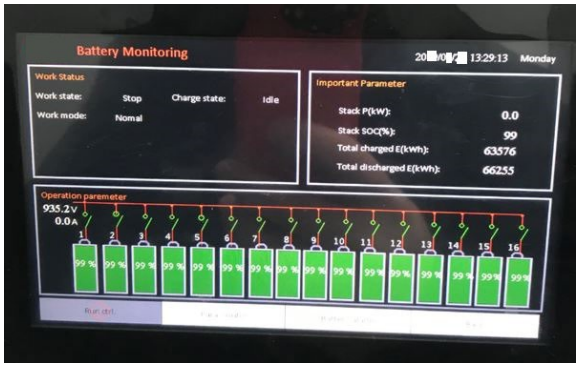
The hazardous waste management company must comply with all local, state and federal laws. Hazardous waste information is maintained in the Resource Conservation and Recovery Act Information (RCRAInfo), a national program management and inventory system of hazardous waste handlers. You can use the RCRAInfo Search (https://www3.epa.gov/enviro/facts/rcrainfo/search.html) to determine identification and location data for specific hazardous waste handlers. You can also find a wide range of information on treatment, storage and disposal facilities (TSDFs) regarding permit and closure status, compliance with federal and state regulations, and cleanup activities. You can specify a facility using any combination of facility name, geographic location (e.g., zip code) and facility industrial classification (EPA ID).

Decommissioning of malfunctioning energy storage system (emergency decommissioning) should comply with additional requirements; refer to Chapter 10 of this booklet.

CHAPTER 7. OPERATION AND MAINTENANCE

7.1 Remote Monitoring of Energy Storage Management System (ESMS) and Reporting

The Fire Department requires that all stationary energy storage systems shall be designed with an energy storage management system (ESMS) that transmits data regarding energy storage system status and temperature to a remote monitoring facility or other approved location. Indoor systems shall be provided with approved remote monitoring stations at the building's fire alarm control panel location and/or other approved location.



The Fire Department requires that all stationary energy storage systems will be designed with an energy storage management system (ESMS) which monitors, controls, and optimize performance of the energy storage system and has the ability to control the disconnection of the module(s)/containers from the system.

The primary functions of ESMS are to monitor the status of the battery health and provide notification to the SMEs if there is any abnormalities of the ESS. The ESMS protects the batteries from being over-charge/over-discharged, tracks how much energy goes in and out of the batteries and monitors cell voltages; and constantly monitors for shorts, loose connections, breakdowns in wire insulation, and weak or defective battery cells that need to be replaced. It may also monitor the temperature of the energy storage systems and provide real-time information and values, etc. The ESMS can also isolate the individual batteries in cases of emergency. ESMS is an essential tool to provide early warning of any malfunction of the batteries.

The owner of a stationary energy storage system shall arrange for data transmissions from the energy storage system's ESMS to be continuously monitored (on a 24/7 basis) by a remote monitoring facility staffed by trained and knowledgeable persons (ESMS monitoring facility staff) retained by the manufacturer or installer of the energy storage system. If unstaffed, the facilities must be designed to make immediate automatic notifications to the designated facility staff who can address the potential emergency.

The ESMS system monitors and responds to a variety of normal and off-normal conditions associated with the energy storage system. Many of the conditions are associated with non-emergency conditions, such as the energy efficiency and monitoring voltage fluctuations. Off-normal condition can also signal the need for maintenance and service, or in some cases shut down of the ESS until the condition can be evaluated by a trained and knowledgeable personnel. If the monitoring staff notice there is any

deterioration in cell performance that need appropriate maintenance actions, the staff should notify the qualified manufacturer technician, SME(s) or B-28/W-28 COF holder to take a proper action to ensure the state of health of the energy storage system and to prevent unexpected battery failure or severe accidents, such as thermal runaway.

Such remote monitoring ensures the monitoring staff or automatic notifications can provide timely notifications to the Fire Department, Certificate of Fitness holder and manufacturer of the battery if the stationary energy storage system exhibits abnormal behavior that may lead to a serious malfunction that will cause fire, explosion or other serious adverse consequences.

Energy storage systems may be additionally monitored at a constantly-attended location at the premises, but such monitoring cannot substitute for the remote monitoring facility unless a modification (variance) is granted by the Technology Management Unit of the Fire Prevention.

The ESMS monitoring facility staff (or the persons who receive notifications from an automated facility) should be able to provide information about battery readings and what they indicate about battery status, especially as the ESMS is monitoring battery performance for purposes other than emergency notifications. If they are not sufficiently knowledgeable to address more technical questions about the battery's likely performance and the actions that should be taken to render it safe, the ESMS monitoring facility should maintain a notification tree for emergency notifications by which they can reach out to a subject matter expert (SME) on a 24/7 basis and arrange for a direct communication with the on-scene FDNY incident commander.

Prompt provision of technical assistance will protect the owner's investment. In the absence of timely, accurate information, the Fire Department may determine to flood (and may permanently damage) an energy storage system that, for example, is releasing smoke, when no action or more limited action may be warranted by the ESMS data or after the ESMS monitoring facility has remotely shut down the malfunctioning units.

The B-28/W-28 Certificate of Fitness holder shall additionally be notified, as response to the premises will be required if the energy storage system has failed and/or caught fire. Lithium ion energy storage systems, for example, have been known to reignite, so appropriate precautions should be taken to de-energize the energy storage system and/or safely remove the energy storage system or the damaged components from the premises. The Certificate of Fitness holder would be expected to manage the situation pursuant to its Emergency Management Plan, once the fire or emergency has been abated by the Fire Department.

The owner of the ESS's operation is responsible for ensuring the remote monitoring of Energy Storage Management System (ESMS) is provided. If the B-28/W-28 COF holder is aware of any ESS they supervise is not monitored by a remote ESMS monitoring facility, the B-28/W-28 COF holder shall notify the owner to comply with the Fire Code and Fire Department Rule requirements and shall report this non-compliance situation to the FDNY. The enforcement action will be taken for any stationary energy storage system that is not compliant with the FDNY requirements.

7.2 Central Station Monitoring of Fire Protection Systems

All fire protection systems protecting the energy storage system installation, including any automatic fire extinguishing system, and fire and gas detection or other emergency alarm system, shall be monitored by an approved central station.

However, small outdoor/rooftop/mobile and some indoor stationary energy storage systems (e.g. Group R-3 occupancies) are not subject to this requirement unless required as a condition of equipment approval based on full-scale testing.

The list of FDNY approved central stations is available on the following website:

https://www1.nyc.gov/assets/fdny/downloads/pdf/business/approved-companies-central-station.pdf

Refer to Chapter 8 of this booklet regarding the monitored fire alarm systems.

Fire protection systems may be additionally monitored at a constantly-attended location at the premises, but such monitoring cannot substitute for central station monitoring unless a modification (variance) is granted by the Technology Management Unit of the Bureau of Fire Prevention.

7.3 Signage

The following signs (or FDNY approved equivalent markings) shall be durably posted for each *stationary energy storage system*, at the locations indicated:

(A) Warning signs.

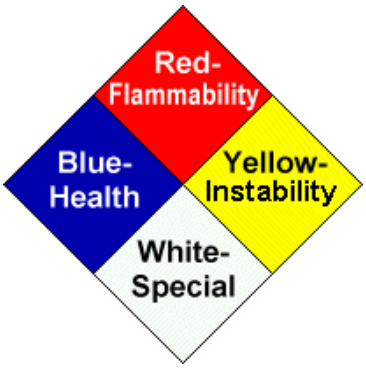
The following warning signs shall be posted on the exterior of medium and large energy storage systems or energy storage system enclosure:

(1) "Danger: High Voltage," or equivalent signage complying with the requirements of the *Electrical Code*; and

(2) NFPA 704 Hazard identification sign.

The sign provides a readily recognized for identifying specific hazards and their severity. The system is characterized by the "diamond shape". It identifies the hazards of a material and the degree of severity of the health, flammability, and instability (reactivity) hazards. In addition, a special precaution symbol

may be used if necessary. Hazard severity is indicated by a numerical rating that ranges from 0 indicating a minimal hazard, to 4 indicating a severe hazard. The hazards are color coded (blue for health, red for flammability, and yellow for instability or reactivity) and arranged spatially as follows:



The six o'clock position on the symbol represents special hazards and has a white background. The special hazards in use are ~~**W**~~, which indicates unusual reactivity with water and is a caution about the use of water in either firefighting or spill control response, and **OX**, which indicates that the material is an oxidizer.

(B) Identification, emergency contact and emergency shut-down signs.

The following signs shall be posted at the fire department connection, if any, utility connection or other approved, conspicuous outdoor location on the premises that is accessible to emergency response personnel and that is a reasonable distance (**but not less than 10 feet**) from the stationary energy storage system installation.

The signage may be posted within a marked, locked box secured by a citywide standard key (2642 key). If the location of the signage would not be readily apparent to emergency response personnel, a sign with large lettering (not less than 3 inches high) shall be posted on or adjacent to the battery installation indicating the location of the following signage:

(1) **Permit.** The permit for the installation, laminated or otherwise suitably weatherproofed.

(2) **Equipment specifications**. The manufacturer and model number of the energy storage system and electrical rating (voltage and current).

(3) **Installation identification**. The number or other unique identifier used by the energy storage management system remote monitoring facility to identify the installation, which firefighters or other Department representatives can reference in communications with the monitoring facility.

(4) **Monitoring facility contact information**. The telephone number of the energy storage management system remote monitoring facility.

(5) **Certificate of fitness contact information.** The name and telephone number of the certificate of fitness holder responsible for the energy storage system.

(6) **Emergency shutdown procedures**. Emergency shutdown procedures for the energy

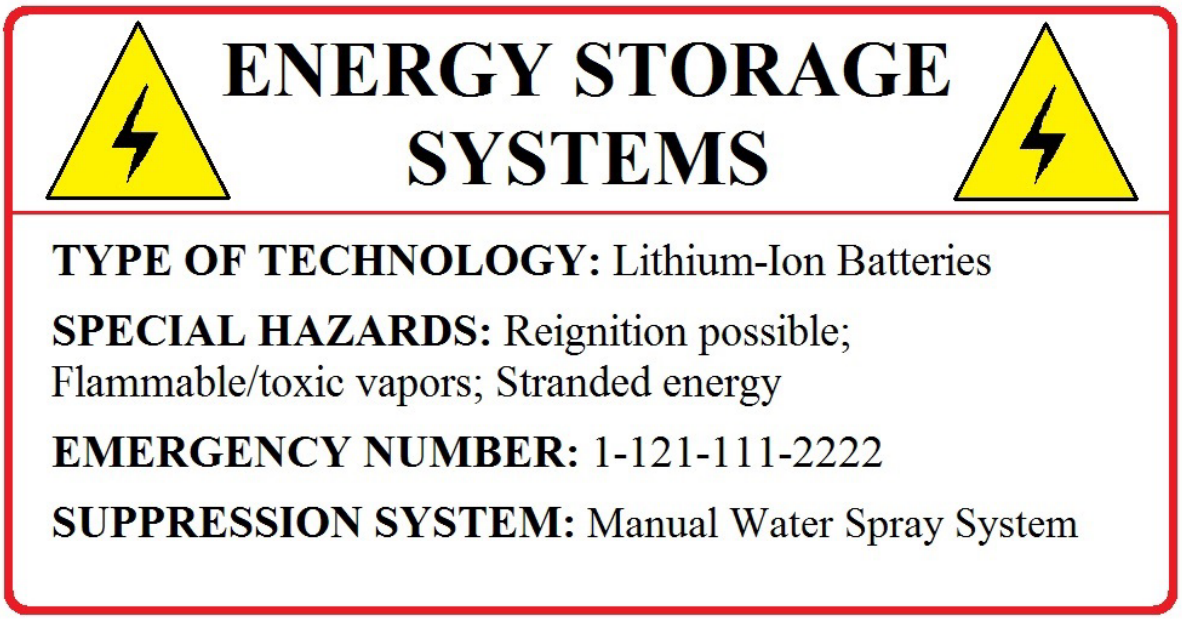
storage system shall be posted at the battery system emergency shut down (e-stop) control and at any attended on-site location.

The signage must also indicate whether the energy storage system is connected to a public utility power grid, such that its shut-down could have widespread or power grid impacts. The emergency shutdown instructions shall clearly indicate "GRID SUPPORT SYSTEM" in large letters (not less than 2 inches high) if immediate shut down of the energy storage system could disrupt.

NFPA 855 also provides recommendations for signage. It suggests that there should be a signage posted in approved locations near entrances to ESS rooms/enclosures. The recommended signage should include the following information:

(1) "Energy Storage Systems" with symbol of lightning bolt in a triangle
(2) Type of technology associated with the ESS
(3) Special hazards associated as identified by the manufacture.
(4) Type of suppression system installed in the area of the ESS
(5) Emergency contact information:
- The B-28 COF holder's contact number (required)
- FLSD/building safety personnel contact number (optional)

Example of the NFPA 855 suggested signage:



➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 COF holder must ensure all required signs are posted at the correct locations.

7.4 Maintenance

The owner shall ensure that stationary energy storage systems are periodically inspected, tested, serviced and otherwise maintained in accordance with manufacturer's specifications and the

requirements of this section by a person trained and knowledgeable in the specific energy storage system.

7.4.1 Periodic inspection

➢ B-28/W-28 COF holder's responsibilities

All medium and large outdoor/rooftop/mobile energy storage system shall be inspected by the B-28/W-28 Certificate of Fitness holder on not less than an **annual basis** to confirm:

- the presence of required signage
- whether any posted information needs to be updated, and
- all required systems are in good working order.

The owner shall ensure that all indoor stationary energy storage systems are periodically inspected, tested, serviced and otherwise maintained in accordance with manufacturer's specifications and the requirements of this section by a person trained and knowledgeable (e.g. B-28 COF holder) in the specific system. The FDNY may prescribe by rule stationary energy storage system periodic inspection requirements.

If the B-28/W-28 Certificate of Fitness holder notices any situation related to the ESS requiring attention, correction, or additional maintenance, the B-28/W-28 COF holder must contact the owner and/or the manufacturer to perform the service, repair or replacement.

7.4.2 Replacement components

Any replacement storage battery units or other energy storage system components shall be designed for the same storage battery technology and/or chemistry and be compatible with the existing energy storage system installation. In-kind replacement of existing components (consistent with the listing for the storage battery unit or energy storage system) constitutes maintenance and does not require Fire Department review and approval.

FDNY review and approval, and, as applicable, Department of Buildings review and approval, is required in the same manner as an application for a new stationary energy storage system installation for replacement of existing components that effect an alteration of the energy storage system, including:

- replacement of components included in the storage battery unit listing, or that could otherwise affect the results of the full-scale testing of the battery storage unit;
- replacement components that use different battery technologies or chemistries (including the electrolyte chemistry in a flow system); and
- replacement components that change the storage/generating capacity or other functionality of the stationary energy storage system.

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 COF holder must ensure that the components for replacement are designed for the same type of ESS and are consistent with the listing for the storage battery unit or energy storage system.

The B-28/W-28 COF holder must also document all the replacement activities and detail the components that have been replaced in the record.

7.4.3 Combustible waste and vegetation

Stationary energy storage system installations shall be kept free from the accumulation of combustible waste and combustible vegetation.

Weeds, grass, vines, brush or other vegetation that is capable of being ignited shall be regularly pruned or cleared and removed for a distance of 10 feet from any building or system.

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 COF holder must ensure that the ESS is kept free from the accumulation of combustible waste and combustible vegetation.

7.4.4 Storage of combustible materials

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 COF holder must ensure that no combustible material be stored in ESS enclosures, containers or in control areas in buildings where ESS is installed.

7.5 Requirements for Impairment Situation

All impairment situations must be documented in written records and maintained for at least 3 years.

7.5.1 ESMS does not transmit signal to the ESMS monitoring facility

The owner of the stationary energy storage system is responsible for ensuring the remote monitoring of ESMS is provided. The owner has the responsibility to ensure the remote monitoring is restored by a trained and knowledgeable personnel.

7.5.2 ESMS is out of service

When the Energy Storage Management System is out of service, the B-28/W-28 COF holder must ensure the operation of the affected ESS components is stopped.

7.5.3 The required fire detection system (fire alarm system) or explosion mitigation is out of service

Common out-of-service/impairment situations in the fire detection system includes but not limited to malfunctioning any detection device (smoke, heat, gas or other detectors); circuit problems; putting system off-line, etc. The B-28/W-28 COF holder must ensure that the Central Station Company include his/her contact information on their notification list. If there is any trouble/supervisory/fire alarm signal is received by the Central Station, the B-28/W-28 COF holder must be notified. If the Energy Storage Management System is functional and correctly transmit the data to the remote ESMS monitoring facility, but the B-28/W-28 COF holder is aware of the fire alarm system or explosion mitigation system is out of service, the following steps should be followed:

➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 COF holder must:

1. Notify the premises and energy storage system owner, the remote ESMS monitoring facility and the SMEs immediately and ensure the qualified licensed technician (S-97 or S-98 COF holder for the fire alarm system) is informed to fix the problem.
2. Place the out-of-service tags on the fire alarm control panel or the explosion mitigation device indicating which fire protection system, or part thereof, is out of service.
3. If the fire alarm control panel of the energy storage system is also linked to the building fire alarm system, inform the other COF holders that are also authorized to monitor and operate the building fire alarm control panel (e.g. FLS Director, F-53 COF holders, FEP Coordinators, etc.). F-01 COF holder(s) may be required to perform the fire watch depending on the size of the affected area and the duration of the out-of-service situation (refer to the F-01 FDNY study material for detail information).
4. Notify the FDNY if the fire alarm system has been out of service for more than 8 hours in any 24-hour period.
5. Shut down the ESS (if it is not used for emergency power system) if the fire alarm system has been out of service for more than
    a. 24 hours in any 24-hour period when the ESS is located on the rooftop of an occupied building; or
    b. 48 hours in any 48-hour period for any other ESSs.

When an out-of-service device, equipment or system is restored to service, the COF holder shall:

1. Conduct necessary inspections and ensure (general supervision) of any necessary tests to verify that the affected systems are operational.
2. Notify the owner, central station, emergency preparedness staff, the remote ESMS monitoring facility and the SMEs.
3. Notify the Fire Department (if previously notified).
4. Remove the out-of-service tags.

7.5.4 Any required fire protection system (e.g. standpipe system, sprinkler system) or manually-operated purge system that serve the ESS is out of service

➢ B-28/W-28 COF holder's responsibilities

Common out-of-service situations in the fire extinguishing system includes but not limited to damaged FDC, malfunctioning fire pump, etc. If the COF holder is aware of the required fire extinguishing system or the manually-operated purge is out of service, the operation of the energy storage system must be stopped.

If the ESS is located on rooftop or indoors, the COF holder must coordinate with the building emergency management staff (if applicable) and ensure they are listed on the notification list when any fire extinguishing system is out of service. F-01 COF holder(s) may be required to perform the fire

watch depending on the size of the affected area and the duration of the out-of-service situation (refer to the F-01 FDNY study material for detail information).

If the B-28/W-28 COF holder is aware of the **standpipe system** (including the FDC connecting to the standpipe system) is out of service, the following steps must be followed:

1. Notify the premises and ESS owner, the remote ESMS monitoring facility, the SMEs, and the S-13/S-14 COF holder (if applicable) immediately and ensure the qualified licensed technician is informed to fix the problem.
2. Shut down the ESS (if it is not used for emergency power system).
3. Ensure that the out-of-service tags are placed at each fire department connection, control valve indicating which fire extinguishing system, or part thereof, is out of service.
4. Ensure that FDNY is properly notified.
5. Maintain communication with the building emergency management staff to follow up the repair.

If the B-28/W-28 COF holder is aware of **required fixed fire extinguishing system** (including the FDC servicing this system) or **the smoke-purge system** is out of service, the following steps must be followed:

1. Notify the premises and ESS owner, the remote ESMS monitoring facility, the SMEs and the COF holder responsible for supervising this system immediately and ensure the qualified licensed technician is informed to fix the problem.
2. Shut down the ESS (if it is not used for emergency power system).
3. Place the out-of-service tags at each fire department connection, control valve indicating which fire extinguishing system, or part thereof, is out of service.
4. Notify the FDNY whenever the system is out of service for 8 hours in any 24-hour period.
5. Maintain communication with the building emergency management staff (if applicable).

When an out-of-service device, equipment or system is restored to service, the B-28/W-28 COF holder shall:

1. Ensure that the necessary inspections and tests have been conducted to verify that the affected systems are operational.
2. Notify the owner, emergency preparedness staff, the remote ESMS monitoring facility and the SMEs.
3. Notify the Fire Department (if previously notified).
4. Remove the out-of-service tags.

CHAPTER 8. Fire Alarm System

8.1 Introduction

Fire alarm systems monitor the status of fire alarm or supervisory signal initiating devices and ensure the appropriate responses. Fire alarm systems are required in many premises as part of a fire protection system.

The Fire Code 608.11.2 requires that all fire protection systems protecting the stationary energy storage system installation, including any fire extinguishing system, and fire and gas detection or other emergency alarm system, shall be monitored by an FDNY approved central station.

The Fire Department rule (3RCNY 608-01(h)) also requires the approved fire alarm system to be installed in all medium and large outdoor/rooftop energy storage system enclosures. Activation of a fire or gas detector in the enclosure must transmit an alarm signal to the fire alarm system and thereby to an approved central station.

For indoor ESS, all fire protection systems required by FC 608, construction codes or the Certificate of Approval must be monitored by an FDNY approved central station.

➢ B-28/W-28 COF holder's responsibilities

The B-28/W-28 COF holder must be familiar with the fire alarm sequence-of-operation matrix of the fire alarm system that he/she supervises. The COF holder must ensure his/her name is listed on the central station contact list and must have the contact information for other responsible COF holders, SMEs, central station and emergency preparedness staff during out-of-service situation or emergency.

The fire alarm system installed for monitoring the outdoor/rooftop ESS enclosure must be under general supervision of a B-28/W-28 COF holder. If the fire alarm system is a subsystem that is linked to a building fire alarm system (commonly applied to the rooftop energy storage system or indoor systems), the B-28 COF holder must maintain communication with a person who is responsible to supervise the main building fire alarm system (the person may be an FLS Director, F-80, F-53 or S-95 COF holder). In many cases, the central station may only contact the person who supervise the main building fire alarm system for signals and alarms. The B-28 COF holder must ensure that he/she is also on the other COF holder's (FLSD, F-80, F-53 or S-95) contact list and the central station contact list. He/she must take care of any signal and alarm sent from the fire alarm subsystem monitoring the energy storage system enclosure and must be aware of fire alarm signal generated from main building fire alarm system.

Section FC901.4.4 of the New York City Fire Code prohibits installation or maintenance of any fire protection system or device that has the physical appearance of fire protection equipment but that does not perform a fire protection function. The law prevents those devices from being confused with actual fire protection equipment.

Examples of prohibited devices are shown in images below:

Dummy Smoke Detector
Hidden Video Camera

A CCTV camera that is installed inside a shell that resembles a sprinkler head

8.2 Fire Alarm Control Panel and Communication Systems

Fire Alarm Control Panel (FACP) is a system component that monitors inputs and control outputs through various circuits. The primary purpose of the FACP is to process signals received from initiating devices and to activate appropriate signals and outputs. **Only authorized personnel (B-28/W-28/FLS Director/F-80/F-53 COF holders) are allowed to operate and address alarms/signals at the FACP.**

8.2.1 Pre-signal systems with Event/Non-Event Mode (only applies to rooftop energy storage system or indoor energy storage systems in assembly occupancies)

Group A occupancies (e.g. theaters, etc.) with a large number of occupants may be provided with a pre-signaling fire alarm system. Such type of fire alarm system is equipped with the Event/Non-Event Mode that can be selected by a two-position key switch, which is operated by a city-wide standard key (#2642). This kind of fire alarm control panel will be supervised by an F-53 COF holder. If the fire alarm is in Event Mode, the alarm will not be sounded to the public immediately but only to be shown on the panel and be transmitted to the Central Station and Fire Department. Fire Department will be dispatched to respond the fire alarm signal. The F-53 COF must notify the emergency preparedness staff to start the investigation to exclude any false alarm before the audible and/or visual notification start to alert the occupants.

If the fire alarm system monitoring the energy storage system enclosure is linked to the FACP of an assembly occupancy, the B-28 Certificate of Fitness must be included in the notification list that the F-

53 COF holder will reach. The B-28 Certificate of Fitness must start the required notification procedure once he/she is aware that the energy storage system may be exposed to any fire risk.

8.2.2 Emergency voice/alarm communication systems (only applies to rooftop energy storage system or indoor energy storage systems)

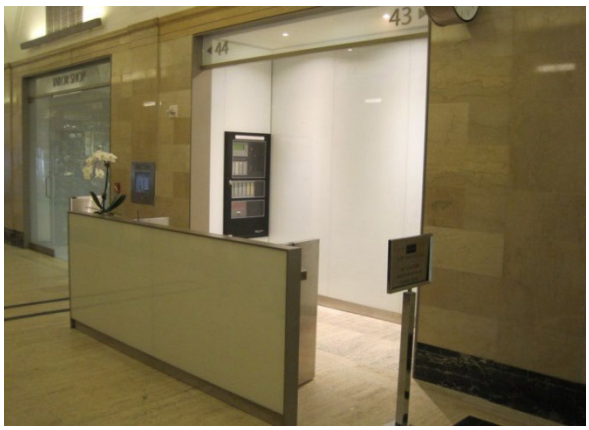
Many Fire Alarm Control Panels (FACP) have also been installed with emergency communication systems based upon the Building and Fire Code requirements.

In high-rise or certain large area buildings, the current NYC Building Code requires that the operation of any automatic fire detector, sprinkler waterflow device, or manual fire alarm box must automatically sound an alert tone to be followed by voice instructions to facilitate an evacuation.

The emergency voice/alarm communication system may have multi-channel capability. It may be designed to broadcast live voice messages by paging zones on a selective and all-call basis.

If there is one-way or two-way emergency communication systems installed in the fire alarm system, the fire alarm system will be required to monitored and operated by an FLSD (F-89/T-89)/F-80/F-53 Certificate of Fitness holder. The B-28 COF holder should coordinate with the COF holders and provide the information they need.

8.2.3 Fire Command Center (only applies to rooftop energy storage system or indoor energy storage systems)



In many high-rise buildings, the Fire Alarm Control Panel will be required to be located at the Fire Command Center. Fire Command Center is the principal attended or unattended location where the status of the detection, alarm communications and control systems is displayed, and from which the system(s) can be manually controlled.

The Fire Command Center location must be in the lobby of the building on the main entrance floor near the Fire Department designated response point or other location approved by the FDNY. The Fire Command Center may be located in the lobby of the building on the entrance floor as part of elevator control panel or immediately adjacent to it. It can be as simple as a Fire Alarm Control Panel used to monitor different signals related to fire alarm systems and to make announcements through the communication system. It may also include elevator recall, ventilation shutdown, activation of the release of all fail-safe (electro-magnetic door release) devices (if applicable), activation of stair pressurization and smoke ventilation systems, etc.

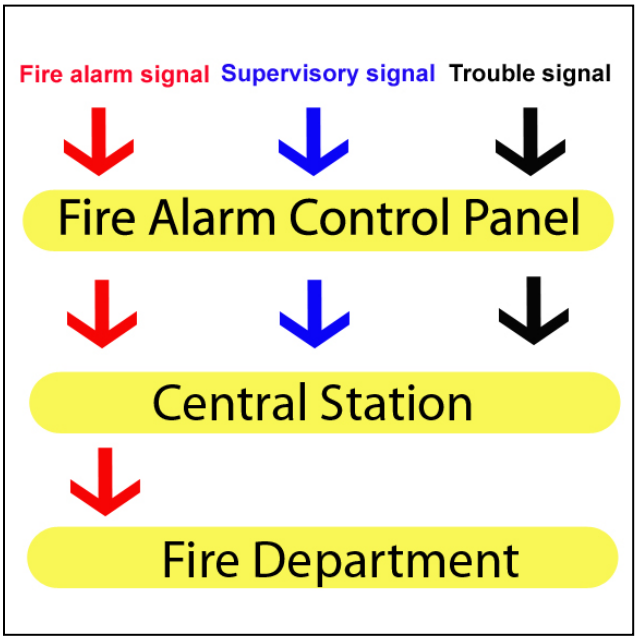
If the fire alarm control panel of the energy storage system is connected to a FACP that located at the Fire Command Center, the B-28 COF holder should maintain communication with the Fire Command Center during fire and non-fire emergencies.

8.3 Three Fire Alarm Control Panel Signals

In order to supervise the fire alarm control panel of the ESS, the B-28/W-28 COF holder must know the components of the Fire Alarm Control Panel (FACP), how to use it, and how to interpret different signals. There are three different signals shown on the FACP: fire alarm signals, supervisory signals and trouble signals.

Signal types	**Description**	**Fire Alarm Control Panel (FACP)**	**The responsible COF holder's actions**
Fire alarm signal	It is initiated by a fire alarm initiating device (e.g. smoke/heat detector, etc.). This signal is an indicator of a fire or smoke condition.	It displays at the FACP. The FACP will activate the audible and visual devices connected to the fire alarm (i.e. horn/strobes). (Exception: the fire alarm systems in Event Mode)	Must treat it as a fire/smoke emergency and perform the required duties & responsibilities
Supervisory signal	It is initiated by a supervisory device to indicate abnormal conditions that could affect the proper operation of the fire protection system(s) including, but not limited to, control valves, pressure levels, pump power, etc.	It displays at the FACP to indicate the supervisory condition. Some FACPs indicate the exact location of the problem. Other FACPs only display a general supervisory signal.	Must investigate and contact the contractor to fix the problem(s).
Trouble signal	It is initiated by a system or device indicative of a fault in a monitored circuit, system, or component.	It displays at the FACP to indicate the trouble condition.	Must investigate and contact the contractor to fix the problem(s).

All three signals will be shown on the FACP and be transmitted to the central station (if this alarm system is monitored). However, only the fire alarm signal will be re-transmitted to the Fire Department through the central station. The FDNY is not dispatched to respond to supervisory/trouble signals. **The COF holder must ensure that he/she will be notified by the central station for any signal (fire alarm, supervisory and trouble) that is transmitted to the central station.**



8.4 Fire Alarm Signal is Generated

8.4.1 Acknowledge switch or button

An acknowledge button, also abbreviated as ACK, is used to acknowledge alarm, trouble, or supervisory conditions. Whenever the alarm is activated, the COF holder must report to the FACP location. The COF holder should press the ACK while reviewing events/signals. This action means the COF holder is aware of the condition(s) and is going to investigate. Pressing acknowledge will silence the tones at the FACP only but not silence the building notification devices.

8.4.2 Alarm silence switch or button

The alarm silence switch is used to silence the building audible and visual devices (such as sirens, bells or gongs) after an evacuation is complete while the source of alarm is being investigated. The alarm signal will continue to be transmitted after pressing the silence button. **Never silence the building alarm tones or reset the fire alarm system until instructed by the FDNY Firefighting personnel**. The alarm silence switch/button will either silence the system's notification appliances completely or will silence only the audible alarm, with strobe lights continuing to flash. The FDNY firefighting personnel may ask the COF holder to silence the building alarm tones, because silencing the alarm allows for easier communication for emergency responders while responding to an alarm. However, if the system is monitored by an FDNY approved central station, the silence switch does not prevent a signal from being transmitted to the central station.

8.4.3 System reset switch or button

This switch is used to reset the fire alarm system after an alarm condition has been cleared. All initiating devices should return to normal condition after manually resetting. If an initiating device is still in alarm

after the system is reset, such as smoke detectors continuing to sense smoke or a manual fire alarm boxes is still in an activated position, another alarm will be generated. Most trouble and supervisory conditions will clear automatically when conditions are returned to normal.

An FACP indicating an alarm signal cannot be reset to "normal" if the device or devices signaling the alarm to the FACP have not returned to "normal" from "alarm".

DO NOT SILENCE BUILDING AUDIBLE VISUAL DEVICE OR RESET THE FIRE ALARM CONTROL PANEL UNTIL INSTRUCTED BY THE FDNY FIREFIGHTING PERSONNEL.

8.5 Initiating Devices

An automatic fire alarm system is a system which sounds a signal automatically when a fire detection device indicates that there is a fire.

An automatic fire detector is an initiating device which detects the presence of a fire condition and initiates action. This includes the detection of the presence of smoke and or heat. **The activation of initiating devices will activate the fire alarm system and send the fire alarm signal to the central station and fire department**. **The fire alarm control panel (FACP) should indicate which devices/systems have been activated.**

As stated in the NYC Fire Code, the term "initiating" device covers not only fire detection devices such as heat detectors and smoke detectors, but also other devices, such as flammable/combustible gas detectors (e.g. Carbon monoxide detector, natural gas detector, etc.), that monitor conditions related to fire safety.

Proper preventative measures must be taken to protect all fire alarm initiating devices i.e. smoke, heat, and duct detectors especially during construction.

8.5.1 Smoke detectors

A smoke detector is a device that detects visible or invisible particles of combustion. Smoke detectors detect most fires much more rapidly than heat detectors. They automatically detect a fire by sensing smoke particles. The smoke particles may be visible or invisible to the human eye.

NEVER cover up the smoke detector. A protective guard used to protect a smoke detector must be listed for use with that detector. When a smoke detector reports the need for maintenance to the Fire Alarm Control Panel, it must be cleaned as soon as possible but not exceeding 1 week.

	
Unacceptable	Acceptable

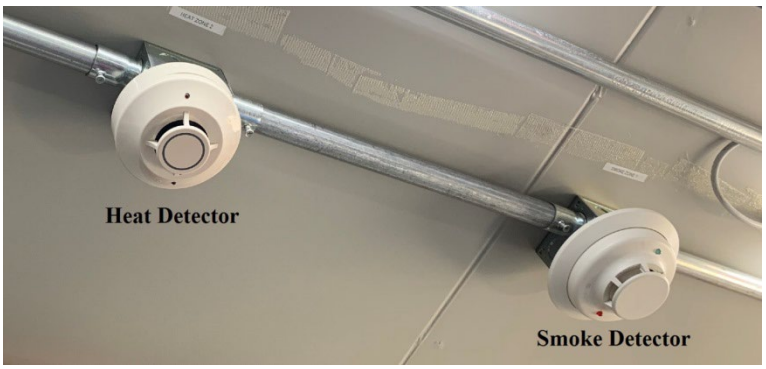
8.5.2 Heat detectors

A heat detector is a device that detects abnormally high temperatures or rate of temperature rise. Heat detectors have been shown to be very effective in reducing fire damage.

Heat detectors can only be tested by authorized fire alarm technicians. If the COF holder notices any heat detector is not functional, he/she must notify fire alarm maintenance companies to make all necessary repairs.

Where subject to mechanical damage, a heat detector must be protected by an approved testing laboratory (i.e. UL or FM Global) mechanical guard as shown in the picture below.

Heat detector with protective mechanical guard



If a fire suppression system (e.g. FM-200 Clean Agent fire suppression system) is voluntary installed to protect the energy storage system enclosure, the activation of smoke detector or/and heat detector normally will trigger the fire suppression system.

8.5.3 Sprinkler waterflow alarm-initiating devices (only applies to the enclosure that protected by an automatic sprinkler system)

The waterflow alarm initiating devices are used to detect the flow of water in a fire sprinkler system and to send an alarm signal. If the water starts to flow in the system, the vane or paddle triggers a switch sending a signal to the Fire Alarm Control Panel and activate bell. This device does not turn on or off the water. The activation of these devices will cause the fire alarm system to sound and send the fire alarm signal to the central station and Fire Department.

8.5.4 Manually actuated alarm-initiating devices

Fire alarm systems that are manually activated use fire alarm manual pull stations. Manual fire alarm boxes (also referred to as pull stations) must be located near the exits throughout the protected area so that they are conspicuous, unobstructed, and accessible.

The manual fire alarm boxes **may not directly transmit a signal to the FDNY. A phone call must always be made to 911. DO NOT assume that the FDNY has been called if you hear a fire alarm or smoke detector sound.**

The Certificate of Fitness holder must know how to manually operate any type of manual fire alarm boxes on the premises. Once activated, the fire alarm system cannot be re-set at the pull station. The alarm must be re-set at a main FACP after the pull station is reset to its normal condition; a key may be required to reset the pull station. Once a manual fire alarm box is activated, it must be reset prior to resetting at the main Fire Alarm Control Panel (FACP). **The FACP must only be reset at the direction of the Fire Department firefighting personnel.**

- **Single action stations** require only one step to activate the alarm. For example, the alarm might be activated by pulling down on a lever. This kind of alarm station is often found indoors (e.g. in office buildings). The cover on these alarm stations serves as a lever. When the cover is pulled down, it allows a switch inside to close. This action sends the alarm signal.

Single action stations

- **<u>Double action stations</u>** require two steps in order to activate the alarm. The user must first break a glass, open a door, or lift a cover. The user can then gain access to a switch or lever which must then be operated to initiate an alarm. To activate this type of alarm station, the cover must be lifted before the lever is pulled. This kind of double action station is often found indoors. Another kind of double action break glass station requires someone to break a small panel of glass with a small metal mallet.

Double action station

The FDNY may require the approved protective covers to be installed over single or double action stations to prevent malicious false alarms or provide the manual fire alarm box with protection from physical damage.

8.5.5 <u>Flammable/combustible gas detectors</u>

If approved gas detection system is required to be installed in a energy storage system enclosure, the system will be also connected to the FACP. When the level of flammable gas inside the energy storage system enclosure exceed 25% of the lower flammability limit (LFL), the gas detection system shall be activated. The activation of the system is programmed as a fire alarm signal and will be transmitted to the Fire Department.

Example of a flammable/combustible gas detector

8.5.6 <u>Types of devices and activations</u>

TYPE OF DEVICE	ACTIVATED BY	ACTION NORMALLY REQUIRED TO RETURN DEVICE TO "NORMAL" CONDITION
Manual fire alarm box	Manually pulling handle	Return handle to normal position. A key or other method may be required to reset the station to a normal condition.
Smoke detectors	Detection of particles of combustion ***see note below**	Smoke detectors will normally reset when the reset button is pressed at the FACP if the condition activating the detector has been cleared.
Heat detectors	Abnormally high temperature (fixed temperature detector) or rapid temperature rise (rate of rise detector)	After activation most **fixed temperature** heat detectors will not self-restore and will require replacement by a qualified service technician. **Rate-of-Rise** detectors will normally self-restore after activation.
Water-flow device	Flow of water in a sprinkler system	Device should return to normal when water ceases to flow.
Flammable/combustible gas detectors	When the level of flammable gas inside the energy storage system enclosure exceeds 25 percent of the LFL.	Device should return to normal when the level of flammable gas does not exceeds 25% of the LFL.
NOTE: Care must be taken at all times to protect all smoke detectors from the entrance of foreign particles which may be airborne. Dust from cutting wood, sheet rock or sanding may trigger a false alarm. Steam is also a common cause for smoke detector activations and steam is also a concern because it often saturates the smoke detector with moisture rendering it out of service. Smoke detectors which have not been properly cleaned and maintained will also create false alarms.		

8.6 Power Supplies for the Fire Alarm System

Fire alarm systems are required to have primary and secondary power supplies. The COF holder must know the power supply source of the building fire alarm system.

Pushing e-stop of the ESS does not isolate the power supplies for the fire alarm system.

8.7 Audible and Visual Notification Devices

Notification appliances are used to alert persons of the need to take action, usually to evacuate. The appliances include bells, horns, or strobes. The audible and/or visual notification alerts the occupants of a fire or other emergency condition requiring action. The activation of these notification devices normally indicates that fire alarm signals are generated by initiating device(s).

Horn Strobe

Strobe

Gongs Bells

The audible or visual notification may be activated by different methods to notify the occupants of a building in case of a fire. Some systems are designed to activate all audible/visual devices throughout the building when a fire is detected. However, some systems are designed to activate the audible/visual devices only on the floor of alarm, the floor immediately above, and/or the floor below (if applicable).

As a COF holder of a ESS installed on rooftop, you must be familiar with the sequence of operation of the specific fire alarm system installed at the premises; know whether the building's fire alarm system is designed to ring only on the selected floors or throughout the building.

After the fire alarm system has been activated it must be reset manually. The fire alarm system must be reset at the FACP under the direction of FDNY representatives. The fire alarm must remain in operating condition at all times.

8.8 Central Station Contact Information, Central Station Transmitter and Fire Alarm System Off-Line

Central Station is different from the ESMS monitoring facility. ESMS is monitored by the ESMS monitoring facility; however, the fire alarm system must be monitored by an FDNY approved central station. The telephone number of the central station must be readily available to the B-28/W-28 Certificate of Fitness holder. The telephone number and the account number associated with the fire alarm system are required to be located on the FACP and central station transmitter.

A central station transmitter is a device that receives alarm signals from protected premises and retransmits those signals to the Fire Department's Bureau of Fire Communication through an FDNY approved central station. The COF holder should be familiar with the location of the central station transmitter box, if it is separated from the FACP.

The Certificate of Fitness holder must make sure that the central station transmitter is operable at all times. When transmitter malfunctions are discovered, the Certificate of Fitness holder must report the malfunctions to the central station company and record it in the logbook. The central station company must arrange for any and all repairs as soon as possible.

B-28/W-28 Certificate of Fitness holders are **prohibited** from performing any repairs on the fire alarm system.

8.9 Periodic Inspection and Testing Requirements

Fire alarm systems are required to be maintained in good working order. To ensure that fire alarm systems are maintained in such condition, the Fire Code and Rules provide minimum requirements for the periodic inspection, testing, and other maintenance of such systems.

Any time a fire alarm system is to be activated during a test, inspection, or fire drill, it is mandatory to take the system "off line" by notifying the FDNY approved central station company monitoring the fire alarm beforehand to prevent the unnecessary dispatching of the Fire Department. It is not necessary to take the system offline when the speaker audibility tests are being conducted.

8.9.1 Inspection frequencies

Mandatory visual inspection frequency requirements for common equipment:

(1) Control equipment: fire alarm system MONITORED for alarm, supervisory, and trouble signals: annually.
(2) Manual fire alarm boxes (pull stations), heat detectors, smoke detectors: semiannually.
(3) In-building fire emergency voice/alarm **communications equipment**: semiannually

****Daily visual inspection of the FACP has been the industrial practice and highly recommended by the Fire Department**. A B-28/W-28 COF holder or other qualified COF holder (listed on the following page) is recommended to visually inspect the Fire Alarm Control Panel and fire alarm devices (such as interfaced equipment, lamps and LEDs, and Primary (main) power supply, etc.) for indicated abnormal conditions. The purpose of the visual inspection is to detect defective components or abnormalities. The visual inspection must be made to ensure that there are no changes that affect equipment performance.

8.9.2 Companies and individual certifications

NFPA Standard 72 sets forth detailed requirements for the periodic inspection, testing and other maintenance of fire alarm systems. Different Certificate of Fitness holders are permitted to carry different levels of responsibilities in inspecting, testing and maintaining the fire alarm systems:

Duties and responsibilities		May be performed by the following COF holders:		
		B-28/W-28/S-95/F-89/T-89/F-80/F-53	**S-78/F-78**	**S-97/S-98**
1.	Visual inspections of fire alarm system or smoke detectors	**Yes**	**Yes**	**Yes**
2.	Smoke detector inspection, maintenance testing & cleaning	**No**	**Yes**	**Yes**
3.	Program, service, clean, test, repair and/or replace fire alarm components	**No**	**No**	**Yes**

F-53: Emergency One-Way Voice Announcement Personnel

F-80: Coordinator of Fire Safety and Alarm System in Homeless Shelters

F-89/T-89: FLSD

S-78/F-78: Inspection, Cleaning & Testing of Smoke Detectors

S-95: Supervision of Fire Alarm Systems

S-97/S-98: Fire Alarm Systems Inspection, Testing and Service Technician

- The approved smoke detector maintenance company list is updated on a monthly basis and can be accessed through the following link:

  http://www1.nyc.gov/assets/fdny/downloads/pdf/business/approved-companies-smoke-detectors.pdf

- The approved central station list is updated on a monthly basis and can be accessed through the following link:

  http://www1.nyc.gov/assets/fdny/downloads/pdf/business/approved-companies-central-station.pdf

8.10 Unnecessary and Unwarranted Alarms

Unnecessary and unwarranted alarms divert essential services from emergencies. These alarms may also cause business disruptions and create public's negative views of fire alarm systems. The owner of any premises whose fire alarm system is monitored by a central station must prevent unnecessary and unwarranted alarms. **It is unlawful to transmit 2 or more unnecessary or unwarranted alarms in any three-month period** and will be subject to issuance of a Fire Department Summons (previously known as Notice of Violation).

CHAPTER 9. CAUSES OF BATTERY FAILURES AND EMERGENCY MANAGEMENT PLAN

9.1 Root Causes of Energetic Cell and Battery Failures

(Information contained in this section is cited from the NFPA report for lithium-ion batteries hazard and use assessment published in July 2011)

Batteries can fail in energetic mode. Typical energetic failure mode is thermal runaway. Cell thermal runaway refers to rapid self-heating of a cell derived from the exothermic chemical reaction of the highly oxidizing positive electrode and the highly reducing negative electrode; it can occur with batteries of almost any chemistry. In a thermal runaway reaction, a cell rapidly releases its stored energy. The more energy a cell has stored, the more energetic a thermal runaway reaction will be.

Generally, the root causes of energetic cell and battery failures can be classified into:

- Thermal abuse;
- Mechanical abuse;
- Electrical abuse;
- Poor cell electrochemical design; and internal cell faults associated with cell manufacturing defects.

9.1.1 Thermal abuse

The most direct way to exceed the thermal stability limits of a battery cell is to subject it to external heating. Acute exposure of a cell to high temperatures will readily induce thermal runaway in that cell. Typically, if an internal cell fault is sufficient to cause thermal runaway in a single cell of a multi-cell battery pack, heat transfer from the faulting cell will cause thermal runaway in neighboring cells of the battery pack. Thus, the thermal runaway reaction will propagate through a battery pack.

The COF holder should ensure the ventilation system of the energy storage system, if applicable, is in a good working order to keep the enclosure under a proper ambient temperature. In addition, if the ESMS system indicates any abnormal temperature change of the energy storage system, the COF holder and/or the SME should be notified to address this issue.

9.1.2 Mechanical abuse/damage

Mechanical abuse/damage of cells can cause shorting between cell electrodes, leading to localized cell heating that propagates to the entire cell and initiates thermal runaway. The mechanical abuse includes mechanical shock, drop, crush, immersion (e.g. flooding), vibration, structure collapse, etc.

Flooding can induce electrical damage to ESS that should be taken into consideration after water has receded. Systems experience severe vibrations might be prone to fire if cells have been mechanically damaged or power electronics are damaged and operating improperly, leading to electrical overcharge or other abuse conditions that can cause fire.

Mobile energy storage system may be subject to more mechanical damages/impacts because of frequent transportations, W-28 COF holders must follow the precautions outlined by the manufacture/installer to protect the system from the mechanical damages/impacts.

The COF holder should ensure the installation of the energy storage systems will prevent the systems from the mechanical abuse/damage. If the COF holder is aware of any cell/pack that have suffered mechanical abuse, the cell/pack must be evaluated by the SMEs or the manufacturer technicians to ensure the damage did not induce a defect likely to cause any problem, or the cell/pack should be disposed of by the trained and knowledgeable personnel.

9.1.3 Electrical abuse

There are a number of ways in which battery cells can be abused electrically, leading to cell thermal runaway reactions. Some of these mechanisms are described are overcharge, external short circuit (may be caused by flooding) and over-discharge. The functional ESMS should eliminate these situations.

9.1.4 Poor design and manufacturing defects

The majority of thermal runaway failures in the field are still caused by internal cell faults related to cell manufacturing defects. The COF holder shall ensure all the components of the stationary energy storage systems are tested and listed by a nationally recognized testing laboratory by checking the equipment approval letter issued by the FDNY before commissioning.

9.1.5 Other possible causes for lead-acid batteries

Sulfation is a buildup of lead sulfate crystals and is the number one cause of early battery failure in lead-acid batteries. Sulfation occurs when a battery is deprived of a full charge, it builds up and remains on battery plates. When too much sulfation occurs, it can impede the chemical to electrical conversion. A buildup of sulfates can cause dramatically shorter battery life and complete battery failure. All lead acid batteries will accumulate sulfation in their lifetime as it is part of the natural chemical process of a battery. Sulfation builds up and causes problems when the battery is overcharged, stored above 75 degrees or stored without a full charge. Swelling of a case can indicate potential improper charging voltage of the cell for the ambient temperature of the site.

9.2 Emergency Management Plan

The owner, manufacturer and/or installer of a stationary energy storage system shall have an emergency management plan or protocol that includes procedures for notifications, provision of technical assistance to the FDNY, mitigation of hazardous conditions, and decommissioning or restoration to normal operation. The FDNY may require that a representative of the stationary energy storage system manufacturer or other subject matter expert with technical knowledge of the system and its operation be available in a timely manner to provide technical assistance to the Fire Department during an emergency involving or affecting the system.

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

The plan should be readily available for use by facility operations and maintenance personnel.

The FDNY requires the Emergency Management Plan including the following information:

- Size and the type of the ESS
- Type of the fire extinguishing system(s) installed, if applicable
    - If clean agent fire suppression system is installed, the designed hold time information
- The type of the occupancy that the energy storage system serves
- Procedure for notifications in case of fire, explosion, release of liquids or vapors, damage to critical moving parts, or other potentially dangerous conditions.
- Procedures for inspection and testing of associated alarms, interlocks, and controls
- Contact information: Name and telephone number of
    - the ESMS remote monitoring facility
    - the SMEs
    - the COF holder
    - the premises owner
- Procedures for safe shutdown, de-energizing, or isolation of equipment and ESS under emergency conditions to reduce the risk of fire, electric shock, and personal injuries, and for safe start-up following cessation of emergency conditions
- Response considerations similar to a safety data sheet (SDS) that will address response safety concerns and extinguishment including:
    - what kinds of hazards may be related to this type of the system (under normal condition and during fire emergency)?
    - What kinds of flammable/corrosive/toxic gases maybe generated by the system
- Decommissioning of malfunctioning energy storage system 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.
- The locations of
    - Required signs
    - E-Stops
    - Disconnect switches (i.e. “lockout, tagout”)

  - Fire Department Connection (FDC) locations,
  - The vent and the manual activation switch of the smoke/gas purge system
  - Fire extinguishing system manual activation (if applicable)
  - Standpipe (if applicable)
  - Hydrants (if applicable)
  - The deflagration vents and/or exhaust outlets (if applicable)
- Standoff distances for electrical hazards and explosion hazards

The Certificate of Fitness holder must be familiar with their site Emergency Management plan and would be expected to manage the situation pursuant to the plan.

CHAPTER 10. NOTIFICATIONS AND EMERGENCY RESPONSES

➢ B-28/W-28 COF holder's responsibilities

B-28/W-28 COF holder must be familiar with all the following notification and emergency procedures.

10.1 Commissioning and Decommissioning Notification

The Fire Code requires notification to the Fire Department in connection with the commissioning and decommissioning of these stationary energy storage systems. Notice of the commissioning and decommissioning of stationary energy storage systems shall be given to the Fire Department, and the removal of a malfunctioning system coordinated with the Fire Department, as follows:

a. Small outdoor/rooftop/mobile energy storage systems and indoor stationary energy storage systems

The owner or certificate of fitness holder shall notify the Fire Department of the commissioning or decommissioning of a small stationary energy storage system, by emailing to tech.mgt@fdny.nyc.gov no later than two (2) business days after installation, the battery type, manufacturer and rated energy capacity, and the name and certificate of fitness number of the certificate of fitness holder who will be, or is no longer, responsible for supervision of the system.

b. Medium and large outdoor/rooftop/mobile energy storage systems

The owner shall notify the Fire Department of the commissioning or decommissioning of a medium or large stationary energy storage system and give Fire Department representatives the opportunity to attend the commissioning or decommissioning to monitor the process; familiarize themselves with a commissioned energy storage system's installation and operation; and/or confirm the proper decommissioning of an energy storage system in accordance with the approved decommissioning plan. The owner shall notify the Fire Department by emailing the date, location, type and size of the energy storage system installation to tech.mgt@fdny.nyc.gov not later than two (2) business days prior to the scheduled action. No confirmation is required and the scheduled action can proceed in the Fire Department's absence. If the action is rescheduled, amended notice shall be given to the Fire Department in as timely a manner as circumstances allow.

c. Decommissioning of malfunctioning energy storage system

The removal and transportation of any ESS that has given abnormal temperature or gas emission readings as a result of physical damage, exposure to fire or other actual or potential cause of damage, shall be coordinated with the Hazardous Materials Unit of the Fire Department's Bureau of Operations, who may send representatives to monitor the decommissioning process. The Hazardous Materials Unit shall be notified two (2) business days prior to the scheduled action, or in as timely a manner as circumstances allow, by calling the Fire Department Communications Office in the borough in which the energy storage system is located.

10.2 Remote monitoring and reporting

The ESMS monitoring facility staff (or the persons who receive notifications from an automated facility) shall, without delay, make the following notifications in the event an energy storage system installed in New York City exceeds or appears likely to exceed thresholds at which fire, explosion or other serious adverse consequences may result:

(A) Notify the Fire Department by calling the Communications Office in the borough in which the energy storage system is located, to alert the Fire Department to the unsafe condition;

(B) Notify the Certificate of Fitness holder responsible for the energy storage system, in a pre-arranged manner, to alert such individual to be ready to provide technical assistance to the Fire Department and/or respond to the incident location; and

(C) Notify the manufacturer of the energy storage system to make a qualified representative available to provide technical assistance to the Fire Department.

The ESMS monitoring facility staff (or the persons who receive notifications from an automated facility) should be able to provide information about battery readings and what they indicate about battery status, especially as the ESMS is monitoring battery performance for purposes other than emergency notifications.

10.3 Technical Assistance and Emergency Management

Once the Certificate of Fitness holder is notified by the ESMS monitoring facility staff in case of the energy storage system has failed and/or other emergencies, the Certificate of Fitness holder shall manage the situation pursuant to its emergency management plan including providing technical assistance and emergency management to the Fire Department.

10.3.1 Technical assistance

Upon request of the Fire Department, both the COF holder responsible for the ESS and the energy storage system manufacturer shall make available to the Fire Department a representative with technical knowledge of the ESS and its operation. Such representative shall be made available immediately.

10.3.2 Emergency Management

Upon request of the Fire Department, the COF holder responsible for the ESS and an authorized representative of the owner of the premises upon which the ESS is installed shall respond to the location of the installation, as soon as possible but in any event within two (2) hours of notification, to

assist the Fire Department in addressing a fire or other emergency involving or affecting the ESS, and to take all other actions necessary for mitigation and decommissioning of the ESS, or restoration to normal operation.

10.4 Interaction with First Responders

10.4.1 Incident Command System (ICS)

The Incident Command System (ICS) is a management system designed to enable effective and efficient domestic incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure.

Incident Command System allows personnel from a variety of agencies to meld rapidly into a common management structure. It ensures that resources are deployed where most needed. It provides the logistical and administrative support to ensure that operational staff can meet incident objectives.

The Incident Commander (IC) has overall responsibility for managing the incident. The IC must be fully briefed and should have a written delegation of authority. Initially, assigning tactical resources and overseeing operations will be under the direct supervision of the Incident Commander. The incident commander will designate the command staff. The command staff are responsible to provide information, safety and liaison service for the ICS. IT is critical in any type of fire that B-28/W-28 COF holder and SME share information describing the specific battery installation with incident commander.

The Incident Sequence created by the NYC Emergency Management Department is provided in the Appendix D of this booklet.

The COF holder, the SMEs and the ESMS monitoring facility staff (if applicable) and all energy storage system related personnel shall comply with the orders of the incident commander and the command staff.

10.4.2 Information that may be required by the first responders

The COF holder, the SMEs and the ESMS monitoring facility staff (if applicable) and all energy storage system related personnel must comply with the orders of FDNY firefighting personnel. The COF holder and/or the SME(s) must quickly provide FDNY firefighting personnel the following information:

- The nature of the emergency
- Location of the fire/smoke or alarm
- Type, size of the energy storage systems
- Location(s) of the energy storage systems (for indoor systems)
- BIC card (if applicable)
- The type of the occupancy that the energy storage system serves

- Hazards of the energy storage systems:
    - What kinds of hazards may be related to this type of the system (under normal condition and during fire emergency)?
    - What kinds of flammable/corrosive/toxic gases maybe generated by the system
- Emergency Management Plan
- Critical information from the ESMS:
    - Is ESMS still working?
    - What part(s) of the system may cause this issue?
    - Is it battery fire or other fire (e.g. cable fire)?
    - What are the real time readings of the battery system that could know the status of the system?
    - What is the battery/module/system temperature trend during this incident?
    - What is the potential stranded energy (state of charge) in the energy storage system?
- Type of fire protection/extinguishing systems installed:
    - What kind of water-based fire extinguishing system is installed and what is its coverage?
    - If applicable, what kind of non-water-based fire extinguishing system is installed and what is its coverage?
- The location of:
    - E-Stops
    - Disconnect switches (i.e. “lock-out, tag-out”)
    - Fire Department Connection locations,
    - The vent and the manual activation switch of the smoke/gas purge system
    - Suppression system pull stations (if applicable)
    - Standpipe (if applicable)
    - Hydrants (if applicable)
    - The deflagration vents and/or exhaust outlets (if applicable)
- Who are the premises owner, system owner and system manufacturer?
- Actions that should be taken to render as safe as possible:
    - E-stop activation: shutdown procedure for the energy storage system
    - When to use of smoke/gas purge system (if clean agent fire suppression system is installed, the designed hold time information should be provided to the first responders)
    - Minimum standoff distances for electrical hazards and explosion hazards

10.5 Post-Fire Consideration and Restoration to Service

Any energy storage system that undergoes a serious failure, including one that results in a fire, release of flammable or toxic gas, and/or physical damage to system components, shall be removed from service forthwith. The energy storage system shall not be restored to service until it has been evaluated

and, if necessary, repaired or replaced, by a trained and qualified person, and recommissioned by the Certificate of Fitness holder responsible for the system.

10.5.1 Site security

The post-fire batteries may reignite. The isolation and monitoring of the damaged energy storage system is critical. If possible, the batteries should be monitored for residual heat and temperature, as reignition is a possible in cells that are not sufficiently cooled. No person should be allowed to enter the ESS enclosure unless the enclosure has been verified that there is no flammable gas accumulation inside. Since the batteries may keep producing flammable gas, the ventilation system, explosion mitigation, and/or smoke purge system should be kept operating.

A qualified technician must ensure the heat has been removed and that the batteries are not at risk of being electrically shorted before the FDNY hands over the fire scene to the owner or responsible party appointed by the owner.

The FDNY recommends the owner should designate a coordinator or site manager or a building security personnel to ensure the scene is properly secured and monitored before decommissioning:

- If applicable, proper monitoring equipment and tactics should be employed to gauge the level of detectable gases during post-fire events.
- Train all watchpersons regarding the emergency management plan and notification requirements.
- Maintain at least one watchperson to supervise the site 24/7 at a safe distance. If the watchperson becomes aware of a fire or other emergency at the site, he must immediately call 911 and report the emergency. This watchperson should also ensure all entries and exits on the ground level to the site are properly secured. It can reduce the chance of entry by unauthorized persons.
- Ensure only authorized persons are allowed near the scene and they should wear proper PPE.
- Prepare the site for decommissioning and notify all the Authority Having Jurisdiction that will be involved in the decommissioning procedures

10.5.2 Emergency decommissioning

The deactivation, de-energizing, dismantling and removal and transportation of any energy storage system that has given abnormal temperature or gas emission readings as a result of physical damage, exposure to fire or other actual or potential cause of damage. This process shall be coordinated with the Hazardous Materials Unit of the Fire Department's Bureau of Operations (FDNY Hazmat), who may send representatives to monitor the decommissioning process. The Hazardous Materials Unit (FDNY Hazmat) shall be notified two (2) business days prior to the scheduled action, or in as timely a manner as circumstances allow, by calling the Fire Department Communications Office in the borough in which the energy storage system is located.

The emergency decommissioning should also be in accordance with the decommissioning plan and the decommissioning procedure (refer to Section 6.2 of this booklet). However, since the batteries are exposed to fire, the decommissioning personnel must also understand the procedures for dealing with damaged ESS equipment in a post-fire incident, including the following: recognizing that stranded electrical energy in fire-damaged storage batteries and other ESS has the potential for re-ignition after initial extinguishment. Following the suppression operations by the FDNY, it is important to have a fire watch until decommissioning is complete.

The owner must contact personnel qualified to safely remove damaged ESS equipment from the facility. (The information could refer to Section 6.2.2 of this booklet)

10.5.3 Restoration to Service (re-commissioning)

Upon completion of the repair and retest by the qualified company/individual/installer, after confirming that the energy storage system is in good working order and operating in accordance with manufacturer's specifications, the Certificate of Fitness holder shall supervise the re-commissioning of the energy storage system. Re-commissioning is required for restoration.

For small outdoor/rooftop/ mobile ESSs or indoor ESSs, the owner or the Certificate of Fitness holder shall notify the Fire Department of the re-commissioning, by emailing to tech.mgt@fdny.nyc.gov **no later than two (2) business days after restoration**, the battery type, manufacturer and rated energy capacity, and the name and certificate of fitness number of the certificate of fitness holder who will be responsible for supervision of the system.

For medium and large outdoor/rooftop/ mobile ESSs, the owner or the Certificate of Fitness holder shall notify the Fire Department of the re-commissioning and give Fire Department representatives the opportunity to attend the re-commissioning to monitor the process; familiarize themselves with a re-commissioned energy storage system's installation and operation. The owner shall notify the Fire Department by emailing the date, location, type and size of the energy storage system installation to tech.mgt@fdny.nyc.gov no later than **two (2) business days prior** to the scheduled action. No confirmation is required, and the scheduled action can proceed in the Fire Department's absence. If the action is rescheduled, amended notice shall be given to the Fire Department in as timely a manner as circumstances allow.

CHAPTER 11. RECORDKEEPING REQUIREMENTS

11.1 Recordkeeping

The B-28/W-28 COF holder must ensure all related permits, all approval documents issued by the New York City agencies must be maintained on the premises. If the ESS is an indoor system or on rooftop, the B-28/W-28 COF holder should ensure that the BIC information (if applicable) also include the information regarding the location and type of the ESS.

The B-28/W-28 COF holder must ensure that the records of the inspections, tests, servicing, fire watch and other operations and maintenance required by this code, the rules, the referenced standards and any other required recordkeeping referenced therein, shall be maintained on the premises or other approved location for a minimum of 3 years.

These records/permits/approval documents must be made available for inspection by any FDNY representative, and a copy of such records shall be provided to the FDNY upon request, without charge.

The FDNY additionally may require that certain records be filed with the FDNY in such manner as the FDNY may prescribe, including online electronic submission, other electronic format or paper filing.

11.2 Energy Storage System (ESS) Recordkeeping

A written record of the following information shall be maintained at the premises or other approved location by the B-28/W-28 Certificate of Fitness holder and by the owner or operator of the stationary energy storage system, except as otherwise prescribed by the Fire Department Rule:

(1) Energy storage system installation and commissioning;

(2) Energy storage system maintenance, including all inspections, servicing and repair (The COF holder must also document all the replacement activities and detail the components that have been replaced in the record);

(3) Energy storage system decommissioning and removal;

(4) Installation and maintenance of energy storage system fire protection systems, including all inspection, testing, servicing and repair; and

(5) Fires or other incidents involving or affecting the energy storage system.

The record shall be maintained for a minimum of 3 years. Such records shall be made available for inspection by any FDNY representative, and a copy of such records shall be provided to the FDNY upon request, without charge.

11.3Fire Alarm Logbook

If the fire alarm system is a stand-alone system that is not linked to a building fire alarm system, the B-28/W-28 COF holder is authorized and responsible to maintain the fire alarm logbook.

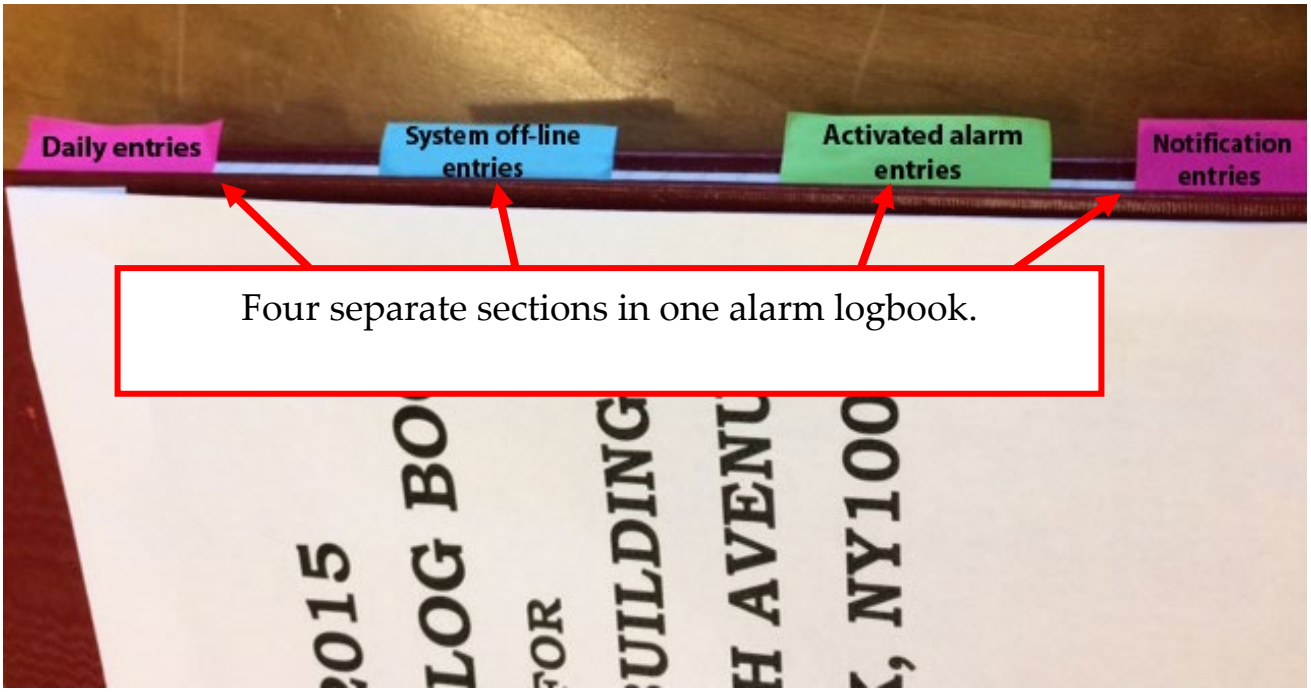
If the fire alarm system is linked to a building fire alarm system, the fire alarm logbook should be maintained by S-95/F-53/F-80/F-89/T-89.

Alarm logbook entries must be made in chronological order, recording the location and causes of all alarm signals transmitted by such fire alarm system. The entries must be recorded by a person who physically performed the test or visual inspection.

The alarm logbook shall be a bound book (other than spiral bound) with consecutively numbered and lined pages. The cover of the logbook shall bear the inscription, “ALARM LOGBOOK”, together with the name and address of the building. All entries shall be made in ink and dated. A separate logbook shall be kept for each calendar year. Logbooks shall be retained for a period of three (3) years from the date of the last entry. The record shall be maintained for a minimum of 3 years. Such records shall be made available for inspection by any FDNY representative, and a copy of such records shall be provided to the FDNY upon request, without charge.

The alarm logbook must be divided into **4 separate sections** as set for below. Each section must have a sufficient number of pages to allow for entries for at least one year.

The following logbook entries are required and must be made in each instance:



(A) Daily entries.

This daily entries section is only required when the fire alarm system needs to be under continuous personal supervision by a licensed staff (e.g. Fire and Life Safety Director). If the fire alarm system is not required to be staffed during operation, this section is allowed to be omitted.

The name of the person who made the entry, if applicable, and the time each tour of duty began and ended, must be entered in the alarm logbook on a daily basis. These entries must be set forth in columns in the logbook as follows:

(1) Certificate Fitness holder's name

(2) Certificate of Fitness number

(3) time started

(4) time relieved

It should also include the actions taken if defective equipment or abnormal conditions witnessed

(B) System off-line entries.

The date and time the alarm system was taken off-line, the reason for such action, the name and Certificate of Fitness number of the person notified at the central station (or other evidence of notification satisfactory to the Fire Department), and the date and time the system was restored to service, must be entered in the alarm logbook in each such circumstance. These entries should be set forth in columns in the logbook as follows:

(1) time off line

(2) reason off line

(3) central station name and telephone number

(4) central station operator's name and COF number

(5) time restored

(6) name and COF number of the COF holder who made the entry

(C) Activated alarm entries.

The date and time the alarm activated, the type and location of the device (e.g., smoke detector, 27th floor, elevator lobby), the probable cause of the alarm, and the Fire Department unit and officer responding must be entered in the alarm logbook in each such circumstance. These entries should be set forth in columns in the logbook as follows:

(1) date and time activated

(2) location and detector type

(3) probable cause

(4) responding FDNY unit and officer

(5) name and COF number of the COF holder who made the entry

It should also include the testing of manual station conducted by an S-97/S-98 Certificate of Fitness holder.

(D) Notification entries.

The date and time of any notification to the occupants of the premises regarding a non-functioning or improperly functioning alarm system. These entries should be set forth in columns in the logbook as follows:

(1) date and time of notification made

(2) reason of notification

(3) action description

(4) name and COF number of the COF holder who made the entry

(5) memo for the follow up actions

SUGGESTED FORMAT FOR LOGBOOK ENTRY

(A) Daily Entries

Date	Time Started	Time Relieved	Name of COF holder	COF holder's COF number and type	Duty Description	Alarm Condition Description
1/06/15	1:00PM	1:30 PM	Joe Doe	89924922 (B-28)	Daily visual inspection	System is normal
1/07/15	2:00PM	2:45 PM	Jane Doe	89353423 (B-28)	Daily visual inspection	Discovered defective horn/strobe on 6th floor and notified ABC Fire alarm Co. for service call.

(B) System Off-line Entries

Date & Time Off Line	Reason Off Line	Central Station Name & Phone Num.	Central Station Operator's Name	Central Station Operator's COF Num.	Date & Time Restored	COF holder for Record Entry	COF Number and Type
1/07/15 3:30pm	ABC Fire alarm Co. came to fix the defective horn/strobe on 6th floor.	OKK, 718-999-9999	Steve Doe	89924900	1/07/15 7:00pm	Jane Doe	89353423(B-28)
1/21/15 7:30 am	testing of all pull stations on 5th floor	OKK, 718-999-9999	Jane Smith	99991111	1/21/15 7:45 am	Tom Doe	99346550 (B-28)
1/22/15 8:20 am	ABC Fire Alarm Co. fix the defective pull station on 5th floor	OKK, 718-999-9999	Jim Harris	22221234	1/22/15 10:00am	Tom Doe	99346550 (B-28)

(C)Activated alarm entries.

Date & time activated	Location & detector type	Probable cause	Responding FDNY Unit	Responding FDNY Officer	COF holder for Record Entry	COF Number and Type
1/17/15 3:15 pm	Smoke detector of pantry room on 3rd floor	Smoke came from a microwave activated the smoke detector	Engine 23	Chief Ronald	David Doe	89345678 (B-28)
1/21/15 7:30 am	All pull stations on 5th Floor	testing of post station	NA	NA	Tom Doe	99346550 (B-28)

(D) Notification entries.

Date & Time	Reason	Action	COF holder for Record Entry	COF Number and Type	Follow Up Memo
1/21/15 8:30 am	A pull station in elevator lobby on 5th Floor found to be defective.	Place "out of service" sign over the pull station	Tom Doe	99346550 (B-28)	Repair made and sign removed. 1/22/15

APPENDIX A: REFERENCE MATERIAL

(This Part will be provided to you during the B28/W28exam)

OUTDOOR STATIONARY ESS COMPLIANCE REQUIREMENTS

Section	Compliance Requirement	Small	Medium	Large
(c)	**General Provisions**			
(c)(4)	Permit	No	Yes	Yes
(c)(5)	Supervision (Certificate of Fitness)	Yes	Yes	Yes
(c)(6)	Obligations of Owner and Operator	Yes	Yes	Yes
(c)(7)	Listing and Full-Scale Testing Standards			
(c)(7)(A)	• Listing			
	o *Lead Acid Battery*	Yes	Yes	Yes
	o *Ni-Cd or NiMH Battery*	Yes	Yes	Yes
	o *Li-Ion Battery*	Yes	Yes	Yes
	o *Flow Battery*	Yes	Yes	Yes
(c)(7)(B)	• Full-Scale Testing			
	o *Lead Acid Battery*	No	No	No[g]
	o *Ni-Cd Battery*	No	No	No[g]
	o *NiMH Battery*	No	No	No[g]
	o *Li-Ion Battery*	Yes	Yes	Yes
	o *Flow Battery*	No	No	No[g]
(c)(8)	• Manufacturer's Requirements	Yes	Yes	Yes
(c)(9)	• Multiple Battery System Approval	No[a]	Yes	Yes
(c)(10)	• Mobile energy storage Systems/Equipment Approval	Yes[b]	Yes[b]	Yes[b]
(d)	• Equipment Approval	Yes[b]	Yes[b]	Yes[b,h]
(e)	• Installation Approval	No	No[f]	Yes
(f)	• Commissioning and Decommissioning	No[c]	Yes	Yes
(g)	**General Design and Installation Requirements**			
(g)(1)	• Location and Construction	Yes	Yes	Yes
(g)(2)	• Remote Monitoring	Yes	Yes	Yes
(g)(3)	• Electrical Components	Yes	Yes	Yes
(g)(3)(C)	o Secondary Power	No	Yes	Yes
(h)	**Enclosure Design and Installation Requirements**			
(h)(1)	• Human Occupancy Prohibited	N/A	Yes	Yes
(h)(2)	• Racks	N/A	Yes	Yes
(h)(3)	• Fire Extinguishing System	No[d]	No[d]	Yes

(h)(4)	• Explosion Mitigation	No[d]	No[d]	Yes
(h)(5)	• Fire Detection	No[d]	Yes	Yes
(h)(6)	• Gas Detection			
	o Lead Acid Battery	Yes[e]	Yes	Yes
	o Ni-Cd and NiMH Battery	Yes[e]	Yes	Yes
	o Li-Ion Battery	No[d]	No[d]	No[d]
	o Lead Acid Battery	Yes	Yes	Yes
(h)(7)	• Detector Alarm Notification / Fire Alarm System	No[d]	Yes	Yes
(h)(8)	• Ventilation System	No[d]	No[d]	Yes
(h)(9)	• Smoke/Gas Purge System	No[d]	No[d]	Yes
(i)	**Operational and Maintenance Requirements**			
(i)(1)	• Remote Monitoring of Energy Storage Management System and Reporting	Yes	Yes	Yes
(i)(2)	• Central Station Monitoring of Fire Protection System	N/A[d]	Yes	Yes
(i)(3)	• Remote Monitoring at Constantly Attended On-Site Location	No	No	No
(i)(4)	• Technical Assistance	Yes	Yes	Yes
(i)(5)	• Emergency Management	Yes	Yes	Yes
(i)(6)	• Signage	Yes	Yes	Yes
(i)(7)	• Maintenance			
(i)(7)(A)	o Periodic Inspection	No	Yes	Yes
	o Restoration to Service After Serious Failure	Yes	Yes	Yes
(i)(7)(B)	o Replacement Components	Yes	Yes	Yes
(i)(7)(C)	o Combustible Waste	Yes	Yes	Yes
(i)(7)(D)	o Storage of Combustible Materials	Yes	Yes	Yes
(j)	Recordkeeping	Yes	Yes	Yes

a. Except for multiple small energy storage systems installed in a single enclosure or as part of a single installation.

b. Except for energy storage systems tested and *listed* by a nationally recognized testing laboratory with installation conditions, as set forth in R608-01(c)(7)(C), or other *approved listing* based on *approved* test data.

c. Except for: (1) notifying the *Department* of the *certificate of fitness* responsible for supervision of the installation; and (2) coordination of removal and transportation of small energy storage systems experiencing abnormal temperature or gas emission readings, as set forth in R608-01(f)(3)(C).

d. Unless required as a condition of equipment approval based on full-scale testing. The

Department will assess the results of the full-scale testing to determine whether there are any hazards that are not resolved or mitigated by the equipment or installation design and, if the installation is approved, prescribe appropriate safeguards.

e. Required for equipment approval, as an element of the storage battery unit design, not as part of an energy storage system enclosure.

f. Limited post-installation review by inspection unit for *Department* permit issuance only.

g. *Approved* test data is required for explosion mitigation measures. If no other *approved* test data is available, test data from UL Test Method 9540A testing will be required.

h. Except project-specific installation designs. Large installations that utilize full-scale tested and *Department*-approved *storage battery units* in non-standard configurations or other project-specific designs may be field-tested in accordance with UL Standard 9540 or other *approved* standard.

Hazards of Different Energy Storage Systems

Technology	Potential Hazards	Potential Hazards Under Normal Conditions	Potential Hazards Under Emergency/Abnormal Conditions
Lithium Ion (Li-ion)	Fire/explosion hazards	Latent defects within the cells or design issues: • Flammable gas concentrations • Thermal runaway	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A.	• Off-gassing of flammable or toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly.
	Physical hazards	• Lifting hazards due to the weight of the battery.	• Overheating • Heavy system components • The guards of moving hazardous parts (e.g. fans) might be missing.
Flow	Fire hazards	N/A	• Flammable gas concentrations
	Chemical hazards	• Corrosive liquid	• Corrosive liquid • Toxic Vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting
	Stranded or stored energy hazards	N/A	• N/A
	Physical hazards	N/A	• Overheating • Overpressure gas if sufficient pressure relief is not provided • The guards of moving hazardous parts (e.g. fans) might be missing
Nickel Cadmium (Ni-Cad)	Fire hazards	If not properly vented: • Flammable gas concentrations	• Flammable gas concentrations
	Chemical hazards	• Corrosive/caustic potassium hydroxide electrolyte	• Corrosive/caustic potassium hydroxide electrolyte • Toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards

Technology	Potential Hazards	Potential Hazards Under Normal Conditions	Potential Hazards Under Emergency/Abnormal Conditions
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly.
	Physical hazards	• Lifting hazards due to the weight of the battery.	• Overheating • Heavy system components
Nickel-Metal Hydride (Ni-MH)	Fire hazards	N/A	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A	• Corrosive electrolyte • Off-gassing of toxic vapors
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Electric shock
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly.
	Physical hazards	N/A	• Overheating • The guards of moving hazardous parts (e.g. fans) might be missing.
Flooded (Vented) Lead-Acid	Fire hazards	If not properly vented: • Flammable gas concentrations	• Flammable gas concentrations
	Chemical hazards	• Sulfuric acid electrolyte	• Corrosive sulfuric acid electrolyte
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly.
	Physical hazards	• Lifting hazards due to the weight of the battery.	• Overheating • Heavy system components
Valve-Regulated Lead-Acid (VRLA)	Fire hazards	N/A	• Flammable gas concentrations • Thermal runaway
	Chemical hazards	N/A.	• Corrosive electrolyte (minor)
	Electrical hazards	• High DC voltage hazards • Arc flash	• High AC and DC voltage hazards • Arc flash, short circuiting • Risk of electric shock during manual suppression • Ground paths altered and unexpected shock hazards
	Stranded or stored energy hazards	• Stranded or stored energy hazards during maintenance.	• Stranded energy may present electric shock hazards during disassembly.
	Physical hazards	• Lifting hazards due to the weight of the battery.	• Overheating • Heavy system components

Benefits of different Energy Storage Systems

Technology	Benefits
Lithium Ion (most commonly used)	• Low maintenance, • High cycle life, • Due to popular demand this technology is continually evolving. • Fast power response rate
Flow	• Long life, deep discharge, • Can be replenished at end of life by replacement of electrolytes.
Nickel Cadmium (Ni-Cad)	• Good load performance • Forgiving if abused.
Nickel-Metal Hydride	• Memory degradation but less prone to memory than Ni-Cad, can be long usage life • More environmentally friendly
Flooded (Vented) Lead Acid	• Require a refill with distilled water. • Low risk of thermal runaway • Well understood causes and remedies for thermal runaway
Valve-Regulated Lead-Acid (VRLA)	• No electrolyte to fill. • Low risk of thermal runaway • Well understood causes and remedies for thermal runaway.

Outdoor Stationary ESS Size Thresholds

Battery Technology	**Aggregate Rated Energy Capacity**		
	Small	**Medium**	**Large**
Lead Acid Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Ni-Cd Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
NiMH Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Li-ion Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 250 kWh	> 250 kWh
Flow Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 500 kWh	> 500 kWh

Ampere-Hour Conversion

KWh shall equal rated voltage times amp-hour rating divided by 1000:

(voltage x amp-hours)/1000 = kWh

Fire Alarm System Mandatory Visual Inspection Frequency

(4) Control equipment: fire alarm system MONITORED for alarm, supervisory, and trouble signals: annually.

(5) Manual fire alarm pull stations (boxes), heat detectors, smoke detectors: semiannually.

(6) In-building fire emergency voice/alarm **communications equipment**: semiannually

Different COF Duties and Responsibilities for Fire Alarm System

Duties and responsibilities		May be performed by		
		B-28/W-28/S-95/F-89/T-89/F-80/F-53	**S-78/F-78**	**S-97/S-98**
1.	Visual inspections of fire alarm system or smoke detectors	**Yes**	**Yes**	**Yes**
2.	Smoke detector inspection, maintenance testing & cleaning	**No**	**Yes**	**Yes**
3.	Program, service, clean, test, repair and/or replace fire alarm components	**No**	**No**	**Yes**

F-53: Emergency One-Way Voice Announcement Personnel

F-80: Coordinator of Fire Safety and Alarm System in Homeless Shelters

F-89/T-89: FLSD

S-78/F-78: Inspection, Cleaning & Testing of Smoke Detectors

S-95: Supervision of Fire Alarm Systems

S-97/S-98: Fire Alarm Systems Inspection, Testing and Service Technician

APPENDIX B: Fire Code Section 608

STATIONARY ENERGY STORAGE SYSTEMS

608.1 Scope. This section shall govern stationary energy storage systems, including emergency power, standby power, uninterruptible power and mobile systems.

608.2. General. Stationary energy storage systems shall be designed, installed, operated and maintained in accordance with this section, the rules, manufacturer's specifications, and, to the extent not inconsistent with this code and rules, NFPA 855, as modified by FC Appendix B.

608.3 Permits. Permits shall be required as set forth in FC105.6.

608.4 Testing and listing standards. All stationary energy storage systems shall be tested and listed by a nationally recognized testing laboratory to the standards set forth in FC 608.4.1 through 608.4.3 (or later editions of these standards when necessary to address evolving standards applicable to a rapidly developing technology):

608.4.1 Listing standards. Stationary energy storage systems shall be listed to the following standards:

1. Underwriters Laboratories (UL) Standard 1741 (2010 edition), entitled "Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources;"

2. Underwriters Laboratories (UL) Standard 1973 (2018 edition), entitled "Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications;" and

3. Underwriters Laboratories (UL) Standard 9540 (2020 edition), entitled "Energy Storage Systems and Equipment."

Exceptions:

1. Any stationary energy storage system technology or application not subject to one or more of these listing standards shall comply with such other testing or listing standards as may be approved by the department.

2. A stationary energy storage system that received a listing under Underwriters Laboratories (UL) Standard 9540 (2016 edition) prior to the effective date of this section may be considered for a certificate of approval provided that such listing is still valid and the system was subjected to full-scale testing in accordance with FC608.4.2.

3. A stationary energy storage system approved by the department under a listing standard superseded by a later edition may continue to be operated under such listing standard and department certificate of approval, provided that the listing is still valid and except as may be required by the department in accordance with FC102.5.

608.4.2 Full-scale testing. Stationary energy storage systems shall be subjected to full-scale testing (referred to as "large-scale testing" in NFPA 855) in accordance with ANSI/Underwriters Laboratories (UL) Test Method 9540A (4th edition), entitled "Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems," or other approved test method, or its failure mode and effects documented by other approved test data.

608.4.3 Listing with installation conditions. Upon approval by the department and the Department of Buildings of a listing standard that is used to establish listings with installation conditions based upon test data, such approved listing standard shall replace the existing listing and testing standards set forth in FC 608.4.1 and 608.4.2. The approved listing standard and listings shall supersede the equipment approval process set forth in FC608.5 and, to the extent addressed in such approved listing, the required separation distances.

608.5 Equipment approval. The design of each storage battery unit, including pre-engineered and pre-packaged systems, shall be approved by the department. The manufacturer of the storage battery unit shall obtain a certificate of approval for such unit in accordance with FC112 and the rules. Application for a certificate of approval shall include the results of the full-scale testing of the storage battery unit in accordance with FC608.4.2, including a failure modes and effects analysis (FMEA) or other approved hazard mitigation analysis. The certificate of approval may set forth terms and conditions for stationary energy storage system use. Such terms and conditions may authorize below-grade installation, or indoor installation in Group R-3 occupancies, based on the hazards demonstrated by the full-scale testing data and the mitigation thereof.

608.6 Installation approval. The design of each stationary energy storage system installation shall be reviewed and approved by the department as required by FC 608.6.1 and 608.6.2.

608.6.1 Indoor systems. Department review and approval of indoor system installations is required for systems utilizing equipment not approved by the department or not in accordance with the terms and conditions of the certificate of approval, equipment listing or requirements of this code. Otherwise, indoor system installation shall be reviewed and approved by the Department of Buildings in accordance with that agency's requirements, with department review and approval of energy storage management systems and monitoring stations, smoke control and smoke purge systems, explosion mitigation, and such fire protection and hazard mitigation systems and measures as are required to be reviewed by the department under this code or the construction codes.

608.6.2 Outdoor systems. Department review and approval of outdoor system installations, including mobile and rooftop systems, shall be in accordance with the rules.

608.7 Supervision. Stationary energy storage systems shall be operated and maintained under the supervision of a person holding the certificate of fitness required for such purpose.

608.7.1 Indoor systems. Except as may be otherwise provided in the rules, indoor systems shall be operated and maintained under the general supervision of such certificate of fitness holder, provided, however, that an FLS director, FEP coordinator, certificate of qualification holder or other responsible person with approved qualifications shall be on the premises during the regular business hours in any building with an indoor system with an aggregate rated energy capacity of one megawatt (1 MWh) or more. Such person shall be responsible for assisting emergency responders, including coordinating with such certificate of fitness holder and the remote monitoring facility in accordance with the emergency management plan.

608.7.2 Outdoor systems. Outdoor systems shall be operated and maintained under the general supervision of such certificate of fitness holder, except as may be otherwise provided in the rules.

608.7.3 Qualifications and responsibilities. A certificate of fitness holder responsible for a stationary energy storage system shall possess the following qualifications and shall have the following duties and responsibilities and such other duties and responsibilities as may be set forth in the notice of examination for such certificate:

1. Be trained and knowledgeable in the installation and operation of the stationary energy storage system, such as a person engaged in the design or installation of such systems;

2. Possess the manufacturer's installation and operating specifications for each stationary energy storage system and any associated fire protection systems;

3. Immediately report any emergency condition affecting a stationary energy storage system to the department; and

4. Provide technical assistance about the stationary energy storage system installation to the department in accordance with FC608.8 and the rules, and, in coordination with the energy storage management system monitoring facility, identify a subject matter expert who can provide technical assistance about the stationary energy storage system's design and performance in the event of an emergency condition affecting the stationary energy storage system.

608.8 Emergency management plan. The owner, manufacturer and/or installer of a stationary energy storage system shall have an emergency management plan or protocol that includes procedures for notifications, provision of technical assistance to the department, mitigation of hazardous conditions,

and decommissioning or restoration to normal operation. The department may require that a representative of the stationary energy storage system manufacturer or other subject matter expert with technical knowledge of the system and its operation be available in a timely manner to provide technical assistance to the department during an emergency involving or affecting the system.

608.9 Design and installation. Stationary energy storage systems shall comply with the requirements set forth in FC 608.9.1 through 608.9.4.

Exception:

Lead acid and nickel-cadmium stationary energy storage systems with a maximum operating voltage of 50 volts alternating current or 60 volts direct current, designed and installed for the purpose of supplying emergency power, standby power or uninterruptible power to telecommunications equipment under the exclusive control of a telecommunications provider, when such systems are located outdoors or in an indoor telecommunications facility used exclusively for powering telecommunications equipment, and are in compliance with the requirements of NFPA 855, as adopted and modified by the Department of Buildings, and NFPA 76.

608.9.1 Maximum aggregate rated energy capacity. The maximum aggregate rated energy capacity of stationary energy storage systems shall be in accordance with FC 608.9.1.1 and 608.9.1.2.

608.9.1.1 Indoor systems. The aggregate rated energy capacity per control area of indoor systems shall not exceed the limitations set forth in FC Table 608.9.1.1.

FC TABLE 608.9.1.1
MAXIMUM AGGREGATE RATED ENERGY CAPACITY OF INDOOR STATIONARY ENERGY STORAGE SYSTEMS

TYPE OF STORAGE BATTERY	MAXIMUM AGGREGATE RATED ENERGY CAPACITY (kWh) PER CONTROL AREA[a,b]
Lead-acid, all types	600[c]
Nickel, all types except sodium nickel chloride	600[c]
Lithium-ion, all types	400
Sodium nickel chloride	400
Flow	400
Other	As prescribed by rules or approved by the department

a. Subject to the control area limitations set forth in FC Table 5003.8.3.3
b. The control areas on a floor of a dedicated use building, other than on a high-rise floor, may be combined or otherwise modified, provided that the total maximum aggregate rated energy capacity of indoor systems allowed per floor is not exceeded.
c. Except where a greater maximum aggregate rated capacity is allowed per floor by FC608.9.4.1.10.

608.9.1.2 Outdoor systems. The aggregate rated energy capacity of outdoor stationary energy storage systems (including mobile systems) shall be as approved by the department, unless the department prescribes by rule a maximum aggregate rated energy capacity for such systems.

608.9.2 Energy storage management system monitoring. All stationary energy storage systems shall be designed with an energy storage management system that transmits data regarding energy storage system status and temperature to a remote monitoring facility or other approved location. Indoor systems shall be provided with approved remote monitoring stations at the building's fire command center and/or other approved location.

608.9.3 Fire protection and hazard mitigation. Stationary energy storage systems shall be designed to address the hazards identified by full-scale testing, including protecting the stationary energy storage system and the building or enclosure that houses such system with, as applicable, fire barriers, fire alarm systems, explosion mitigation, gas detection and other emergency alarm systems, fire extinguishing systems and ventilation systems.

608.9.3.1 Indoor systems. Indoor systems shall be provided with the fire protection and hazard mitigation systems and measures required by the conditions of the system's listing and equipment approval, this section, the construction codes, the Electrical Code and the rules.

608.9.3.2 Outdoor systems. Outdoor systems shall be provided with the fire protection and hazard mitigation systems and measures required by the rules.

608.9.4 Location. Stationary energy storage systems shall be installed in accordance with the location requirements and restrictions set forth in FC 608.9.4.1 and 608.9.4.2.

608.9.4.1 Indoor systems. Indoor systems shall be installed in accordance with FC 608.9.4.1.1 through 608.9.4.1.9.

608.9.4.1.1 Below-grade locations. Indoor systems shall not be installed below grade, except when approved by the department in a dedicated use building, or as otherwise approved pursuant to FC608.5.

608.9.4.1.2 Sprinkler protection required. Indoor systems may be installed only in buildings fully protected throughout by a sprinkler system, except as otherwise provided in FC608.9.4.1.9. Control areas housing stationary energy storage systems shall be fully protected throughout by a sprinkler system designed in accordance with NFPA 15, except as may otherwise be approved based on equipment listings and testing results pursuant to FC608.4.

608.9.4.1.3 Occupancy restrictions. Indoor systems may be installed in Group A, Group R-1, Group R-2 and Group I buildings and occupancies only when the building is of noncombustible construction, except as otherwise provided in FC608.9.4.1.9.

608.9.4.1.4 Control areas. Indoor systems shall be installed only in control areas designed, installed, operated and maintained in accordance with this section. The maximum aggregate rated energy capacity of indoor systems per control area shall be in accordance with FC608.9.1. The design and number of control areas per floor shall be in accordance with FC5003.8.3.3, including FC Table 5003.8.3.3, except that (subject to FC608.9.4.1.9 and FC608.9.4.1.10) each control area housing an indoor stationary energy storage system shall be designed and constructed as a high-hazard occupancy, and rooftop installations shall be treated as outdoor installations.

608.9.4.1.5 Smoke detection. Control areas housing stationary energy storage systems shall be protected by a fire alarm system or, if a fire alarm system is not otherwise required in the building or occupancy, by a dedicated smoke detection system.

608.9.4.1.6 Ventilation. Control areas housing stationary energy storage systems shall be equipped with ventilation systems designed for high-hazard occupancies in accordance with the construction codes. Such ventilation systems shall be adequate to exhaust any flammable or other gases generated during the normal operation and/or failure of the stationary energy storage system.

608.9.4.1.7 Spill control, neutralization, drainage and containment. Control areas housing stationary energy storage systems shall be provided with a means to control leaks and spills of liquid electrolyte and such containment and drainage systems as may be required by the construction codes and NFPA 855, as modified by FC Appendix B.

608.9.4.1.8 Emergency power. All fire protection and hazard mitigation systems required by this section shall be provided with an emergency power system in accordance with the Building Code.

608.9.4.1.9 Exceptions for certain battery systems for fire and life safety. Lead acid battery systems, and nickel-cadmium battery systems, and where approved by the certificate of approval based on their testing results, other types of energy storage systems, designed and installed solely for the purpose of supplying emergency or standby power for building fire safety and life safety systems in accordance with the construction codes and this code may be:

1. installed in buildings that are not protected throughout by a sprinkler system.

2. installed in buildings of combustible construction.

3. housed in control areas that are not constructed as high-hazard occupancies but meet such fire separation standards as may be set forth in the construction codes.

608.9.4.1.10 Exceptions for certain battery systems for business operations. The exceptions set forth in FC608.9.4.1.9 shall also be applicable to lead acid battery systems and nickel-cadmium battery systems, not exceeding a maximum aggregate rated energy capacity of 70 kWh per floor, and where approved by the certificate of approval, other types of energy storage systems, designed and installed for the purpose of supplying emergency power, standby power or uninterruptible power, for business operations, in accordance with the construction codes and this code.

608.9.4.2 Outdoor systems. Outdoor systems, including reach-in and walk-in facilities and mobile systems, shall be designed and installed in accordance with the rules. Rooftop systems with an aggregate rated energy capacity exceeding 400 kWh, other than lead acid battery systems, may be installed only on the rooftops of buildings of noncombustible construction.

608.10 Commissioning and decommissioning. Stationary energy storage systems shall be installed and activated for use (commissioned) and deactivated from use and removed from the premises (decommissioned) in accordance with this section, the rules and NFPA 855, as modified by FC Appendix B.

608.10.1 Commissioning. Stationary energy storage systems shall be installed by trained and knowledgeable persons in accordance with manufacturer's specifications. Upon completion of the installation, the certificate of fitness holder assuming responsibility for supervision of the system shall authorize it to be activated, after confirming that the energy storage system is in good working order and operating in accordance with manufacturer's specifications. Approved fire protection, smoke control and smoke purge, and hazard mitigation systems and measures installed to protect the system shall also be inspected and tested by a person holding the qualifications required by this code, the construction codes and/or the Electrical Code, and any required acceptance testing conducted, prior to activation of the system.

608.10.2 Decommissioning. The certificate of fitness holder supervising a stationary energy storage system shall be responsible for its decommissioning. The deactivation, de-energizing, dismantling and removal of the system shall be conducted by trained and knowledgeable persons in accordance with manufacturer's specifications. The owner, manufacturer, installer, hazardous materials carrier or other party responsible for removal, transportation and/or disposal of the stationary energy storage system shall ensure that the energy storage system is lawfully decommissioned, transported and disposed of in accordance with DOTn hazardous materials regulations and other applicable laws, rules and regulations.

608.10.3 Notice to department. Notice of the commissioning and decommissioning of stationary energy storage systems shall be given to the department, and the removal of a malfunctioning system coordinated with the department, in accordance with the rules.

608.11 Operation and maintenance. Stationary energy storage systems shall be operated and maintained in accordance with FC 608.11.1 through 608.11.6.

608.11.1 Remote monitoring of energy storage management system and reporting. Except for telecommunications equipment subject to the exception set forth in FC608.9, the owner of a stationary energy storage system shall arrange for data transmissions from the energy storage system's energy storage management system to be continuously monitored (on a 24/7 basis) by a remote monitoring facility staffed by trained and knowledgeable persons retained by the manufacturer or installer of the energy storage system. The remote monitoring facility shall, without delay, make all necessary notifications, as required by the rules and the emergency management plan, including notifications to the department, the certificate of fitness holder and the subject matter expert, in the event a stationary energy storage system installed in New York City exceeds or appears likely to exceed thresholds at which fire, explosion or other serious adverse consequences may result.

608.11.2 Central station monitoring of fire protection systems. All fire protection systems protecting the stationary energy storage system installation, including any fire extinguishing system, and fire and gas detection or other emergency alarm system, shall be monitored by an approved central station.

608.11.3 Signage. Stationary energy storage systems shall be identified by signs or markings in accordance with the rules. The department may require that such signs and markings provide required warnings, location of controls, emergency shut down procedures, energy storage management system monitoring facility and other emergency contact information, and other necessary information.

608.11.4 Maintenance. The owner shall ensure that stationary energy storage systems are periodically inspected, tested, serviced and otherwise maintained in accordance with manufacturer's specifications and the requirements of this section by a person trained and knowledgeable in the specific system. The department may prescribe by rule stationary energy storage system periodic inspection requirements.

608.11.5 Restoration to service after serious failure. Any stationary energy storage system that undergoes a serious failure, including one that results in a fire, release of flammable or toxic gas, and/or physical damage to system components, shall be removed from service forthwith. The stationary energy storage system shall not be restored to service until it has been evaluated and, if necessary, repaired or replaced, by a trained and qualified person, and recommissioned by the certificate of fitness holder responsible for the system.

608.11.6 Replacement components. Any replacement storage battery units or other stationary energy storage system components shall be designed for the same storage battery technology and/or chemistry and be compatible with the existing energy storage system installation. In-kind replacement of existing components (consistent with the listing for the storage battery unit or stationary energy storage system) constitutes maintenance and does not require department review and approval. Department review and approval, and, as applicable, Department of Buildings review and approval, is required in the same manner as an application for a new stationary energy storage system installation for replacement of existing components that effect an alteration of the energy storage system, including:

1. replacement of components included in the storage battery unit listing, or that could otherwise affect the results of the full-scale testing of the battery storage unit;

2. replacement components that use different battery technologies or chemistries (including the electrolyte chemistry in a flow system); and

3. replacement components that change the storage/generating capacity or other functionality of the stationary energy storage system.

608.12 Recordkeeping. A written record of the following information shall be maintained at the premises or other approved location by the certificate of fitness holder and by the owner or operator of the stationary energy storage system, except as otherwise prescribed by the department by rule:

1. Stationary energy storage system installation and commissioning;

2. Stationary energy storage system maintenance, including all inspections, servicing and repair;

3. Stationary energy storage system decommissioning and removal;

4. Installation and maintenance of stationary energy storage system fire protection systems, including all inspection, testing, servicing and repair; and

5. Fires or other incidents involving or affecting the stationary energy storage system.

608.13 Group R-3 occupancies. Stationary energy storage systems installed in or on the premises of Group R-3 occupancies (indoor and outdoor systems) shall comply with the foregoing provisions of this section, except as follows:

1. Notwithstanding any provision of FC608.7 to the contrary, both indoor systems and outdoor systems shall be operated and maintained under the general supervision of such certificate of fitness holder.

2. In lieu of FC608.9, the following provisions shall apply to the design and installation of stationary energy storage systems in a Group R-3 dwelling and any attached or detached garage space serving such a dwelling:

2.1. No indoor system shall be installed below grade in such a dwelling or garage except when approved by the department.

2.2. No indoor system shall be installed in such a dwelling except when approved for such installation by its certificate of approval based on UL9540 listing meeting the performance-cell level test requirements of UL9540A or as otherwise approved pursuant to FC608.5.

2.3. The maximum rated energy capacity of any storage battery in an energy storage system installed in such a dwelling, attached garage or detached garage or mounted outdoors on an exterior wall thereof, shall not exceed 20 kWh, and the maximum aggregate rated energy capacity of such energy storage system shall not exceed the following amounts:

2.3.1 in any such dwelling, 20 kWh per dwelling unit, except as may be approved by the department; or

2.3.2 in any such attached garage, or when mounted outdoors on an exterior wall of such a dwelling or attached garage, 40 kWh, provided that there is an approved two-hour fire barrier separating such indoor system or wall mounted installation from the dwelling, or other approved measure based on the testing results of the energy storage systems; or

2.3.3 in any such detached garage, or mounted on an exterior wall thereof, 40 kWh.

2.4. Indoor systems installed in such a dwelling shall be protected by a one-hour fire barrier. Indoor systems shall otherwise be located, installed and protected in such dwellings and garages in accordance with the construction codes, the Electrical Code and the rules.

2.5. Indoor systems shall be equipped with an energy storage management system in accordance with FC608.9.2.

3. Outdoor systems shall be designed and installed in accordance with the rules.

APPENDIX C: Fire Department Rule Section 608-01

Outdoor Stationary Storage Battery Systems

(a) **Scope.** This section governs the design, installation, operation and maintenance of outdoor *stationary storage battery systems* for all energy storage uses, including *stationary storage battery systems* installed on a mobile trailer (or other form of mobile installation). This section does not govern the design, installation, operation and maintenance of:

(1) indoor *stationary storage battery systems*;

(2) *stationary storage battery systems* specifically designed and used for an emergency, standby or uninterruptible power supply; and

(3) outdoor *stationary storage battery systems* with an aggregate rated energy capacity of not more than 250 kWh that are a component of individual *motor vehicle* charging stations and used for the purpose of *motor vehicle* charging.

(b) **Definitions.** The following terms shall, for purposes of this section and as used elsewhere in the *rules*, have the meanings shown herein:

Flow battery. A storage battery that stores and generates an electrical current by ion exchange through a membrane separating liquid electrolytes.

Lead acid battery. A storage battery that is comprised of lead electrodes immersed in sulfuric acid electrolyte, including vented (flooded) or valve regulated lead acid (VRLA) batteries, as those terms are defined in FC602.1.

Lithium-ion (Li-ion) battery. A lithium-ion battery, as that term is defined in FC602.1.

Nickel cadmium (Ni-Cd) battery. A *nickel cadmium battery*, as that term is defined in FC602.1.

Nickel metal hydride (NiMH) battery. An alkaline storage battery in which the positive active material is nickel oxide, the negative active material is a hydrogen-absorbing alloy, and the electrolyte is potassium hydroxide.

Stationary storage battery system. A rechargeable electrochemical energy storage system, consisting of one or more interconnected storage batteries, inverters and other electrical equipment, designed as a stationary installation (or mounted to a trailer for mobile use) to provide electrical power. *Stationary storage battery systems* typically include associated fire protection, explosion mitigation, ventilation and/or exhaust systems.

Storage battery unit. A storage battery system in the configuration in which it was tested and *listed* to Underwriters Laboratories Standard 9540 (UL Standard 9540), including any cabinet or other enclosure.

(c) **General Provisions**

(1) **Applicability.** This section supplements FC608 by addressing *stationary storage battery system*s that are installed outdoors for energy storage uses. Rooftop installations are deemed outdoor installations solely for purposes of this section. The design and installation of *stationary storage battery systems* shall also comply with the requirements of the *Department of Buildings*.

(2) **Battery system size thresholds.** *Stationary storage battery systems* are classified by size as small, medium or large for each type of battery technology, as set forth in Table 1 of this section. The size of the *stationary storage battery system* is based on the energy storage/generating capacity of such system, as rated by the manufacturer, and includes any and all storage battery units operating as a single system. Table 1 is not applicable to multiple battery systems operating independently at a single premises, which are subject to R608-01(c)(9).

Table 1

Battery Technology	**Aggregate Rated Energy Capacity**		
	Small	**Medium**	**Large**
Lead Acid Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Ni-Cd Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
NiMH Battery	>2 kWh and ≤70 kWh	>70 kWh and ≤ 500 kWh	> 500 kWh
Li-ion Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 250 kWh	> 250 kWh
Flow Battery	>2 kWh and ≤20 kWh	>20 kWh and ≤ 500 kWh	> 500 kWh

(3) **Battery system compliance requirements.** *Stationary storage battery systems* shall comply with all requirements of this section applicable to the type of installation, as specified in Table 2.

Table 2 Stationary Storage Battery System Compliance Requirements (Refer to the Appendix A.)

(4) **Permit.** When required by Table 2 of this section, a *permit* is required to maintain and operate a *stationary storage battery system*.

(5) **Supervision.** A *stationary storage battery system* shall be operated and maintained under the *general supervision* of a person holding a *certificate of fitness*, who shall:

(A) be trained and knowledgeable in the installation and operation of the battery system, such as a person engaged in the design or installation of such systems;

(B) possess the manufacturer's installation and operating specifications for each battery system and any associated fire protection systems;

(C) immediately report any emergency condition affecting a battery system to the *Department*; and

(D) provide technical assistance about the stationary storage battery system installation to the *Department* in accordance with R608-01(i), and, in coordination with the battery management system monitoring facility, identify a subject matter expert (such as a representative of the manufacturer) who can provide technical assistance about the battery's design and performance in the event of an emergency condition affecting the battery system.

(6) **Obligations of owner and operator.** Both the owner of the premises at which the *stationary storage battery system* has been installed, and the business responsible for the battery system's operation, if any, are responsible for compliance with all battery system installation, operational and maintenance requirements, including the lawful and proper removal and disposal of the battery system.

(7) **Listing and full-scale testing standards.** The following standards are applicable to the *listing* and full-scale testing of *stationary storage battery systems*. The *Department* may accept battery systems *listed* and tested to later editions of these standards when necessary to address evolving standards applicable to a rapidly developing technology.

(A) **Listing.** All *stationary storage battery systems* shall be tested and *listed* by a nationally recognized testing laboratory to the following standards:

(1) Underwriters Laboratories (UL) Standard 1741 (2010 edition), entitled "Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources;"

(2) Underwriters Laboratories (UL) Standard 1973 (2018 edition), entitled "Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications;" and

(3) Underwriters Laboratories (UL) Standard 9540 (2016 edition), entitled "Energy Storage Systems and Equipment."

(B) **Full-scale testing.** When full-scale testing is required by this section, *stationary storage battery systems* shall be tested to Underwriters Laboratories (UL) Test Method 9540A (2018 edition), entitled "Safety Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems," or other *approved* standard or test data.

(C) **Listing with installation conditions.** Upon approval by the *Department* and the *Department of Buildings* of a *listing* standard that is used to establish *listings* with installation conditions based upon test data, such *approved listing* standard shall replace the existing listing and testing standards set forth in R608-01. The *approved listing* standard and *listings* shall supersede the equipment approval process set forth in R608-01 and, to the extent addressed in such *approved listing*, the required separation distances.

(8) **Manufacturer's requirements**. *Stationary storage battery systems* shall be designed, installed, operated and maintained in compliance with the manufacturer's specifications.

(9) **Multiple battery systems**. Installation of more than one *stationary storage battery system* on a single premises requires *Department* review and approval and is subject to such additional or alternative requirements as the *Department* may impose in the interests of public safety. Multiple small *stationary storage battery systems* are not subject to this requirement if they:

(A) are not part of a single installation or installed in a single enclosure; and

(B) operate independently of each other and are not interconnected with other small, medium or large battery systems.

(10) **Mobile battery systems**. *Stationary storage battery systems* installed on a trailer or otherwise designed to be moveable for use at multiple locations shall be designed, installed, operated and maintained in compliance with the provisions of this section, including equipment approval, except as follows:

(A) Installation approval (R608-01(e)) is not required. The equipment approval application submitted to the *Department* pursuant to R608-01(d) shall include information and documentation relating to the design of the trailer and the installation of the battery system. Any limitations on the use of mobile battery systems will be addressed through conditions on the equipment approval.

(B) Compliance with commissioning and decommissioning requirements (R608-01(f)) is not required, except that decommissioning of a malfunctioning battery system shall be coordinated with the *Department* in accordance with R608-01(f)(3)(C).

(d) **Equipment Approval.** When required by Table 2 of this section, the design of each *storage battery unit* shall be approved by the *Department*. The manufacturer of the *storage battery unit* shall obtain a *certificate of approval* for such unit in accordance with FC112, R112-01 and this section. The application for such equipment approval shall include the following information and documentation and such other information and documentation as the *Department* may require:

(1) Any application filed with the *Department of Buildings*; and

(2) The manufacturer's specifications and ratings, listing documents (including failure mode/effects analysis and, when required, complete UL Test Method 9540A test data or other *approved* data) for, and photographs of:

(A) each type of storage battery unit;

(B) the cabinet, container or other enclosure, and, if the installation consists of more than one storage battery unit, the arrangement of the storage batteries, including any rack storage (with seismic support criteria) and aisle dimensions;

(C) battery management system (BMS) operation;

(D) any fire extinguishing system intrinsic to the unit or enclosure;

(E) any fire detection and gas detection systems intrinsic to the unit or enclosure; and

(F) any ventilation and/or exhaust system intrinsic to the unit or enclosure.

(e) **Installation Approval**. When required by Table 2 of this section, the design of each *stationary storage battery system* installation shall be approved by the *Department*. The *owner* shall obtain *Department* approval of the design and installation documents in accordance with this section. The application for

installation approval shall include the following information and documentation and such other information and documentation as the *Department* may require:

(1) Any application filed with the *Department of Buildings*;

(2) The *Department* equipment approval for each *battery system unit* (or a separate application for such equipment approval);

(3) A site plan containing the following information:

(A) Exact location of the *stationary storage battery system* installation; including location of access panel or enclosure entrance(s);

(B) Surrounding public streets, fire apparatus access roads and pedestrian walkways;

(C) All buildings and structures on the premises (or within 100 feet, whichever is less), identified by occupancy group and construction type, and any measures to mitigate the impact of storage battery or battery system on adjoining buildings or structures or other site-specific hazard mitigation, including those required by a UL Standard 9540 hazard mitigation analysis.

(D) Any walls or fencing enclosing the installation or the premises on which it is located.

(E) All transportation and utility infrastructure, including electrical power lines, within 250 feet of the installation.

(F) Location and content of signage.

(G) Location and type of other *stationary storage battery systems* located on the premises or within 50 feet of the proposed installation (if 50 feet extends to other premises, as determined by visual inspection of the outdoor space or reasonable inquiry of the owner).

(H) Emergency shutdown procedures, including the location of the *stationary storage battery system* emergency shut down control; and

(4) A commissioning and decommissioning plan, including disposal procedures, in accordance with R608-01(f).

(f) **Commissioning and decommissioning.** *Stationary storage battery systems* shall be commissioned (installed and activated for use) and decommissioned (deactivated from use and removed from the premises) in accordance with the following procedures:

(1) **Commissioning.** *Stationary storage battery systems* shall be installed by trained and knowledgeable persons in accordance with manufacturer's specifications. Upon completion of the installation, the *certificate of fitness* holder assuming responsibility for supervision of the battery system shall authorize it to be activated, after confirming that the battery system is in good working order and operating in accordance with manufacturer's specifications.

(2) **Decommissioning.** The *certificate of fitness* holder supervising a *stationary storage battery system* shall be responsible for its decommissioning. The deactivation, de-energizing, dismantling and removal of the *stationary storage battery system* shall be conducted by trained and knowledgeable persons in accordance with manufacturer's specifications. The *owner*, manufacturer, installer, hazardous materials carrier or other party responsible for removal, transportation and/or disposal of the *stationary storage battery system* shall ensure that the battery system is lawfully decommissioned, transported and disposed of in accordance with *USDOT* hazardous materials regulations and other applicable laws, rules and regulations. The *owner*, manufacturer or installer of *stationary storage battery systems* shall have an emergency management plan or protocol that includes procedures for notifications and technical assistance in accordance with R608-01(i)(4) and (5) and all other actions necessary for mitigation and decommissioning (or restoration to normal operation).

(3) **Notice to Department**. Notice of the commissioning and decommissioning of *stationary storage battery systems* shall be given to the *Department*¸ and the removal of a malfunctioning system coordinated with the *Department*, as follows:

(A) **Small battery systems.** The *owner* or *certificate of fitness* holder shall notify the *Department* of the commissioning or decommissioning of a small *stationary storage battery system*, by emailing to tech.mgt@fdny.nyc.gov no later than two (2) business days after installation, the battery type, manufacturer and rated energy capacity, and the name and *certificate of fitness*

number of the *certificate of fitness* holder who will be, or is no longer, responsible for supervision of the system.

(B) **Medium and large battery systems.** The *owner* shall notify the *Department* of the commissioning or decommissioning of a medium or large *stationary storage battery system* and give *Department* representatives the opportunity to attend the commissioning or decommissioning to monitor the process; familiarize themselves with a commissioned battery system's installation and operation; and/or confirm the proper decommissioning of a battery system in accordance with the *approved* decommissioning plan. The *owner* shall notify the *Department* by emailing the date, location, type and size of the battery system installation to tech.mgt@fdny.nyc.gov not later than two (2) business days prior to the scheduled action. No confirmation is required and the scheduled action can proceed in the *Department*'s absence. If the action is rescheduled, amended notice shall be given to the *Department* in as timely a manner as circumstances allow.

(C) **Decommissioning of malfunctioning battery system**. The removal and transportation of any battery system that has given abnormal temperature or gas emission readings as a result of physical damage, exposure to fire or other actual or potential cause of damage, shall be coordinated with the Hazardous Materials Unit of the *Department's* Bureau of Operations, who may send representatives to monitor the decommissioning process. The Hazardous Materials Unit shall be notified two (2) business days prior to the scheduled action, or in as timely a manner as circumstances allow, by calling the *Department* Communications Office in the borough in which the battery system is located.

(g) **General Design and Installation Requirements.** When required by Table 2 of this section, *stationary storage battery systems* shall be designed and installed in accordance with the following requirements:

(1) **Location and construction.** *Stationary storage battery systems* shall be located and constructed in accordance with the following requirements:

(A) **Outdoor location.** *Stationary storage battery systems* shall be located outdoors. This includes rooftops when authorized by this section. Medium and large battery systems shall not be installed in enclosed areas without direct access from a public street, or fire apparatus access road, unless full-scale testing demonstrates intrinsic safety, or hazard mitigation measures that the *Department* determines to be appropriate for the particular location are provided.

(B) **Fire Department access and water supply.** Where feasible, a direct, unobstructed pathway shall be provided from the battery system installation to the public street or fire apparatus access road on which the premises fronts. *Stationary storage battery systems* located more than 250 feet from a hydrant shall be provided with a private hydrant or other *approved* water supply for firefighting operations in accordance with FC508.

(C) **Separation distances**. *Stationary storage battery systems* shall be located a minimum of 10 feet from the following exposures, except where lesser or greater distances are required by the equipment approval or installation approval based on full-scale testing data that indicate that a battery system fire will or will not adversely impact one or more of the following exposures:

(1) Lot lines;
(2) Public streets, fire apparatus access road, public walkways and other public ways;
(3) Any vehicle parking;
(4) Any building entrance, openable window, or ventilation intake;
(5) Any exit discharge or other means of egress from a building or outdoor area;
(6) Any outdoor hazardous materials or combustible materials storage facility or area;
(7) Any outdoor storage facility or area for high-piled combustible materials or other combustible items;
(8) Overhead power lines or other aboveground electrical installation, measured from the boundary of the utility easement or, if there is no easement, from the vertical plane of the installation at its widest point; and
(9) Any public utility or transportation infrastructure.

(D) **Rooftop locations.** *Stationary storage battery systems* may be located on a building rooftop, subject to the following requirements:

(1) The building roof covering or roofing system, or other *approved* material placed underneath the rooftop battery system installation, shall be noncombustible for a distance of five (5) feet from such installation.

(2) Rooftop battery system installations, including structural, electrical or other associated equipment, shall not obstruct the rooftop access and clear path required by FC504.4 for buildings 100 feet or less in height. Rooftop battery systems may be installed underneath solar panels, subject to the access and clearance requirements set forth in R608-01(g)(1)(D).

(3) There shall be access to the rooftop from a building stairway, or other means of rooftop access authorized by the *Building Code.* A safe, unobstructed path must be provided from the bulkhead door or other point of entry to the entrance(s) to the battery system enclosure or to the service/access panel (if any).

(4) Any dunnage or other structural support for the battery system installation shall have a minimum one (1) hour fire rating for small and medium battery systems and two (2) hours for large battery systems.

(5) On rooftops of buildings provided with a standpipe, a minimum of two (2) standpipe hose outlets shall be provided within the building bulkhead, in accordance with FC912, at an *approved* distance from the *stationary storage battery system* installation sufficient to ensure safety of firefighting operations. On rooftops of buildings that do not have a standpipe, an *approved* water supply source shall be provided for firefighting operations. If a standpipe is provided for the battery system installation, the fire department connections shall be identified by durable signage or markings conspicuously posted at street level in accordance with FC912.

(6) Rooftop installations shall comply with the separation distances set forth in R608-01(g)(1)(c) for means of egress; hazardous materials or combustible materials storage facility or area; overhead power lines or other aboveground electrical installation; public utility or transportation infrastructure; and other *stationary storage battery system* installations.

(7) Rooftop installations shall be located a reasonable distance (but not less than 10 feet) from the bulkhead entrance door or other rooftop access location pursuant to R608-01(g)(1)(D)(3).

(8) Valve-regulated lead-acid (VRLA) and flow batteries may not be installed on rooftops unless the applicant demonstrates to the satisfaction of the *Department* that the hazardous materials used in such systems can be safely stored and used on a rooftop, and the application adequately addresses leak detection, spill containment and the movement of such *hazardous materials* through the building.

(E) **Physical Protection.** *Stationary storage battery system* installations shall be protected from damage in accordance with the following requirements:

(1) **Temperature.** The storage battery or battery system shall be designed for operation throughout the entire expected range of ambient temperature, in accordance with manufacturers' specifications, or provided with appropriate protection from damage from extreme ambient temperatures.

(2) **Vehicle impact protection**. Where the battery system is subject to impact by a motor vehicle or other motorized equipment, such as a fork lift or other powered industrial trucks, vehicle impact protection shall be provided in accordance with FC312.

(3) **Security**. The battery system installation shall be secured against unauthorized entry. All battery system enclosures shall be securely locked and, where appropriate, safeguarded by a chain link fence or other *approved* barrier.

(2) **Remote monitoring.** All *stationary storage battery systems* shall be designed to transmit data regarding battery system status and temperature to a remote monitoring facility.

(3) **Electrical components.** The electrical components of *stationary storage battery systems* shall be designed and installed in accordance with the following requirements:

(A) **Compliance with testing standard.** The electrical components of the battery system shall comply with UL Standard 9540.

(B) **Operating conditions.** The electrical components of the battery system shall be designed to operate safely during normal battery system operating conditions.

(C) **Secondary power.** A separate source of electrical power shall be provided for battery system controls and safety functions, unless the battery system is designed to power such systems for at least 30 minutes after battery system shut-down. A separate source of electrical power shall be provided for all external battery safety systems, including detection, ventilation and smoke/gas purge systems. Such secondary power can be supplied from any independent power source. If the secondary power supply is an emergency power system designed in accordance with the *Building Code*, it shall be capable of supplying secondary power for a duration of two hours.

(D) **Emergency shut down.** An emergency shut down control (e-stop), in the form of a red button or other *approved* design, designed to shut down all *stationary storage battery system* operations (without affecting the fire protection systems and other safety measures required by this section) shall be provided at the fire department connection, if any, utility connection or other *approved*, conspicuous outdoor location on the premises that is accessible to emergency response personnel and is a reasonable distance (but not less than 10 feet) from the *stationary storage battery system* installation. The shut down control shall be secured in a lock box operable by a *citywide standard key* (2642 key) in accordance with FC506. Signage shall be provided as set forth in R608-01(i)(6).

(h) **Enclosure Design and Installation Requirements.** When required by Table 2 of this section, *stationary storage battery systems* housed in a shipping container or other type of outdoor enclosure (but not a storage battery system housing, except as otherwise provided in R608-01(h)(3)) shall be designed and installed in accordance with the following requirements:

(1) **Human occupancy prohibited.** No *stationary storage battery system* shall be housed in an enclosure used for human occupancy. Access to such an enclosure (whether walk-in or reach-in) shall be provided solely for maintenance purposes, including inspection, testing, servicing and repair of the battery system.

(2) **Racks.** *Stationary storage battery systems* may be installed on open racks within enclosures provided that water-based fire extinguishing, explosion mitigation, ventilation and smoke/gas purge systems are provided within the enclosure in accordance with R608-01(h).

(3) **Fire extinguishing system**. An *approved* dry pipe water fire extinguishing system designed and installed in accordance with NFPA Standard 15 (2007 edition), shall be provided in *stationary storage battery system* enclosures. The fire department connections shall be located at an *approved* distance from the *stationary storage battery system* enclosure as to ensure the safety of firefighting operations. An external fire extinguishing system of such design and installation shall be provided for any large *stationary storage battery system* in an outdoor cabinet or other battery system housing.

(4) **Explosion mitigation**. Explosion mitigation shall be provided for battery system enclosures in accordance with the following requirements:

(A) **Deflagration venting.** Deflagration venting shall be provided in accordance with NFPA Standard 68 (2007 edition), based on UL Test Method 9540A or other *approved* test data. Such venting shall be provided and designed to vent upwards or other safe location. Vents shall not face toward any exit discharge path from a nearby building or other pedestrian walkway, or any location from which emergency response personnel may access the enclosure.

(B) **Explosion prevention.** The concentration of combustible vapors during abnormal operation may be controlled in accordance with NFPA Standard 69 (2008 edition) if a hazard mitigation analysis, based on full-scale testing or other *approved* test data, indicates that such mitigation

measures will be effective in keeping the target *lower flammability limit (LFL)* within the enclosure at or below 25 percent of the *LFL*.

(5) **Fire detection system.** An *approved* automatic fire detection system shall be installed in battery system enclosures in accordance with FC907. System activation shall initiate alarm, shut down and hazard mitigation measures in accordance with R608-01(h)(7).

(6) **Gas detection system.** An *approved* gas detection system shall be installed in battery system enclosures in accordance with FC908. The placement of detectors shall be in accordance with manufacturer's specifications. When the level of flammable gas inside the battery system enclosure exceeds 25 percent of the *LFL*, the gas detection system shall initiate alarm, shut down and hazard mitigation measures in accordance with R608-01(h)(7).

(7) **Detector alarm notification.** Activation of a fire or gas detector in a battery system enclosure shall initiate the following notifications and other actions:

(A) Activate a distinct audible and visible alarm signal at the battery system installation or an *approved* constantly attended on-site location.

(B) Transmit an alarm signal to the *fire alarm system* and thereby to an *approved central station*.

(C) Shut down the battery system, if warranted.

(D) Activate all necessary shut down and hazard mitigation measures of the ventilation system.

(8) **Ventilation system.** An automatic mechanical ventilation system shall be provided for the space within the battery system enclosure in accordance with the *Mechanical Code* and the following design requirements. The ventilation system shall be designed to maintain optimal operating conditions for the *stationary storage battery system* in accordance with manufacturer's specifications or Institute of Electrical and Electronics Engineers (IEEE) Standard 1635/ASHRAE Standard 21 (2012 edition), whichever requires a higher level of protection. The ventilation system shall be intrinsically safe for, and/or explosion protected from, any toxic and flammable gases generated by the battery system during normal operating conditions, and shall be designed to limit the maximum concentration of toxic gases inside the battery enclosure to 25 percent of the *permissible exposure limit (PEL)* for such gases, unless full-scale testing demonstrates that the storage battery unit does not generate toxic gas concentrations in excess of 25 percent of *PEL*.

(9) **Smoke/gas purge system.** A manually-operated purge system designed to exhaust heat, smoke and toxic gases generated by the *stationary storage battery system* during abnormal operating conditions, for use by firefighting personnel, shall be provided for a battery system enclosure. The smoke/gas purge system shall be intrinsically safe and/or explosion protected for any such toxic gases and be designed in accordance with the following requirements:

(A) **Manual operation.** The smoke/gas purge system shall be designed to be manually activated. A manual activation switch shall be installed at the fire department connection, if any; otherwise, near the utility connection or other *approved* location on the premises. The activation switch shall be identified by a conspicuously posted and durable sign that reads: "Battery System Emergency Smoke/Gas Purge." The activation switch shall be secured in a lock box operable by a *citywide standard key* (2642 key) in accordance with FC506.

(B) **Exhaust venting.** The smoke/gas purge system shall vent in a manner that will minimize the risk to surrounding buildings and building occupants, pedestrians, and emergency response personnel. Exhaust vents shall not face toward any exit discharge path from a nearby building or other pedestrian walkway, or any location from which emergency response personnel may access the enclosure.

(i) **Operational and Maintenance Requirements.** *Stationary storage battery systems* shall be operated and maintained in accordance with this section.

(1) **Remote monitoring of battery management system and reporting.** The *owner* of a *stationary storage battery system* shall arrange for data transmissions from the battery system's battery management system to be continuously monitored (on a 24/7 basis) by a remote monitoring facility staffed by trained and knowledgeable persons retained by the manufacturer or installer of the battery system. The remote monitoring facility shall, without delay, make the following

notifications in the event a battery system installed in New York City exceeds or appears likely to exceed thresholds at which fire, explosion or other serious adverse consequences may result:

(A) Notify the *Department* by calling the Communications Office in the borough in which the battery system is located, to alert the *Department* to the unsafe condition;

(B) Notify the *certificate of fitness* holder responsible for the battery system, in a pre-arranged manner, to alert such individual to be ready to provide technical assistance to the *Department* and/or respond to the incident location in accordance with R608-01(i)(4) and (5); and

(C) Notify the manufacturer of the battery system to make a qualified representative available to provide technical assistance to the *Department* pursuant to R608-01(i)(4).

(2) **Central station monitoring of fire protection systems**. All *fire protection systems* protecting the battery system installation, including any *fire extinguishing system*, and fire and gas detection or other *emergency alarm system* required by this section, shall be monitored by an *approved central station*.

(3) **Constantly attended on-site locations.** Battery systems and *fire protection systems* may be monitored at a constantly attended on-site location, but such monitoring may not substitute for the remote monitoring facility and/or *central station* required by R608-01(i)(1) and (2), unless such substitution is approved in writing by the Technology Management Unit of the *Bureau of Fire Prevention*.

(4) **Technical assistance.** Upon request of the *Department,* both the *certificate of fitness* holder responsible for the battery system and the battery system manufacturer shall make available to the *Department* a representative with technical knowledge of the battery system and its operation. Such representative shall be made available as soon as possible, but in any event within 15 minutes of receipt of the *Department*'s request.

(5) **Emergency management.** Upon request of the *Department*, the *certificate of fitness* holder responsible for the battery system and an authorized representative of the *owner* of the premises upon which the battery system is installed shall respond to the location of the battery installation, as soon as possible but in any event within two (2) hours of notification, to assist the *Department* in addressing a fire or other emergency involving or affecting the battery system, and to take all other actions necessary for mitigation and decommissioning of the battery system, or restoration to normal operation in accordance with R608-01(i)(7).

(6) **Signage.** When required by Table 2 of this section, the following signs (or equivalent markings) shall be durably posted for each *stationary storage battery system*, at the locations indicated:

(A) **Warning signs.** The following warning signs shall be posted on the exterior of medium and large battery systems or battery system enclosure:

(1) "Danger: High Voltage," or equivalent signage complying with the requirements of the *Electrical Code*; and

(2) Hazard identification sign complying with NFPA Standard 704 (2007 edition).

(B) **Identification, emergency contact and emergency shut-down signs**. The following signs shall be posted at the fire department connection, if any, utility connection or other *approved*, conspicuous outdoor location on the premises that is accessible to emergency response personnel and that is a reasonable distance (but not less than 10 feet) from the *stationary storage battery system* installation. The signage may be posted within a marked, locked box secured by a *citywide standard key* (2642 key). If the location of the signage would not be readily apparent to emergency response personnel, a sign with large lettering (not less than 3 inches high) shall be posted on or adjacent to the battery installation indicating the location of the following signage:

(1) **Permit.** The *permit* for the installation, laminated or otherwise suitably weatherproofed.

(2) **Equipment specifications**. The manufacturer and model number of the battery system and electrical rating (voltage and current).

(3) **Installation identification**. The number or other unique identifier used by the battery management system remote monitoring facility to identify the installation, which

firefighters or other *Department* representatives can reference in communications with the monitoring facility.

(4) **Monitoring facility contact information**. The telephone number of the battery management system remote monitoring facility.

(5) **Certificate of fitness contact information.** The name and telephone number of the *certificate of fitness* holder responsible for the battery system.

(6) **Emergency shutdown procedures**. Emergency shutdown procedures for the battery energy storage system shall be posted at the battery system emergency shut down (e-stop) control and at any attended on-site location. The emergency shutdown instructions shall clearly indicate "GRID SUPPORT SYSTEM" in large letters (not less than 2 inches high) if immediate shut down of the battery system could disrupt public utility operations.

(7) Maintenance. The *owner* shall ensure that *stationary storage battery systems* are periodically inspected, tested, serviced and otherwise maintained in accordance with manufacturer's specifications and the requirements of this section by a person trained and knowledgeable in the specific battery system.

(A) **Periodic inspection.** When required by Table 2 of this section, the battery system shall be inspected by the *certificate of fitness* holder on not less than an annual basis to confirm continued compliance with applicable code, *rule* and *permit* requirements, including checking for the presence of required signage and whether any posted information needs to be updated, and confirming that all required systems are in good working order.

(B) **Restoration to service after serious failure.** Any battery system that undergoes a serious failure, including one that results in a fire, release of flammable or toxic gas, and/or physical damage to system components, shall be removed from service forthwith. The battery system shall not be restored to service until it has been evaluated by a trained and qualified person, repaired and tested, re-commissioned in accordance with R608-01(f) by a person holding a *certificate of fitness*.

(C) **Replacement components.** Any replacement storage battery units or other battery system components shall be designed for the same storage battery technology and/or chemistry and be compatible with the existing battery system installation. In-kind replacement of existing components (consistent with the *listing* for the *storage battery unit* or *storage battery system*) constitutes maintenance and does not require *Department* review and approval. Replacement of existing components with different battery technologies or chemistries (including the electrolyte chemistry in a flow battery system) or that change the storage/generating capacity or other functionality of a battery system, or other change to *listed* components, constitutes an alteration of the battery system and shall be submitted for *Department* review and approval, and, as applicable, *Department of Buildings* review and approval, in the same manner as an application for a new *stationary storage battery system* installation.

(D) **Combustible waste.** *Stationary storage battery system* installations shall be kept free from the accumulation of combustible waste and combustible vegetation in accordance with FC304.1.

(E) **Storage of combustible materials.** Combustible materials not required for battery system operation shall not be stored in battery system enclosures.

(j) **Recordkeeping Requirements.** A written record of the following information shall be maintained at the premises or other *approved* location by the *certificate of fitness* holder, and, for medium and large battery systems, by the *owner* or operator of the battery system:

(1) Battery system installation and commissioning;
(2) Battery system maintenance, including all inspections, servicing and repair;
(3) Battery system decommissioning and removal;
(4) Installation and maintenance of battery system fire protection systems, including all inspection, testing, servicing and repair; and
(5) Fires or other incidents involving or affecting the battery system.

APPENDIX D: INCIDENT COMMAND SYSTEM INCIDENT SEQUENCE