



NYSERDA

Battery Energy Storage for First Responders

Fire Code Considerations for Battery Energy Storage Systems

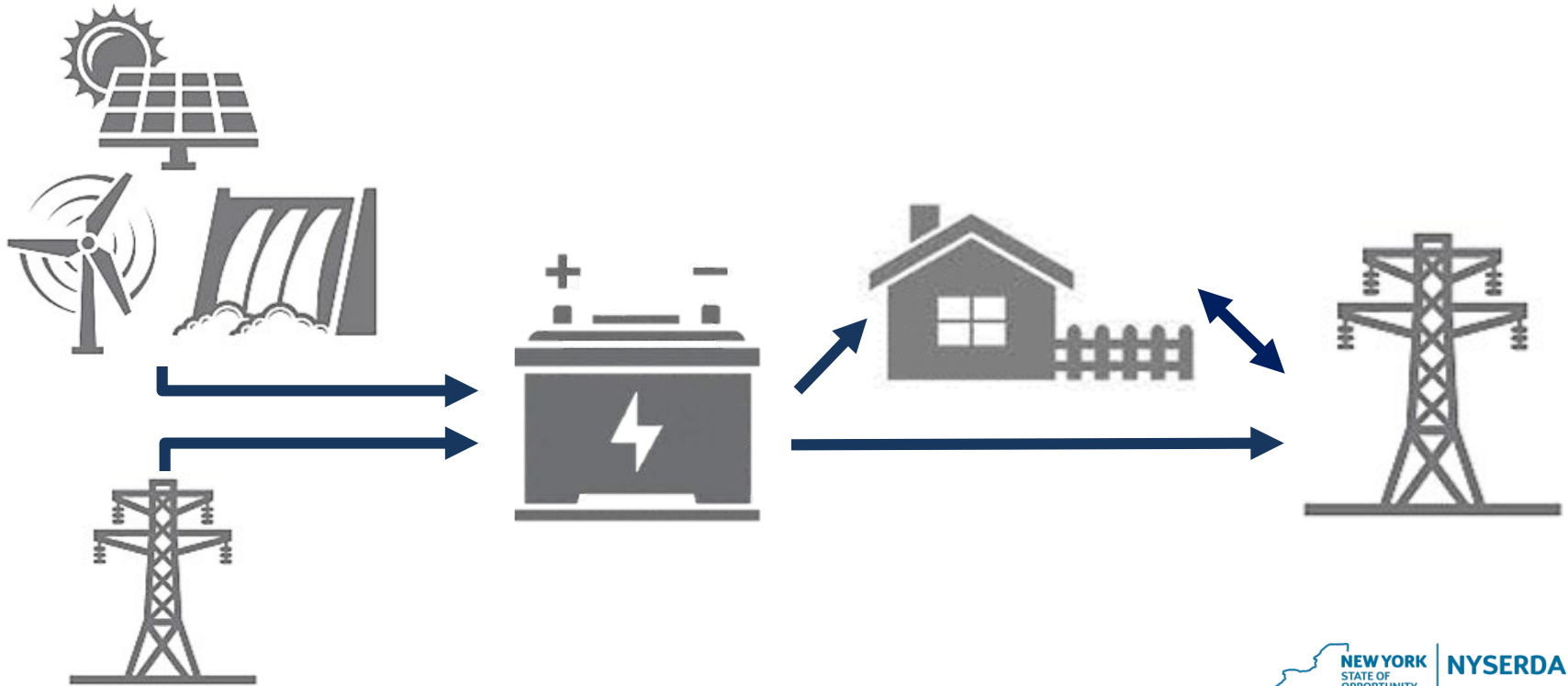
Jennifer Manierre, Clean Energy Siting

Niagara Frontier Building Officials Conference

1/27/2020

Battery Energy Storage Overview

Introduction to Battery Energy Storage



Battery Energy Storage System Types

Pumped Hydroelectric

Mechanical

- Compressed Air Energy Storage
- Flywheel

Electrochemical

- Lead acid, Lithium Ion, Sodium Sulfur, Sodium Nickel Chloride
- Flow batteries – Vanadium redox, Zinc-bromine

Thermal

- Sensible – Molten Salt, Chilled Water
- Latent – ice storage, phase change materials
- Thermochemical storage

Chemical (Hydrogen)

- Power-to-Power (Fuel Cells, etc)
- Power-to-Gas

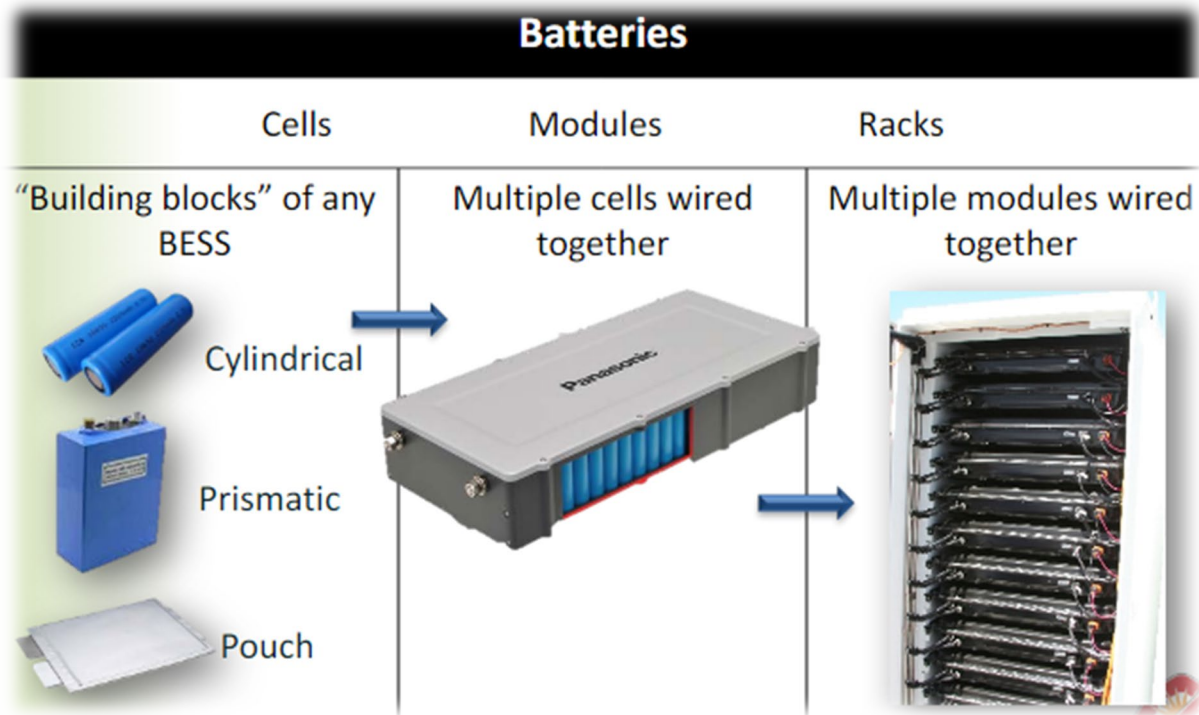
Electrochemical Battery Types

	Lead Acid	Sodium-Sulfur	Flow Batteries	Lithium-Ion
Round-trip efficiency	70-85%	70-80%	60-80%	85-95%
Typical duration	2-6 hours	6-8 hours	4-12 hours	0.25-4 hours
Time to build	6-12 months	6-18 months	6-12 months	6-12 months
Operating cost	High	Moderate	Moderate	Low
Space required	Large	Moderate	Moderate	Small
Cycle life	500-2,000	3,000-5,000	5,000-8,000+	2,000-6,000+
Technology maturity	Mature	Commercial	Early-moderate	Commercial

Adapted from: http://cnee.colostate.edu/wp-content/uploads/2018/08/Storage_July2018.pdf



Battery System Design



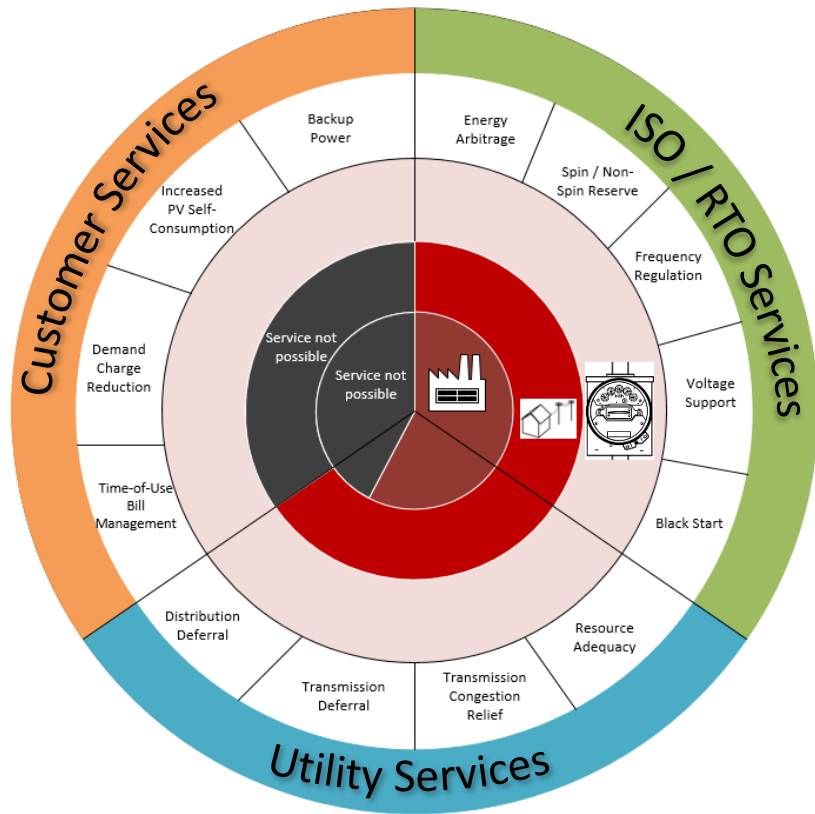
“The Role of Storage and DER for California, Solar + Storage for Resiliency.” Angelina Galiteva, Founder Renewables 100 Policy Institute, November 2017.

Battery Management System

- Monitors each individual cell within the system
- Will alarm if there are potential issues
- If required, can isolate affected cells or modules from the total system



Applications for BESS



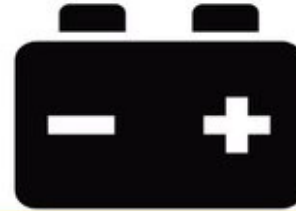
Valuable Applications:

Energy storage fits in everywhere on the grid! From a home system to a 400MWh facility, there are numerous different applications that storage can be used for!

- It's not about 'sunshine at night'
- Storage is systemic value, impacting every facet of supply, transmission, and consumption
- A single system can provide multiple values to grid/owner

Batteries can provide up to 13 services to three stakeholder groups

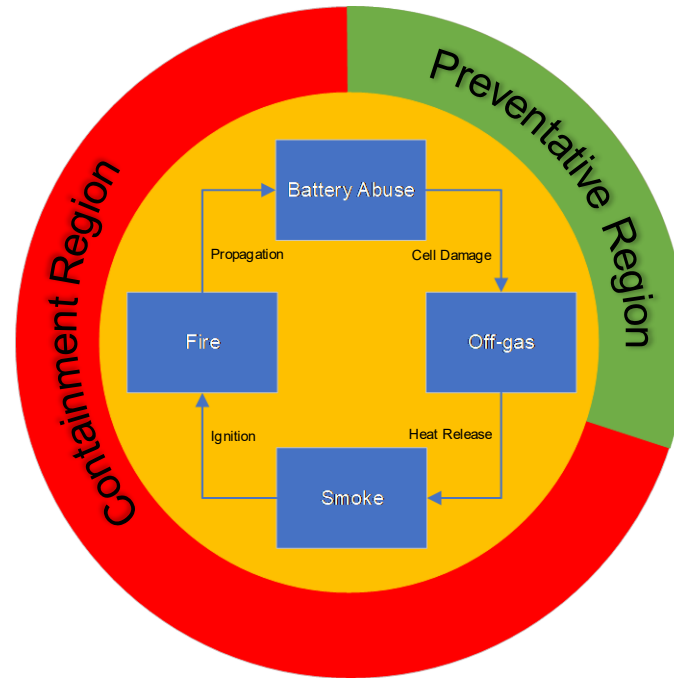
Example: Peaker Replacement



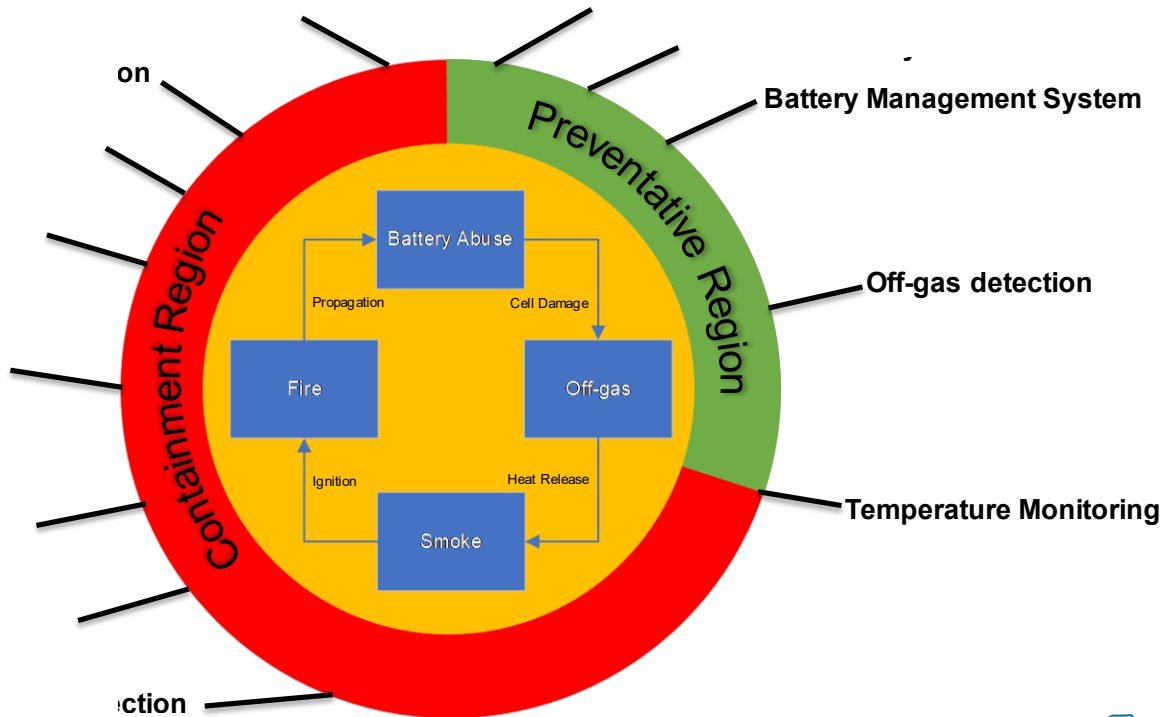
	Gas Peaker	Energy Storage
Range	~80% of capacity – minimum operational limits	200% of capacity – can act as supply or demand
Utilization	Low—only to meet peak demand or emergencies	High—simultaneous grid services
Dispatch Time	Minutes	Seconds
Standby	Costs and emissions	No costs or direct emissions

Battery Failure Sequences/Diagnosis

Thermal Runaway in Batteries



Thermal Runaway Protections



2019 Energy Storage Supplement

2019 Energy Storage Supplement

- Amended New York State's Uniform Code, effective July 1, 2019
- Added provisions related to the installation, use, and maintenance of energy storage systems
- Permanent ruling put in place November 1, 2019

Amendments to the International Fire Code

Energy Storage System Threshold Quantities

- **Scope** -Battery energy storage systems that exceed the following thresholds:

Technology	Energy Capacity ^a
Lead-acid batteries, all types	70 kWh (252 Megajoules) ^c
Nickel-cadmium batteries (Ni-Cd)	70 kWh (252 Megajoules)
Nickel metal hydride (Ni-MH)	70 kWh (252 Megajoules)
Lithium-ion batteries	20 kWh (72 Megajoules)
Flow batteries ^b	20 kWh (72 Megajoules)
Other battery technologies	10 kWh (36 Megajoules)
Capacitor energy storage systems	3 kWh (10.8 Megajoules)
Other electrochemical energy storage systems technologies	3 kWh (10.8 Megajoules)

a) Energy capacity is the total energy capable of being stored (nameplate rating), not the usable energy rating. For units rated in Amp-Hours, kWh shall equal rated voltage times amp-hour rating divided by 1000.

b) Shall include vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte type technologies.

c) An installation that exceeds 50 gallons of lead-acid battery electrolyte shall be considered to have exceeded the threshold quantities of this Table



Construction Documents

- Location and layout diagram
- Details on the fire-resistance rating of assemblies
- Quantities and types of BESS
- Manufacturer's specifications, ratings and listings
- Description of energy storage management systems and operation
- Location and content of required signage
- Details on fire suppression and detection, thermal management, ventilation, exhaust, and deflagration venting systems
- Support arrangement for installation, including seismic restraint
- Commissioning and Decommissioning plans
- Peer reviewer identification and qualifications

Hazard Mitigation Analysis

HMA will evaluate the consequences of failure modes

- Thermal runaway in a single BESS rack, module, or unit
- Failure of any battery management system
- Failure of any ventilation system
- Voltage surges on the primary
- Short circuits on the load side of BESS
- Failure of smoke or gas, fire suppression.
- Failure of spill neutralization or containment system

Analysis approval

- Fires will be contained for the minimum duration of the fire-resistance and detected in time to allow occupants to safely evacuate
- Toxic and highly toxic gases released during fires will not reach concentrations in excess of Immediately Dangerous to Life or Health (IDLH) level in the building or adjacent means of egress routes during the time deemed necessary to evacuate occupants from any affected area
- Flammable gases will not exceed 25% of their LFL and will be controlled through ventilation of the gases preventing accumulation or by deflagration venting

Large Scale Fire Test

- Where required, must be conducted in accordance with **UL 9540A** or approved equivalent
- Demonstrates that fire will not spread to adjacent systems and will be contained for duration of fire-resistance rating of assemblies
- May be used for fire code official to approve exceptions to certain requirements

Fire Remediation

- BESS owner shall mitigate the hazard or remove damaged equipment from the premises to a safe location
- BESS owner shall dispatch fire mitigation personnel to respond to possible ignition or re-ignition of a damaged BESS and remain on duty after the fire department leaves the premise until the damaged energy storage equipment is removed from the premises
- On-duty fire mitigation personnel shall have the following responsibilities:
 - Fire watch
 - Notify FD if a fire occurs
 - Maintain until decommissioning is finished
 - Evacuate building if needed



Peer Review

- Where required by the AHJ, the BESS owner is responsible for retaining and furnishing the services of a registered design professional or special expert to perform as a peer reviewer.
- The costs of the services shall be borne by the BESS owner.
- If a design professional is not required for scope of work, an approved special expert may be employed by the owner as the person in responsible charge of the limited or focused activity.
 - The scope of work of a special expert shall be limited to the area of expertise as demonstrated in the documentation submitted to the fire code official for review and approval.
- Special experts are those individuals who possess the following qualifications:
 - Has credentials of education and experience in an area of practice that is needed to evaluate risks and safe operations associated with the design, operation and special hazards of the BESS.
 - Licensing or registration, when required by any other applicable statute, regulation, or local law or ordinance



Commissioning Plan

- Outlines commissioning activities to be conducted *prior* to system being placed in service
 - Installed according to plan and manufacturer's specs
 - Testing that will take place on all components
 - Training plan for facility and operating staff
 - Identifies personnel responsible for responding to incidents
- Plan must be approved prior to initiating
- Report approved prior to final inspection
- Includes a decommissioning plan and operation and maintenance documentation



<https://www.gausman.com/Our-Company/News/entryid/135/the-purpose-of-a-commissioning-plan>

Operation and Maintenance Manual

- Provided to owner and system operator prior to system being put into operation
- Retained at an onsite location
- Outlines all required maintenance, contact information, diagrams, desired set points, and inspection, service, and testing schedules and logs

Decommissioning Plan

- Submitted as part of Commissioning Plan
- Notify AHJ prior to decommissioning
- Description of activities to remove system from service and facility
 - Contingencies for removing intact system from service
 - **Contingencies for removing system damaged by fire or other event**

Equipment Listing

- All systems listed in accordance with **UL 9540** “Standard for Energy Storage Systems and Equipment”
 - Except certain lead-acid systems under exclusive control of communications utilities
- Chargers, inverters, and energy storage management systems covered as part of UL 9540 listing or listed separately
 - Inverters for utility interactive systems listed under UL 1741
- Non-identical repairs are considered retrofits

Battery Energy Storage Management System

- Monitors and balances within the manufacturer's specifications
 - Cell voltages
 - Currents
 - Temperatures
- BMS shall disconnect electrical connections to the BESS or place it in a safe condition if potentially hazardous temperatures or other conditions such as short circuits, over voltages, or under voltages are detected



Enclosures

- Must be of noncombustible construction



General Installation Requirements

Electrical Disconnects

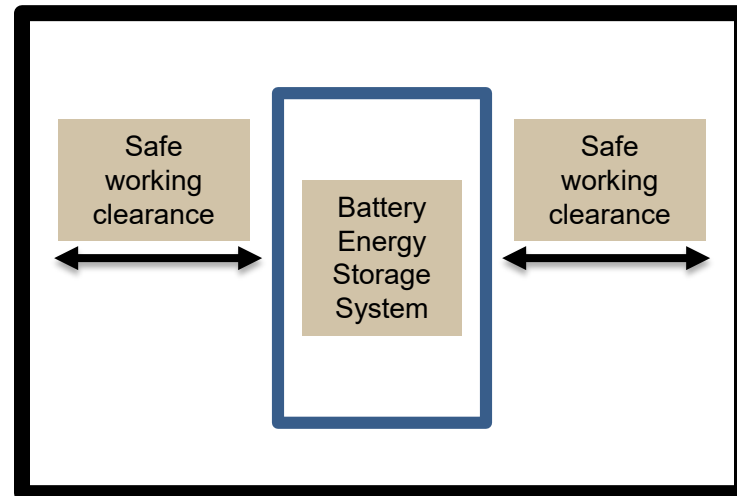
- Electrical Disconnect should be installed near the main electrical service.
- If not, placards shall be placed at the main electrical service indicating the location of the disconnect.



General Installation Requirements

Working clearances

- Access and working space clearance should be maintained around electrical equipment to permit ready and safe operation and maintenance of such equipment

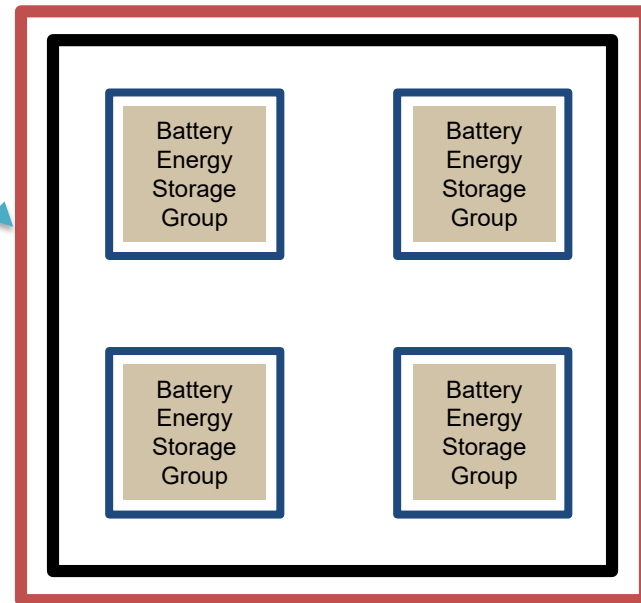


General Installation Requirements

Fire-resistance rated construction

- Rooms and other indoor areas containing BESS shall be separated from other areas of the building
- BESS shall be permitted to be in the same room with the equipment they support

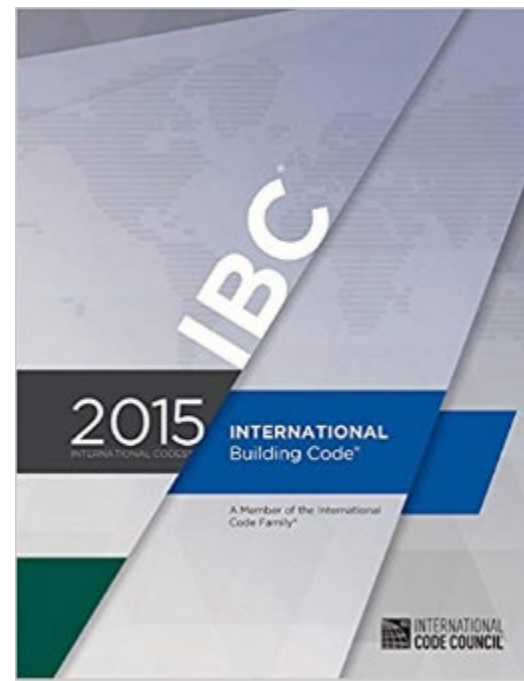
Fire-
resistance
rated
separation



General Installation Requirements

Seismic and structural design

- BESS shall comply with the seismic design requirements in Chapter 16 of the IBC, and shall not exceed the floor loading limitation of the building



General Installation Requirements

Vehicle impact protection

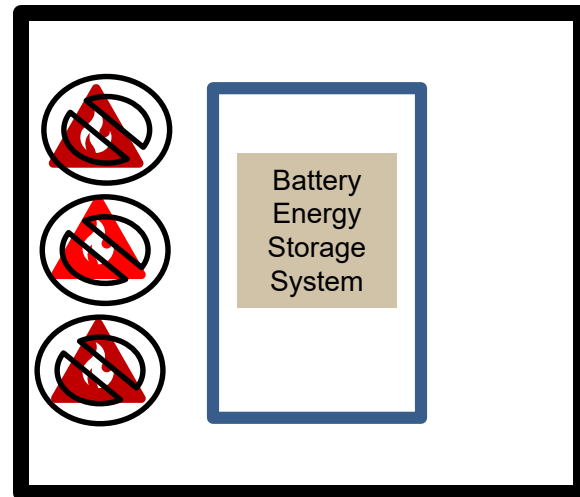
- Where BESS are subject to impact by motor vehicle, including fork lifts, vehicle impact protection must be provided



General Installation Requirements

Combustible storage

- Combustible materials shall not be stored in BESS rooms, areas, or walk-in units



General Installation Requirements

Toxic and highly toxic gases

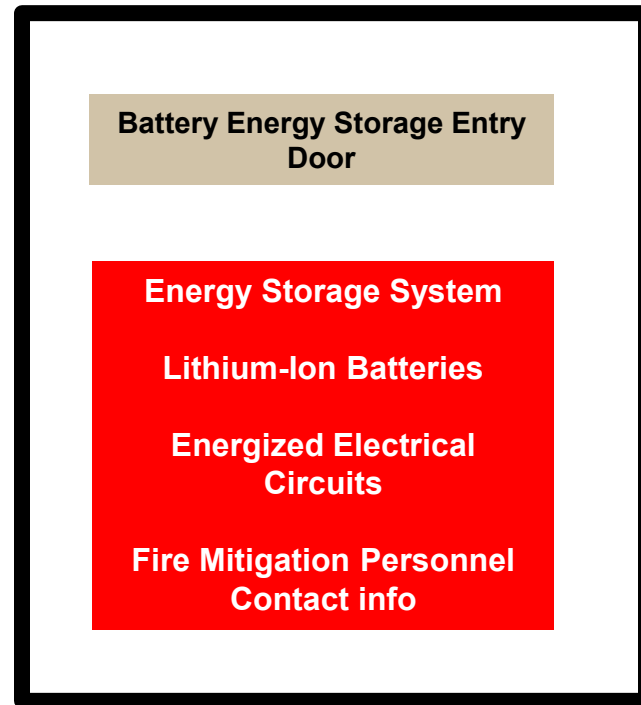
- BESS that may release toxic gas during charging, discharging, and normal use conditions shall be provided with a hazardous exhaust system



General Installation Requirements

Signage

- Approved signs shall be provided on or adjacent to all entry doors for BESS rooms or areas and on enclosures of BESS cabinets and walk-in units
- The signage shall include the following or equivalent



General Installation Requirements

Security of installations

- Rooms, areas, and walk-in units in which BESS are located shall be secured against unauthorized entry and safe-guarded in an approved manner
- Ensure that this does not inhibit the required air flow to or exhaust from the BESS



General Installation Requirements

Occupied work centers

For BESS in occupied work centers

- Housed in locked noncombustible cabinets or enclosures
- BESS in cabinets shall be located within 10 feet of the equipment they support



General Installation Requirements

Open rack installations

- BESS shall be allowed on open racks when they are installed in a separate equipment room and only authorized personnel have access to the room



General Installation Requirements

Walk-in units

- Walk-in units shall only be entered for inspection, maintenance, and repair of the BESS and equipment



Fire Safety Compliance: Electrochemical BESS Protection

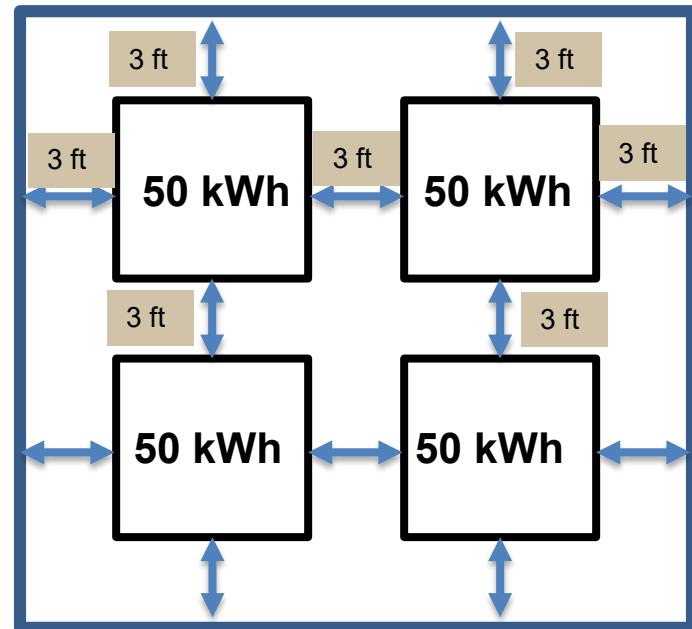
Electrochemical BESS Protections

Size and separation

- Segregated into groups not exceeding 50 kWh
- Each group separated a minimum of 3 feet from other groups and from walls in the storage room or area

Lead-acid and nickel-cadmium battery systems in facilities under the exclusive control of communications utilities and operating at less than 50 VAC and 60 VDC in accordance with NFPA 76 are exempt.

Larger capacities or smaller separation distances based on large scale fire testing



Electrochemical BESS Protections

Maximum allowable quantities

Fire areas within rooms, areas, and walk-in energy storage system units containing electrochemical energy storage systems shall not exceed the maximum allowable quantities.

1. Where approved by the fire code official, systems that exceed the amount in this table, shall be permitted based on HMA and LSFT
2. Lead-acid and nickel-cadmium battery systems in facilities under the exclusive control of communications utilities and operating at less than 50 VAC and 60 VDC in accordance with NFPA 76 are exempt
3. Dedicated use buildings are exempt

TECHNOLOGY	MAXIMUM ALLOWABLE QUANTITIES ^a
STORAGE BATTERIES	
Lead-acid, all types	Unlimited
Nickel-cadmium (Ni-Cd)	Unlimited
Nickel metal hydride (Ni-MH)	Unlimited
Lithium-ion	600 kWh
Flow batteries ^b	600 kWh
Other battery technologies	200 kWh
CAPACITORS	
All types	20 kWh
OTHER ELECTROCHEMICAL ENERGY STORAGE SYSTEM	
All types	20 kWh

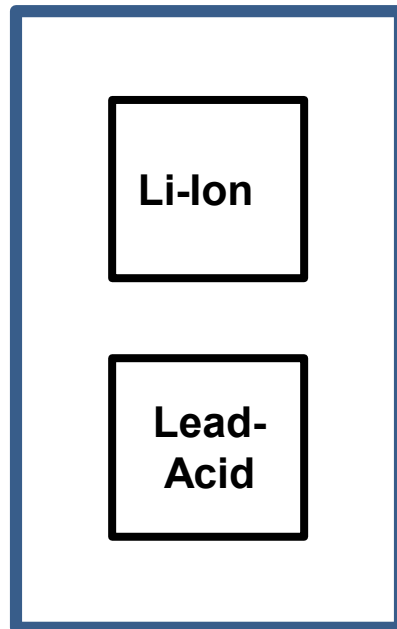
- a. For electrochemical energy storage system units rated in Amp-Hours, kWh shall equal rated voltage times the Amp-hour rating divided by 1000
- b. Shall include vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte type technologies

Electrochemical BESS Protections

Mixed electrochemical systems

- Where areas contain different types of electrochemical energy technologies, the total aggregate quantities of the systems shall be determined based on

$$\frac{\left(\text{Quantity of Tech 1} \right)}{\left(\text{MAQ of Tech 1} \right)} + \frac{\left(\text{Quantity of Tech 2} \right)}{\left(\text{MAQ of Tech 2} \right)} + \frac{\left(\text{Quantity of Tech n} \right)}{\left(\text{MAQ of Tech n} \right)} = \text{Shall not exceed 100\%}$$



Electrochemical BESS Protections

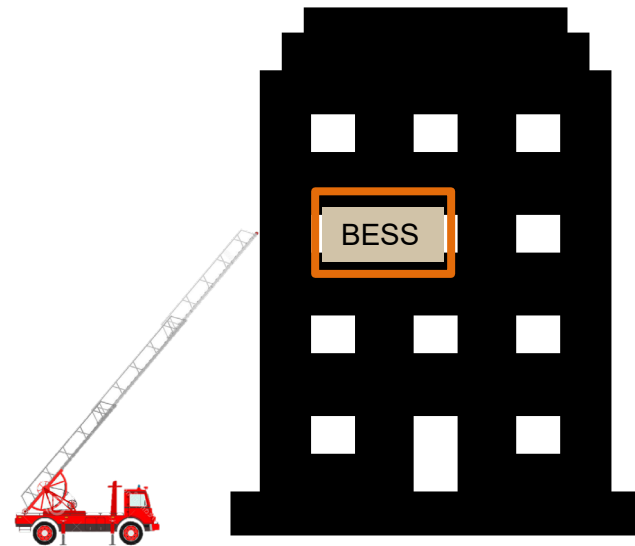
Elevation

BESS shall not be located on

- Floors more than 75 ft above the lowest level of fire department vehicle access
- Floors located below the lowest level of exit discharge

Where approved by the fire code official, installations shall be permitted on higher or lower floors

Lead-acid and Nickel-cadmium battery systems less than 50 VAC and 60 VDC installed in facilities under the exclusive control of communications utilities in accordance with NFPA 76.



Electrochemical BESS Protections

Fire detection

- Automatic smoke detection system or radiant energy sensing fire detection system shall be installed
- Alarm signals shall be transmitted to a central station



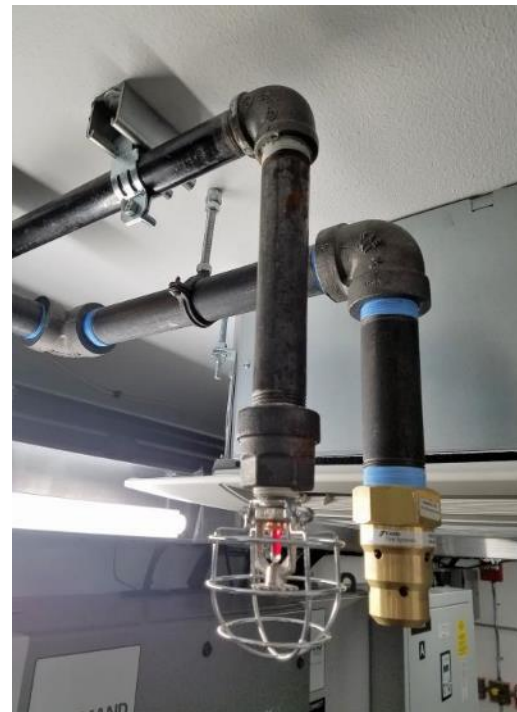
Electrochemical BESS Protections

Fire suppression systems

1. Automatic sprinkler system with minimum density of $0.3\text{gpm}/\text{ft}^2$ or determined based on large scale fire testing
or
2. Alternate automatic fire extinguishing systems designed and installed in accordance with Section 904, approved by the fire code official based on large scale fire testing
 - NFPA 12, Standard on Carbon Dioxide Extinguishing Systems
 - NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection
 - NFPA 750, Standard on Water Mist Fire Protection Systems
 - NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems
 - NFPA 2010, Standard for Fixed Aerosol Fire Extinguishing Systems



Fire Suppression



Dry Standpipe



Electrochemical BESS Protections

Maximum enclosure size

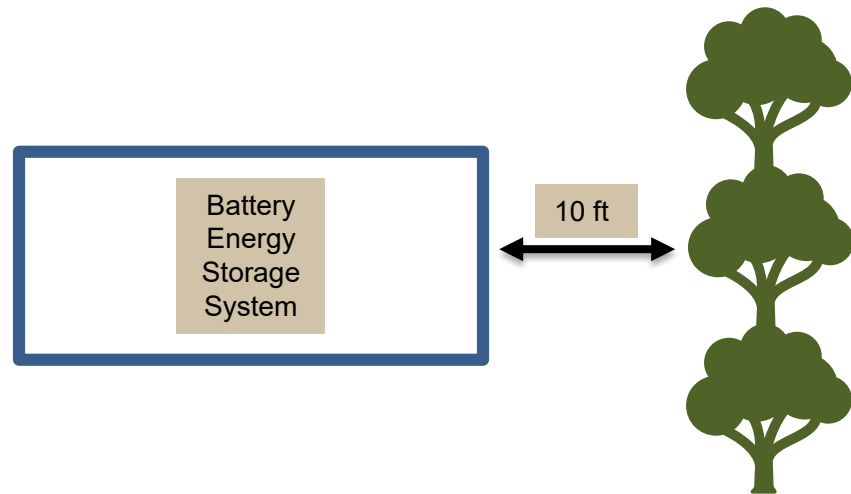


Outdoor walk-in units shall not exceed 4,028 cubic feet, not including bolt-on HVAC and related equipment.

Electrochemical BESS Protections

Vegetation control

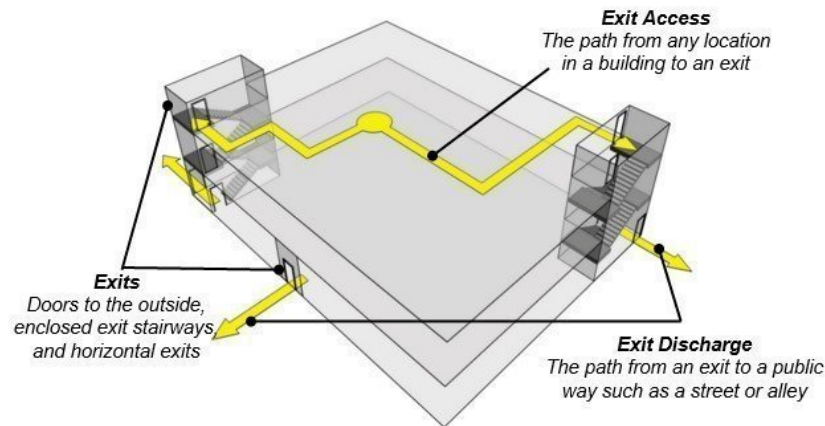
- Areas within 10 feet of each side of outdoor BESS shall be cleared of combustible vegetation and other growth.



Electrochemical BESS Protections

Means of egress separation

- BESS outdoors and in open parking garages shall be separated from any means of egress to ensure safe egress under fire conditions, but no less than 10ft



Means of Egress Upside Innovations, 2019.

Fire Safety Compliance: Technology Specific

Electrochemical BESS Tech Specific Protections

COMPLIANCE REQUIRED ^b	BATTERY TECHNOLOGY				OTHER ENERGY STORAGE SYSTEM AND BATTERY TECHNOLOGIES ^b	CAPACITOR ENERGY STORAGE SYSTEM ^b
	Lead- acid	Ni- Cad and Ni-MH	Lithium- ion	Flow		
608.13.1 Exhaust ventilation	Yes	Yes	No	Yes	Yes	Yes
608.13.2 Spill control and neutralization	Yes ^c	Yes ^c	No	Yes	Yes	Yes
608.13.3 Explosion control	Yes ^a	Yes ^a	Yes	No	Yes	Yes
608.13.4 Safety caps	Yes	Yes	No	No	Yes	Yes
608.13.5 Thermal runaway	Yes ^d	Yes	Yes ^e	No	Yes ^e	Yes

- Not required for lead-acid and nickel cadmium batteries at facilities under the exclusive control of communications utilities that comply with NFPA 76 and operate at less than 50 VAC and 60 VDC.
- Protection shall be provided unless documentation acceptable to the *fire code official* is provided that provides justification why the protection is not necessary based on the technology used.
- Applicable to vented (i.e. flooded) type nickel-cadmium and lead-acid batteries.
- Not required for vented (i.e. flooded) type lead-acid batteries.
- The thermal runaway protection is permitted to be part of an *energy storage management system* that has been evaluated with the battery as part of the evaluation to UL 1973.

Electrochemical BESS Tech Specific Protections

Exhaust ventilation

- Ventilation designed to limit the maximum concentration of flammable gas to 25% of the LFL **OR** provide continuous ventilation at a rate of not less than 1 ft³/min/ft²
- Standby power shall be provided for minimum of two hours
- Exhaust ventilation shall be supervised by central or remote station



Intake port



Electrochemical BESS Tech Specific Protections

Gas detector



- Gas detection system designed to activate the ventilation system where the flammable gas exceeds 25% of the LFL and remain activated until the flammable gas detected is less than 25 % of the LFL
- Initiate distinct audible and visible alarms, transmit an alarm to an approved location, de-energizing of the battery charger, activate the mechanical ventilation, and 2 hours of standby power

Electrochemical BESS Tech Specific Protections

Spill control and neutralization

- Required for areas containing free-flowing liquid electrolyte or hazardous materials
- **Spill control** shall prevent the flow of liquid electrolyte to adjoining rooms or areas
- An approved method to **neutralize** spilled liquid electrolyte capable of neutralizing a spill from the largest battery or vessel to a pH between 5.0 and 9.0



Battery Spill Containment. (n.d.). Retrieved June 07, 2019, from <https://www.sbsbattery.com/products-services/by-product/battery-spill-containment-systems.html>

Electrochemical BESS Tech Specific Protections

Explosion control

Provided for rooms, areas, or walk-in units containing BESS

1. Deflagration venting
 - Pressure panels
2. Deflagration prevention
 - Exhaust fans
 - 25 % of LFL



Electrochemical BESS Tech Specific Protections

Safety caps

- Vented batteries and other BESS shall be provided with flame arresting safety caps
- Hydrogen release
- Pressure build up

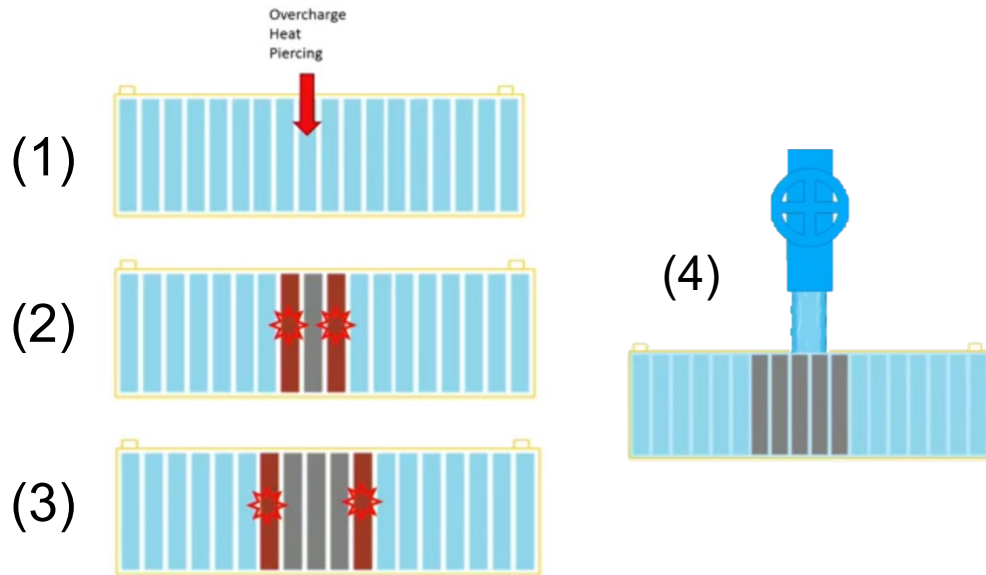


Stationary/Utility Flooded Battery Vent Caps™ Storage Battery Systems, Inc. 2018.

Electrochemical BESS Tech Specific Protections

Thermal runaway

- BESS shall be provided with a listed device or other approved method to prevent, detect, and minimize the impact of thermal runaway.

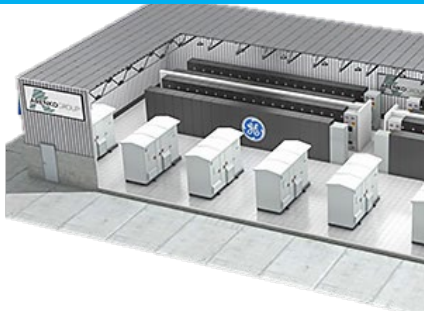


*Opening and A strategy for fighting lithium-ion battery fires. Marko Hassinen, Emergency Services College, November 2018

Fire Safety Compliance: Location Specific

Modern Battery Installations Scenarios

Dedicated Use Building



Outdoors Near Exposures



Non-Dedicated Use Building



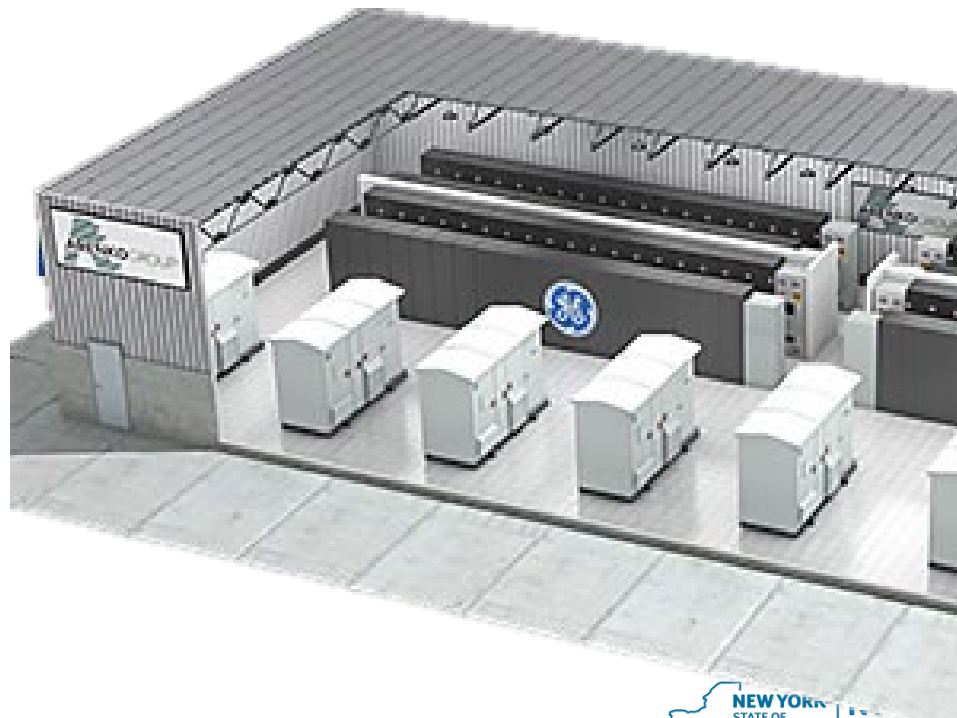
Outdoors Remote



Indoor Installations

Dedicated Use Buildings

- Only used for BESS, electrical energy generation, or grid related operations
- No unauthorized access, only maintenance
- If separate areas for admin, no more than 10% of building area and direct means of egress



Indoor Installations

Dedicated Use Buildings

- Only used for BESS, electrical energy generation, or grid related operations
- No unauthorized access, only maintenance
- If separate areas for admin, no more than 10% of building area and direct means of egress



Indoor Installations

Non-Dedicated Use Buildings

- Contains BESS, but not dedicated use as described above



Indoor Installations

Compliance Required	Dedicated Use Buildings	Non-Dedicated Use Buildings
608.11 General Installation Requirements	Yes	Yes
608.12.1 Size and separation	Yes	Yes
608.12.2 Maximum allowable quantities	No	Yes
608.12.3 Elevation	Yes	Yes
608.12.4 Smoke and automatic fire detection ^e	Yes ^c	Yes
608.12.5 Fire suppression systems	Yes ^d	Yes
608.14.3 Dwelling units and sleeping units	NA	Yes
608.14.4 Fire-resistance rated separations	Yes	Yes
608.13 Technology specific protection	Yes	Yes

c. Where *approved* by the *fire code official*, alarm signals are not required to be monitored by an *approved* supervising station in accordance with NFPA 72.

d. Where *approved* by the *fire code official*, fire suppression systems are permitted to be omitted in dedicated use buildings located more than 100 feet (30.5 M) from buildings, lot lines, public ways, stored combustible materials, hazardous materials, high piled stock and other exposure hazards.

e. Lead-acid and nickel-cadmium battery systems installed in Group U buildings and structures less than 1500 ft(140 m) under the exclusive control of communications utilities and operating at less than 50 VAC and 60 VDC in accordance with NFPA 76 are not required to have an *approved* automatic smoke or fire detection system.

Indoor Installations

Dwelling units and sleeping units

- BESS shall not be installed in sleeping units or in habitable spaces of dwelling units



Indoor Installations

Fire-resistance rated separations

2-hour fire barriers (§707 IBC) and 2-hour fire rated horizontal assemblies (§711 IBC)

- Dedicated use buildings:
 - Separate from admin and support personnel
- Non-dedicated use buildings:
 - Separate from other building areas

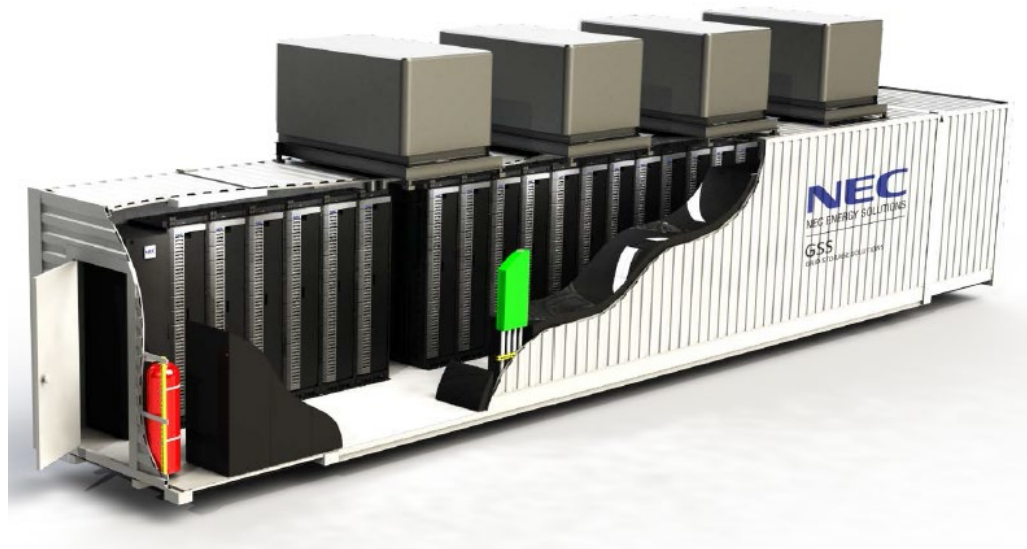
Outdoor Installations

1. Remote outdoor installations

– 100ft clearance from buildings, lot lines, public ways, stored combustible materials, hazardous materials, high piled stock and other exposure hazards

2. Installations near exposures

- not remote as described above



Outdoor Installations

Compliance Required	Remote Installations ^a	Installations Near Exposures ^b
608.11 General Installation Requirements	Yes	Yes
608.12.1 Size and separation	No	Yes ^c
608.12.2 Maximum allowable quantities	No	Yes
608.12.4 Smoke and automatic fire detection	Yes	Yes
608.12.5 Fire suppression systems	Yes ^d	Yes
608.12.6 Maximum enclosure size	Yes	Yes
608.12.7 Vegetation control	Yes	Yes
608.12.8 Means of egress separation	Yes	Yes
608.15.3 Clearance to exposures	Yes	Yes
608.13 Technology specific protection	Yes	Yes

a. See Section 608.15.1.

b. See Section 608.15.2.

c. In outdoor walk-in energy storage system units, spacing is not required between energy storage system units and the walls of the enclosure.

d. Where approved by the fire code official, fire suppression systems are permitted to be omitted.

Walk-in Containers

Max Enclosure Size

Means of Egress

Security of Installations

HVAC units

Exhaust ventilation



Walk-in Unit Installation



#	Description
1	Battery rack
2	Fire Suppression System: Clean Agent
3	Energy Management System
4	HVAC: No ingress, exchanger type
5	Battery Control Panel
6	Power Inverter

BESS Cabinets



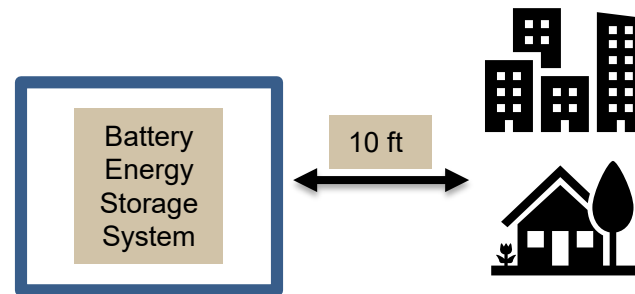
Cabinet Systems



Outdoor Installations

Clearance to exposures

- Clearance ≥ 10 ft from lot lines, public ways, buildings, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards



Exceptions to reduce clearance to 3ft:

- All exposures:
 - 1-hour fire barrier 5ft above and around system boundary
- Buildings:
 - Wall adjacent to system is noncombustible, 2-hour fire rated, with no openings or combustible overhangs
 - Noncombustible, weatherproof enclosure around system and large-scale fire testing demonstrates fire won't spread

Outdoor Installations

Exterior wall installations

May be installed on exterior walls if:

1. Max capacity of each unit $\leq 20\text{kWh}$
2. Otherwise in compliance with Appendix 2
3. Installed according to manufacturer specifications
4. Individual unit separation $\geq 3\text{ft}$
5. Units $\geq 5\text{ft}$ from doors, windows, operable openings into buildings, or HVAC inlets

Exception: smaller separation for 4 and 5 based on large-scale fire testing



Special BESS Installations

1. **Rooftop installations** – installations are those located on the roofs of buildings.
2. **Open parking garage installations** - installations are those located in a structure or portion of a structure that complies with Section 406.5 of the International Building Code.

Compliance Required	Rooftops	Open Parking Garages
608.11 General Installation Requirements	Yes	Yes
608.12.1 Size and separation	Yes	Yes
608.12.2 Maximum allowable quantities	Yes	Yes
608.12.4 Smoke and automatic fire detection	Yes	Yes
608.12.6 Maximum enclosure size	Yes	Yes
608.12.8 Means of egress separation	Yes	Yes
608.16.3 Clearance to exposures	Yes	Yes
608.16.4 Fire suppression systems	Yes	Yes
608.16.5 Rooftop installations	Yes	No
608.16.6 Open parking garage installations	No	Yes
608.13 Technology specific protection	Yes	Yes

Special BESS Installations

Clearance to exposures

Clearance ≥ 10 ft from:

- Buildings, except building on which BESS is mounted
- Any portion of BESS building elevated above rooftop on which system is installed
- Lot lines
- Public ways
- Stored combustible materials
- Locations where motor vehicles can be parked
- Hazardous materials
- Other exposure hazards

Exceptions to reduce clearance to 3ft:

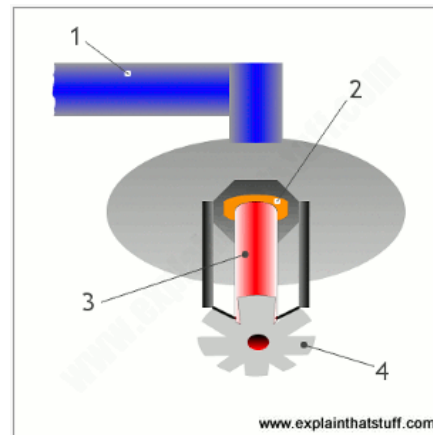
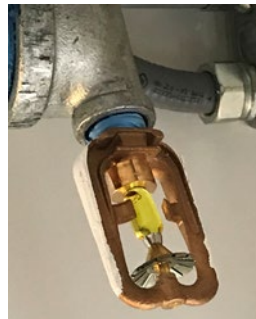
- 1-hour fire barrier 5ft above and around system boundary
- Noncombustible, weatherproof enclosure around system and large-scale fire testing demonstrates fire won't spread

Special BESS Installations

Fire suppression system

Automatic fire suppression system required:

- Inside enclosure of walk-in units
- BESS on parking levels not open to the sky



Water under pressure in a pipe (1) is held in place by a small plug (2), itself held in place by a glass bulb filled with glycerin (3). When a fire breaks out, the bulb breaks, releasing the plug, allowing the water to hit the flower-shaped deflector, which spreads it around in a spray.

Exception: Large-scale fire testing demonstrates fire will not impact exposures in open parking garages

Special BESS Installations

Rooftop installations

- Emergency personnel stairway access to roof
- Service walkways from access point to system, ≥ 5 ft in width
- Located away from edge of roof \geq distance equal to height of system, no less than 5ft
- Roofing materials under and within 5ft of system must be noncombustible or Class A rating ASTM E108 or UL 790
- Class I standpipe outlet installed at roof location
- System ≥ 10 ft from fire service access point on roof

Special BESS Installations

Rooftops and Open parking garages

≥ 50ft from building HVAC air inlets

Exception: May be ≥ 25 feet if automatic fire alarm system monitoring the radiant-energy sensing detectors de-energizes ventilation system connected to air intakes upon detection of fire

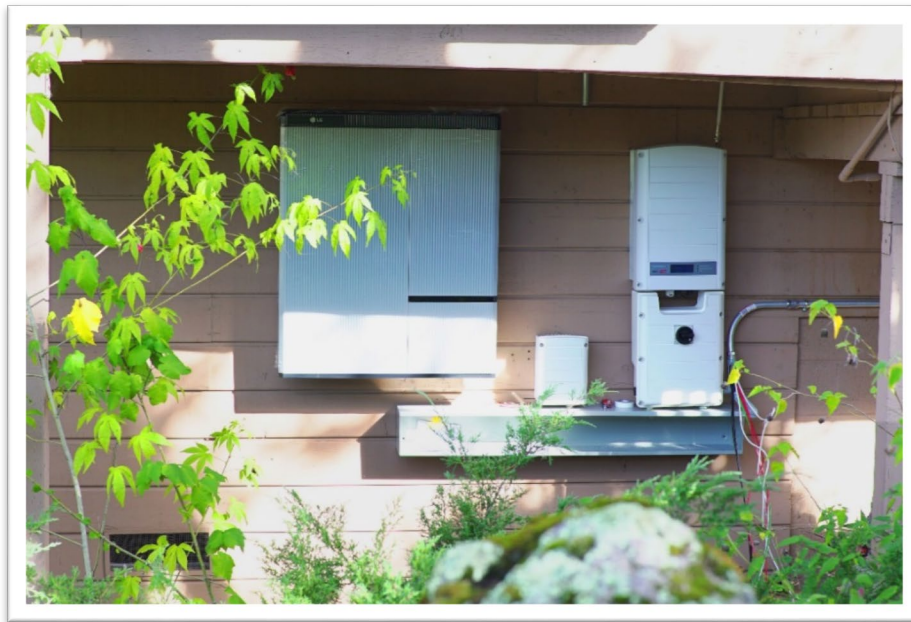
Special BESS Installations

Open parking garages

- Not located within 25 feet of exits where located on a covered level not open to sky above
- Fence with locked gate or other approved barrier to keep general public at least 5 feet from outer enclosure of system

Amendments to the International Residential Code

Residential BESS Installation Photos



Residential Size Threshold

- Battery energy storage systems for one to two family residential dwellings within or outside the structure with an aggregate energy capacity that shall not exceed:
 - 40 kWh within utility closets and storage or utility spaces
 - 80 kWh in attached or detached garages and detached accessory structures
 - 80 kWh on exterior walls
 - 80 kWh outdoors on the ground

Residential – Size and Separation

- Individual BESS units shall have a maximum rating of 20 kWh
- Individual BESS units shall be separated from each other by a minimum of 3 feet
- Individual BESS units installed outdoors on exterior walls shall be located a minimum 3 feet from doors and windows.

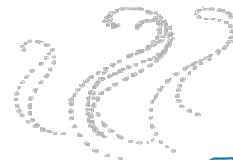
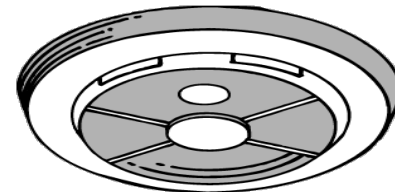


Residential – Fire-resistance Rating

- Rooms and areas containing energy storage systems shall be protected on the system side by no less than 5/8 inch Type X gypsum board or equivalent, installed on the walls and ceiling of the room or area.
- Attached garages containing energy storage systems shall be protected on the system side by fire-resistant construction in accordance with Section R302.

Residential – Fire Detection

- Smoke alarms shall be installed in the area the BESS is installed.
- Where smoke alarms cannot be installed, a heat alarm shall be installed and connected to the smoke alarm system.



Residential – Ventilation

- Indoor installations of BESS that include batteries that produce hydrogen or other flammable gases during charging, shall meet the exhaust ventilation requirements set forth in the applicable fire code.
- If there is potential for release of toxic or highly toxic gas during charging, discharging, and normal use conditions, shall be installed outdoors.