



NYSERDA

Fire Code Considerations for Battery Energy Storage Systems

**Bill Oberkehr, NYSERDA
Paul Rogers, PGR Group LLC**

January 20, 2021

Today's Webinar

- Introductions & Overview
- Battery Energy Storage Systems (BESS) Overview
- NYS Uniform Code Requirements for BESS
- Incident Management for BESS

Presenters

Bill Oberkehr, NYSERDA

Bill Oberkehr is a Project Manager in NYSERDA's Clean Energy Siting group, where he helps guide local government officials through best practices, appropriate local laws, and permitting procedures for solar and battery energy storage installations.

Mr. Oberkehr received his B.A. from SUNY Old Westbury with a concentration in Philosophy and Religion. He also holds Master's degrees in Public Policy from Stony Brook University. He has worked to support responsible renewable energy development at the local, state, and national levels.

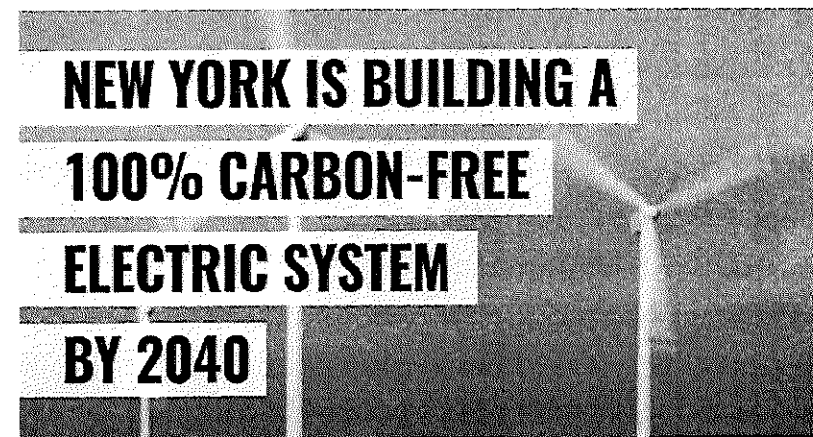
Paul Rogers, PGR Group LLC

Paul Rogers is a retired FDNY lieutenant with over 25 years of experience. As an FDNY officer, Lt. Rogers was the Fire Prevention Subject Matter Expert (SME) for the FDNY Special Operations Command (SOC) Hazardous Materials Division.

As an SME, Lt. Rogers has collaborated with NFPA, UL, Con Edison, FM Global, DOE, EPA, DOT, and many other regulatory entities. Lt. Rogers currently sits on the NFPA 855 (Energy Storage Systems Installations) Standard committee, and is a member of the International Fire Code Action Committee for ESS installations.

New York Energy Policy

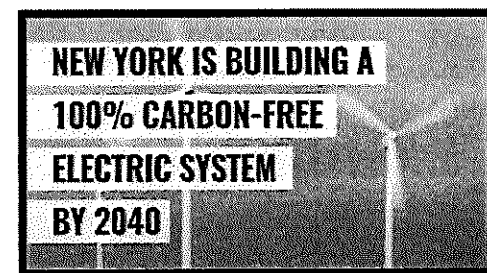
- Reforming the Energy Vision (REV) is Governor Andrew Cuomo's strategy to build a clean, resilient and affordable energy system for all New Yorkers
- Clean Energy Standard: 70% carbon-free by 2030
- Clean Energy Fund (CEF)
 - 10-year, \$5 billion funding commitment
 - Reshapes NY's energy efficiency, renewable energy and energy innovation programs
 - Reduces the cost of clean energy
 - Accelerates the adoption of energy efficiency to reduce load
 - Increases renewable energy to meet demand
 - Mobilizes private investment in clean energy



Energy Storage Initiative

A critical resource for enabling New York's clean energy future

- Avoid CO₂ emissions
- Reduce the impact of outages
- Allow intermittent renewables to be available during peak demand
- Create 30,000 jobs by 2030 in New York



2025 STATEWIDE ENERGY STORAGE TARGET

1,500 MW

2030 STATEWIDE ENERGY STORAGE TARGET

3,000 MW

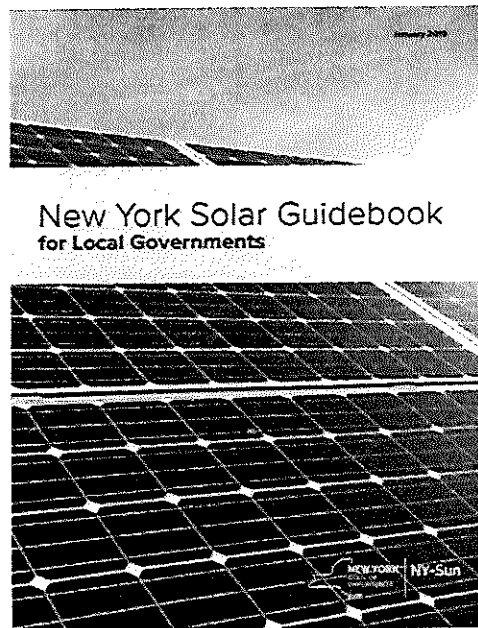
NYSERDA Opportunities

- \$400 million market acceleration bridge incentives: available for retail, bulk, standalone, and storage plus solar PV
- Technical assistance: permitting, interconnection, customer acquisition, and financing resources

nyserdera.ny.gov/EnergyStorage

Clean Energy Siting

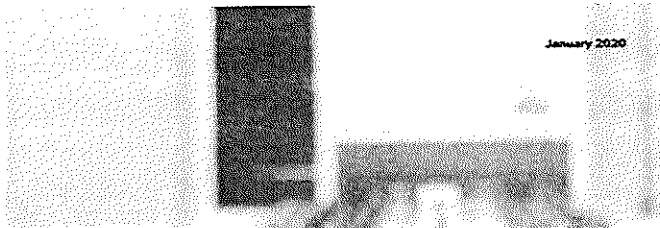
NYSERDA created the NY Solar Guidebook to assist local governments in managing solar energy development in their communities.



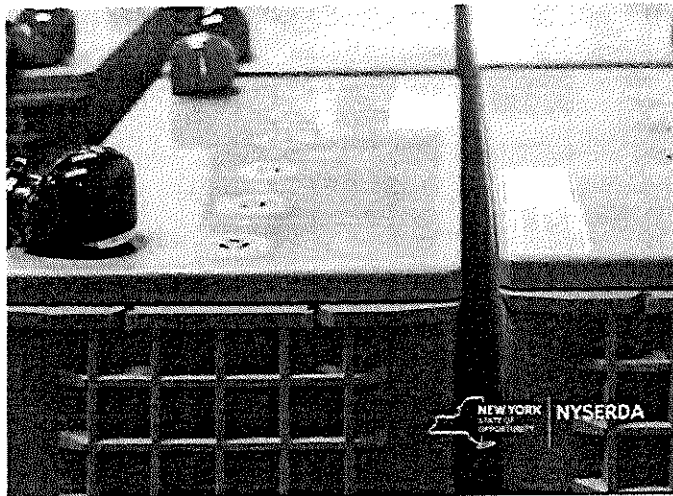
NYSERDA offers local governments free one-on-one technical assistance on, but not limited to:

- Property taxes & Payment-in-Lieu-of-Taxes (PILOTs)
- SEQR process
- Adopting zoning laws
- Municipal procurement
- Adopting & Implementing Unified Solar Permit & Energy Storage Permit

NY Battery Energy Storage System Guidebook



New York Battery Energy
Storage System Guidebook
for Local Governments



Chapter 1 – Battery Energy Storage Model Law

Chapter 2 – Battery Energy Storage Model Permit

Chapter 3 – Battery Energy Storage Inspection Checklist

**Chapter 4 – 2020 New York State Uniform Fire
Prevention and Building Code**

Clean Energy Siting Homepage

Clean Energy Siting for Local Governments

Energy Storage
Guidebook

EV Charging Station
Permitting Resources

Solar Guidebook

Wind Energy Guidebook

Article 10

Technical Assistance and
Workshops

Clean Energy Siting
Email List

The Battery Energy Storage Guidebook is available for download here

Clean Energy Siting for Local Governments

NYSERDA offers several resources to help local governments understand how to manage responsible clean energy development in their communities. These resources include step-by-step instructions and tools to guide the implementation of clean energy, including permitting processes, property taxes, siting, zoning, and more. If you have a question on clean energy siting in your community, or need help with a chapter of the Guidebook, email cleanenergyhelp@nyserda.ny.gov and we'll respond to you within 24 hours. For more hands-on support, learn more about our free training and technical assistance opportunities.

Stay up-to-date with the latest about Clean Energy Siting. Join our email list for local government officials.

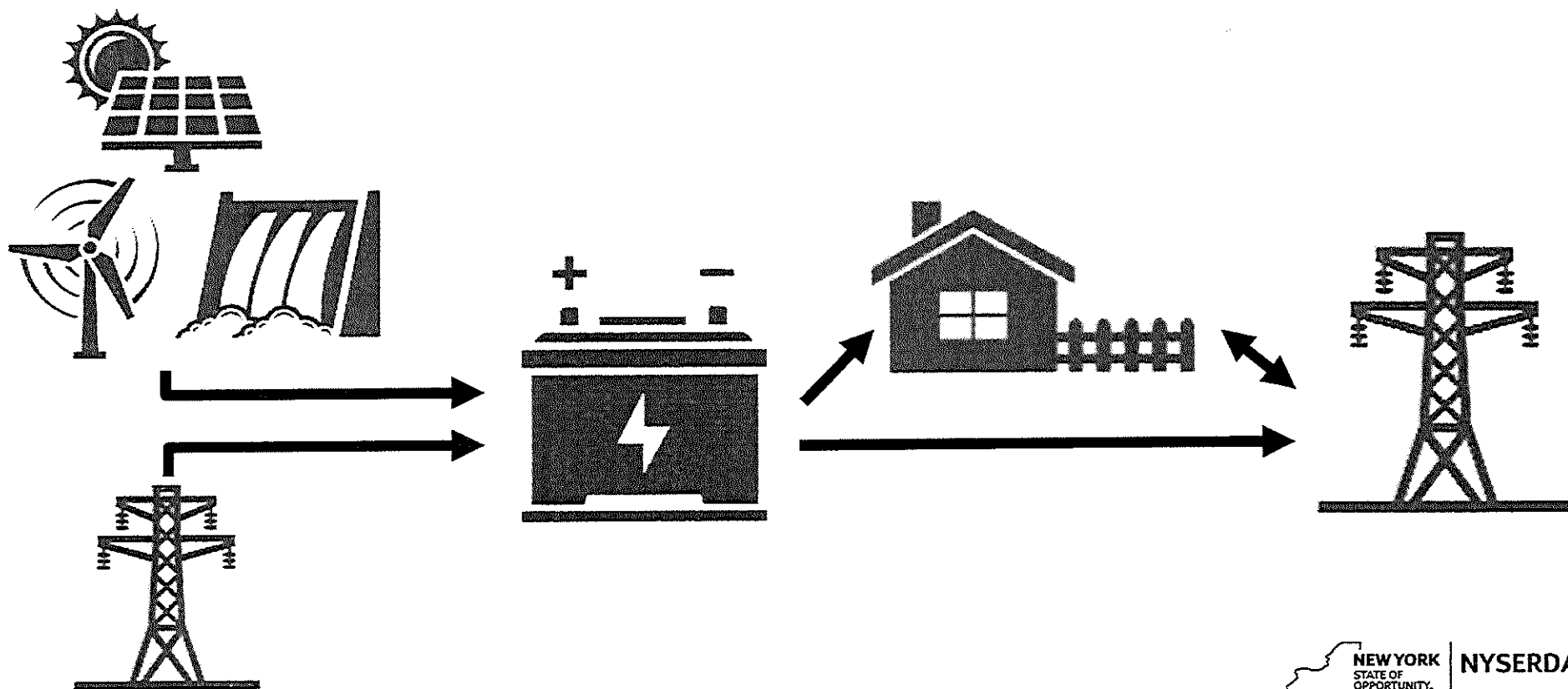
Ask the team any question by sending an email to cleanenergyhelp@nyserda.ny.gov

Municipalities can request trainings or technical assistance here

nyserda.ny.gov/Siting

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

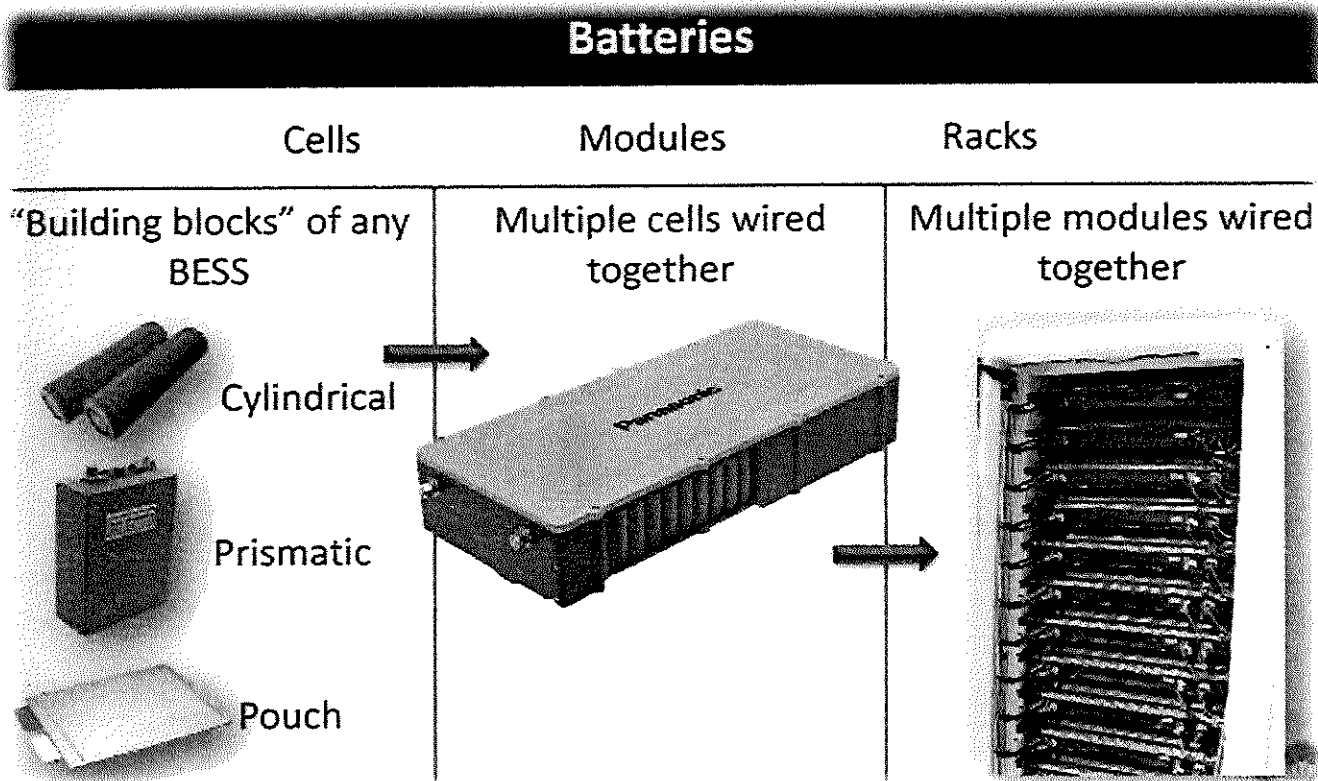
	Lead Acid	Sodium-Sulfur	Flow Batteries	Lithium-Ion
Round-trip efficiency	70-85%	70-80%	60-80%	85-95%
Typical duration	2-6 hours	6-8 hours	4-12 hours	0.25-4 hours
Time to build	6-12 months	6-18 months	6-12 months	6-12 months
Operating cost	High	Moderate	Moderate	Low
Space required	Large	Moderate	Moderate	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



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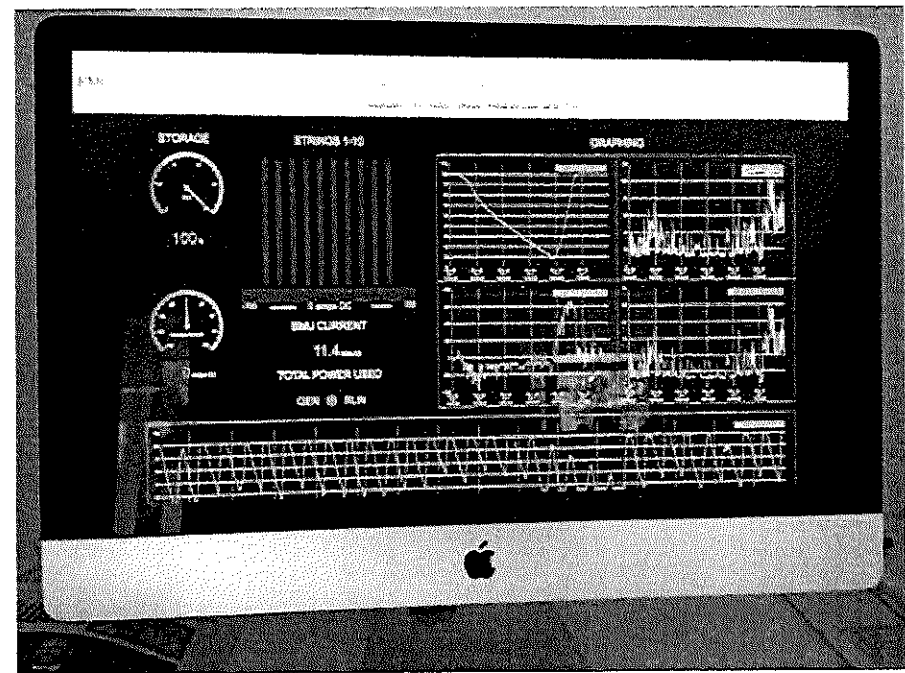
Battery System Design



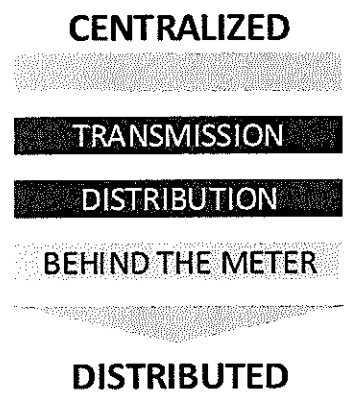
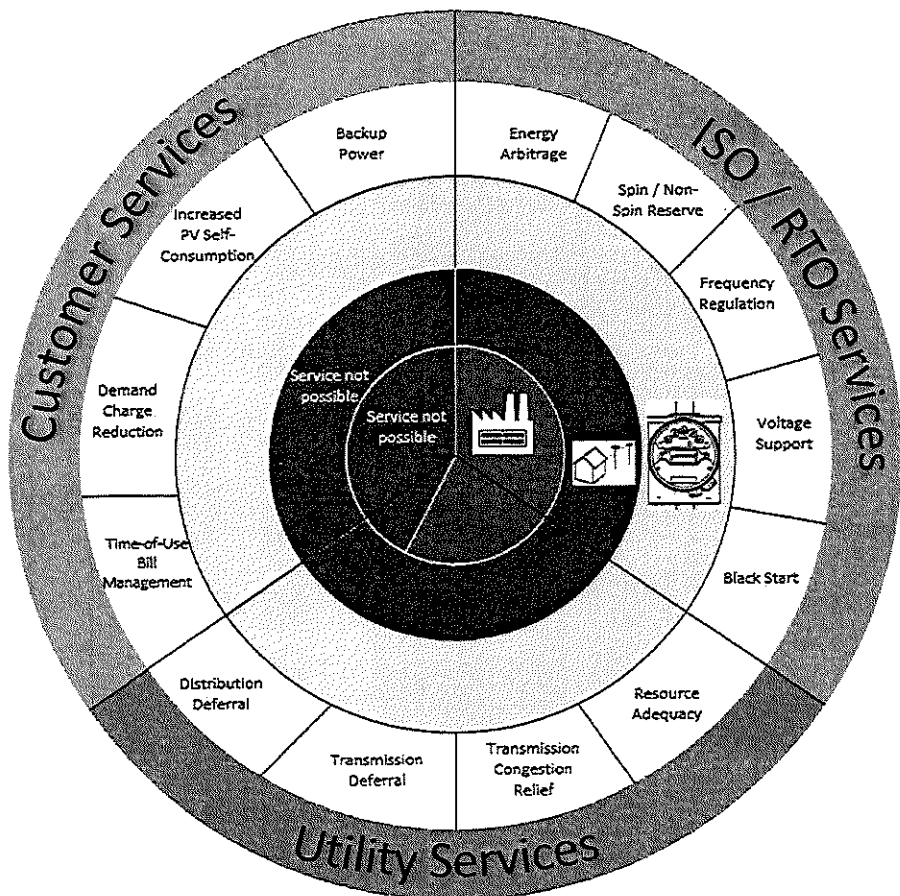
“The Role of Storage and DER for California, Solar + Storage for Resiliency.” Angelina Galiteva, Founder Renewables 100 Policy Institute, November 2017.

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:

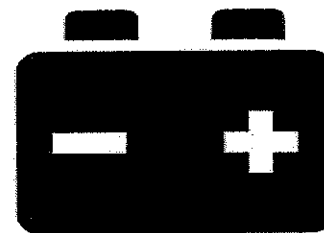
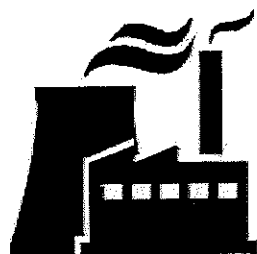
Energy storage fits in everywhere on the grid! From a home system to a 400MWh facility, there are numerous different applications that storage can be used for!

- 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

NYS Uniform Code – Fire Safety

2020 NYS Code Update

<https://www.dos.ny.gov/dcea/noticadopt.html>

Notices of Adoption
Rules amending and updating the Uniform Code and Energy Code

EFFECTIVE May 12, 2020

On December 6, 2019, the State Fire Prevention and Building Code Council (the "Code Council") adopted rules that amend and update the New York State Uniform Fire Prevention and Building Code (the "Uniform Code") and the State Energy Conservation Construction Code (the "Energy Code").

The Department of State, acting on behalf of the Code Council, has filed Notices of Adoption of these rules. The Notices of Adoption will appear in the February 12, 2020 edition of the *State Register*. On and after February 12, 2020, the Notices of Adoption can be viewed by clicking the "February 12" link at: <http://www.dos.ny.gov/info/register/2020.html>.

The rules will become effective on May 12, 2020.

Uniform Code

The Uniform Code (19 NYCRR Parts 1219 to 1229) now includes the 2015 editions of the code books published by the International Code Council (the "2015 I-Codes"), as amended by the publication entitled the *2017 Uniform Code Supplement* (publication date: July 2017).

The rule adopted by the Code Council on December 6, 2019 repeals the current version of the Uniform Code and adopts an amended and updated version of the Uniform Code. The amended and updated version of the Uniform Code incorporates by reference the following publications:

- 2020 Residential Code of New York State (publication date: November 2019)
- 2020 Building Code of New York State (publication date: November 2019)
- 2020 Plumbing Code of New York State (publication date: November 2019)
- 2020 Mechanical Code of New York State (publication date: November 2019)
- 2020 Fuel Gas Code of New York State (publication date: November 2019)
- 2020 Fire Code of New York State (publication date: November 2019)
- 2020 Property Maintenance Code of New York State (publication date: November 2019)
- 2020 Existing Building Code of New York State (publication date: November 2019)

(collectively, the NYS Code Books)

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



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

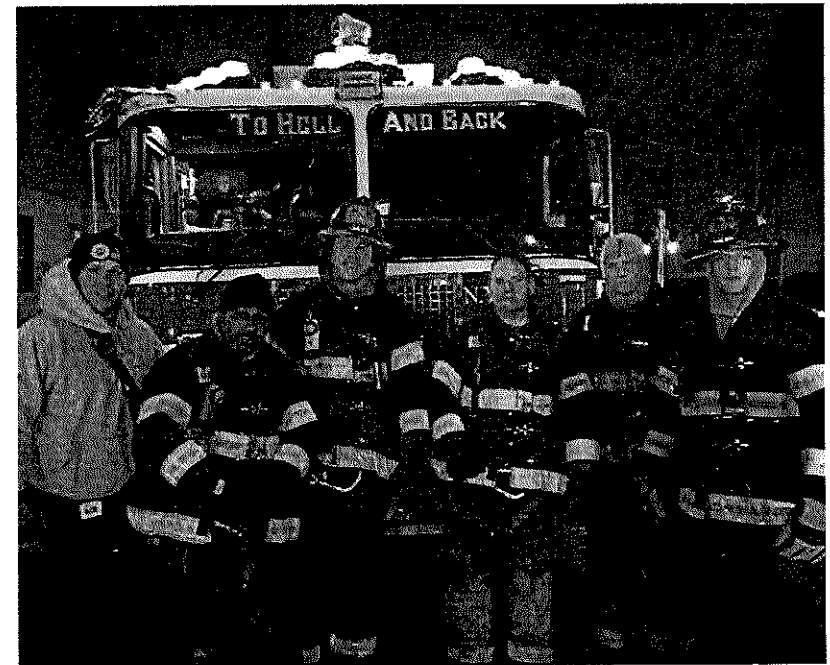
- Fires will be contained for the minimum duration of the fire-resistance and detected in time to allow occupants to safely evacuate
- Toxic and highly toxic gases released during fires will not reach concentrations in excess of Immediately Dangerous to Life or Health (IDLH) level in the building or 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



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

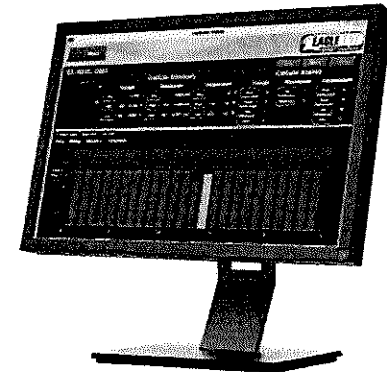
- Submitted as part of Commissioning Plan
- Notify AHJ prior to decommissioning
- Description of activities to remove system from service and facility
 - Contingencies for removing intact system from service
 - **Contingencies for removing system damaged by fire or other event**

Equipment Listing

- All systems listed in accordance with **UL 9540** “Standard for Energy Storage Systems and Equipment” or approved equivalent
 - 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

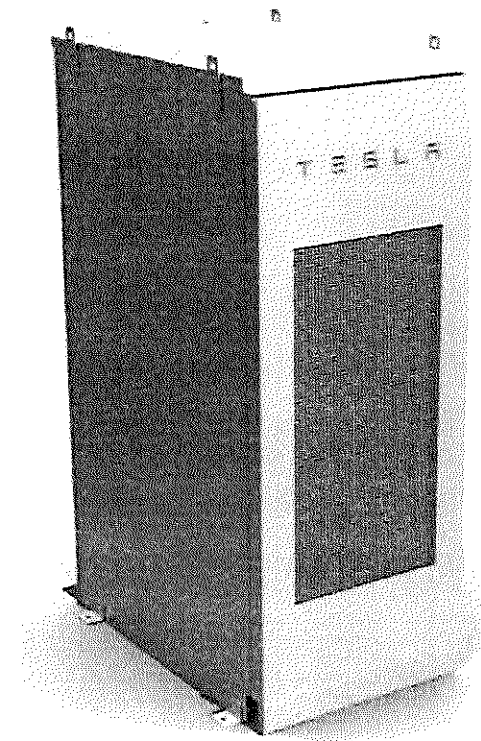
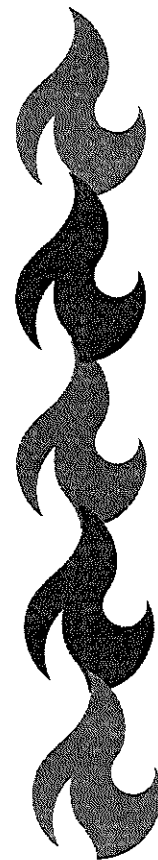
Battery Energy Storage Management System

- 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

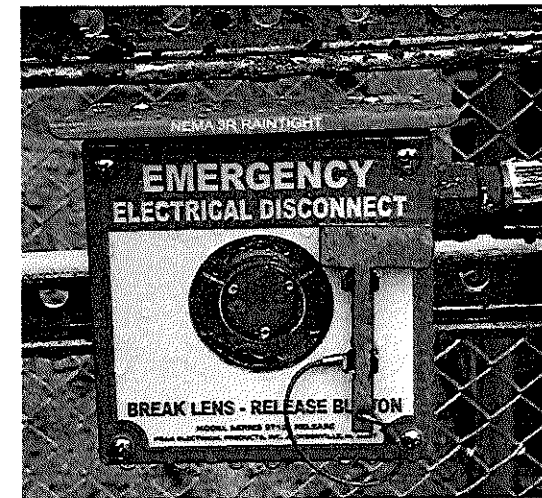
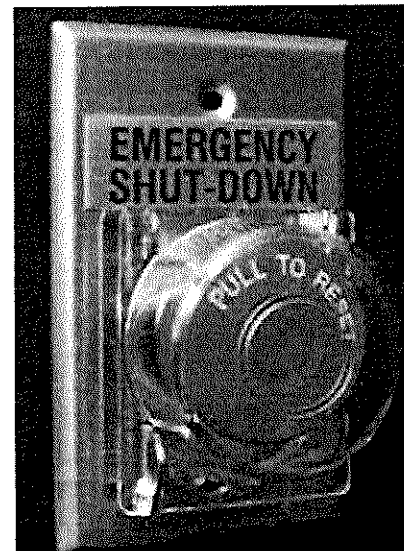
- Must be of noncombustible construction



General Installation Requirements

Electrical Disconnects

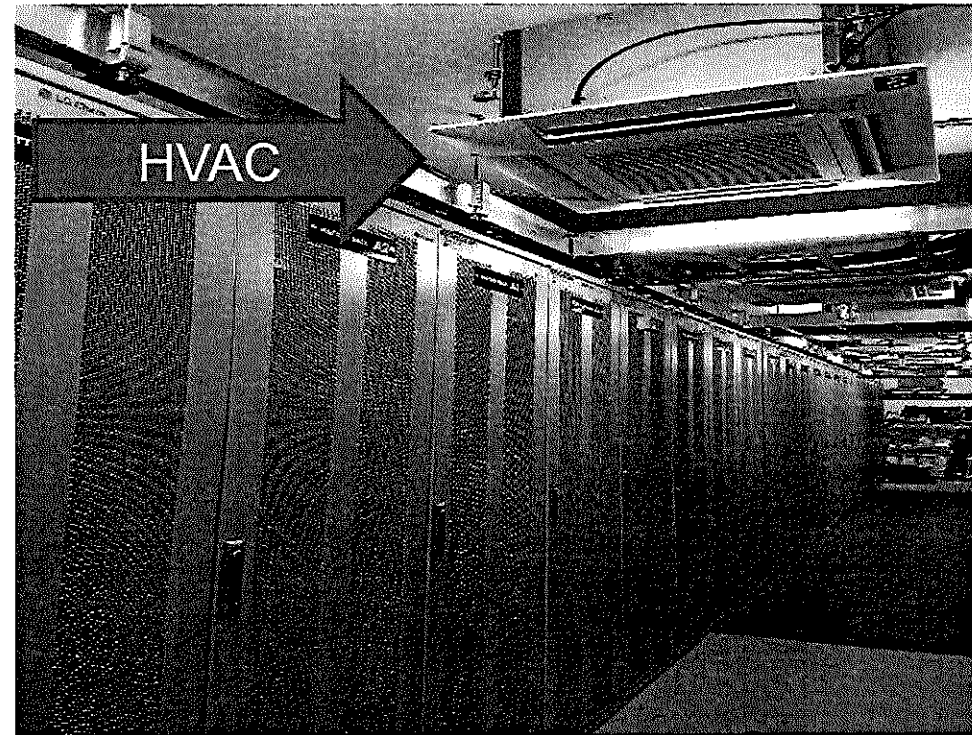
- Electrical Disconnect should be installed near the main electrical service.
- If not, placards shall be placed at the main electrical service indicating the location of the disconnect.



General Installation Requirements

Toxic and highly toxic gases

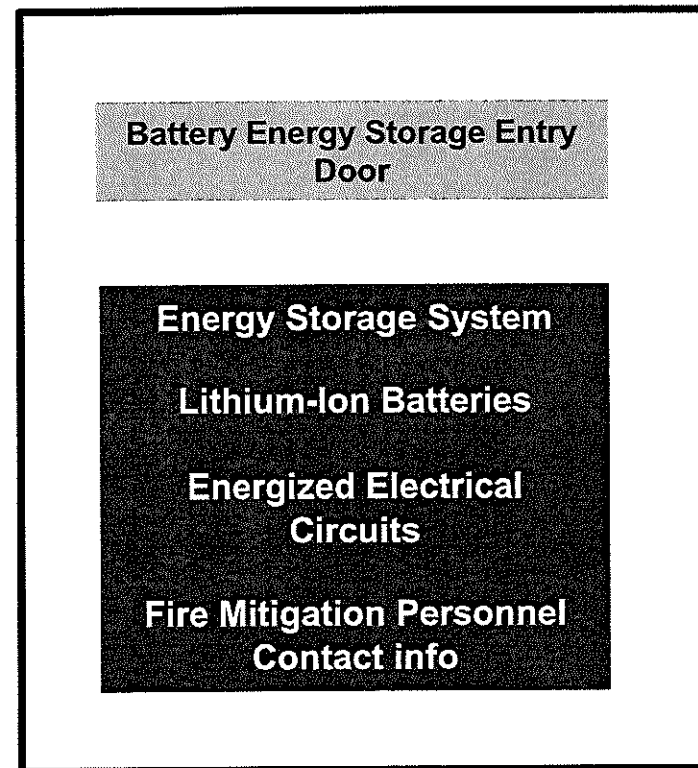
- BESS that may release toxic gas during charging, discharging, and normal use conditions shall be provided with a hazardous exhaust system



General Installation Requirements

Signage

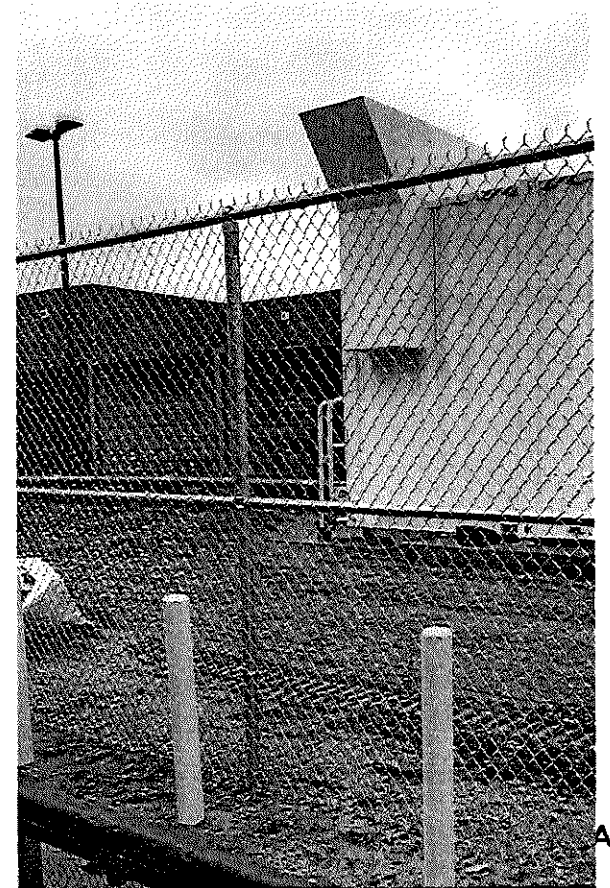
- Approved signs shall be provided on or adjacent to all entry doors for BESS rooms or areas and on enclosures of BESS cabinets and walk-in units
- The signage shall include the following or equivalent



General Installation Requirements

Security of installations

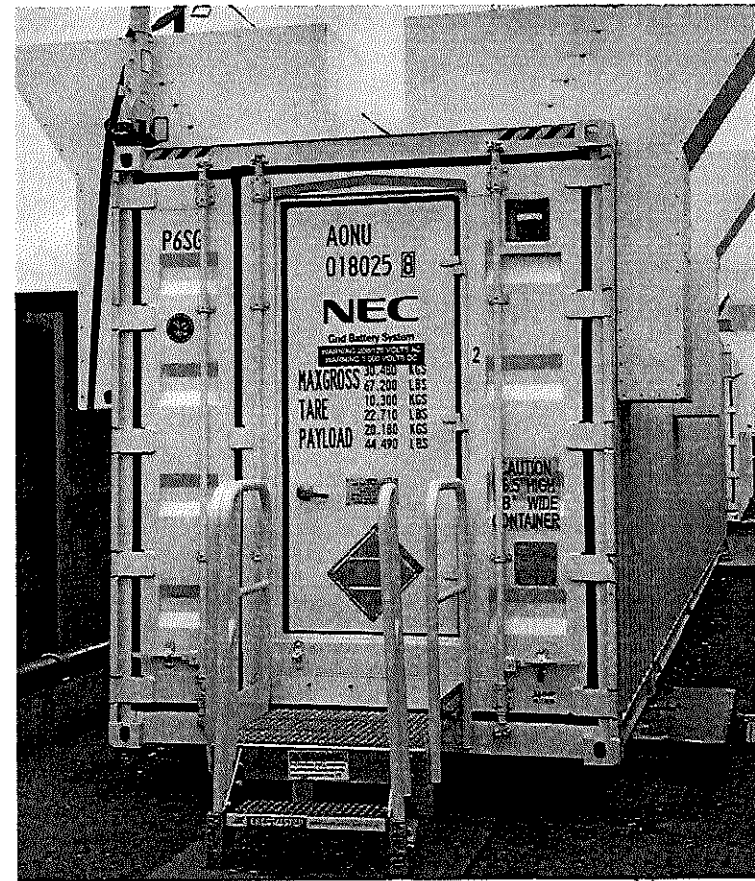
- Rooms, areas, and walk-in units in which BESS are located shall be secured against unauthorized entry and safe-guarded in an approved manner
- Ensure that this does not inhibit the required air flow to or exhaust from the BESS



General Installation Requirements

Walk-in units

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

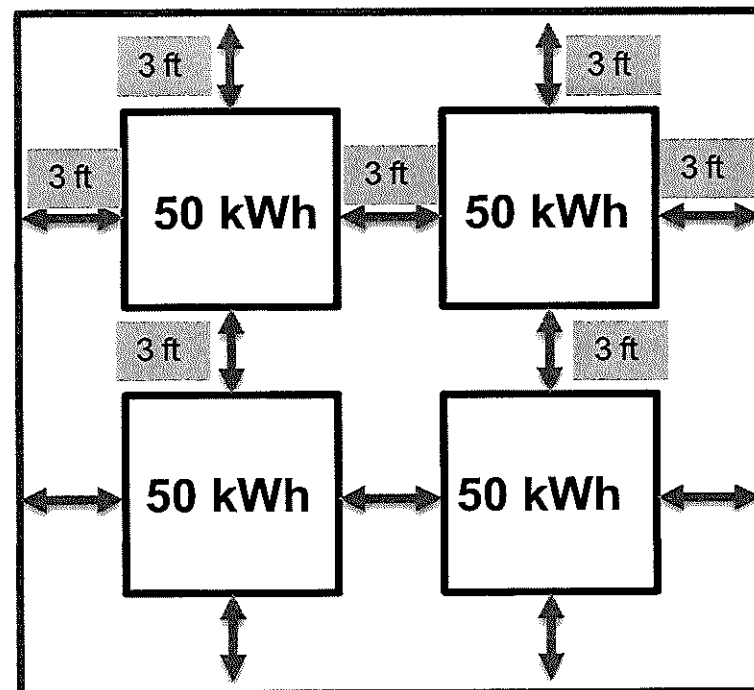


Fire Safety Compliance: Electrochemical BESS Protection

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 is 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

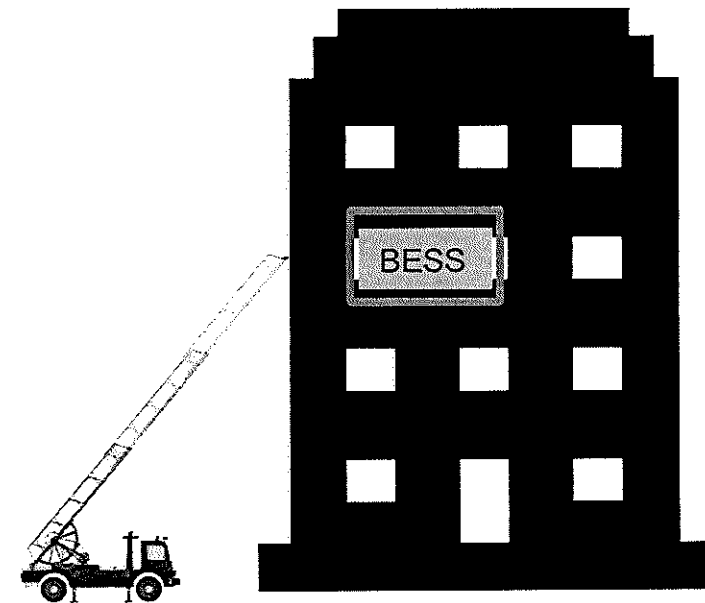
Elevation

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

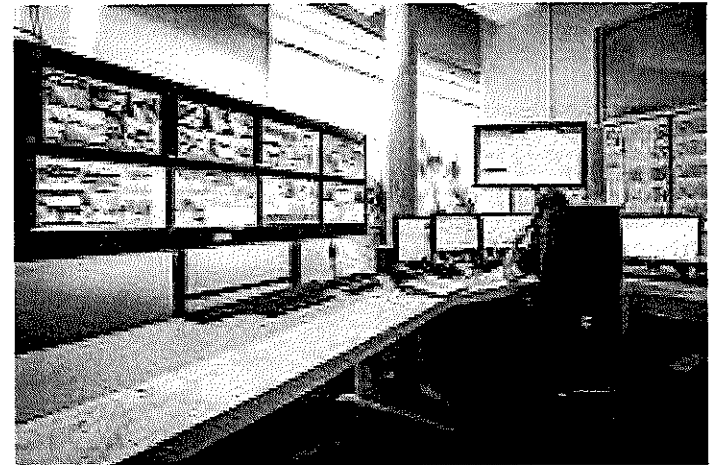
Lead-acid and Nickel-cadmium battery systems less than 50 VAC and 60 VDC installed in facilities under the exclusive control of communications utilities in accordance with NFPA 76.



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

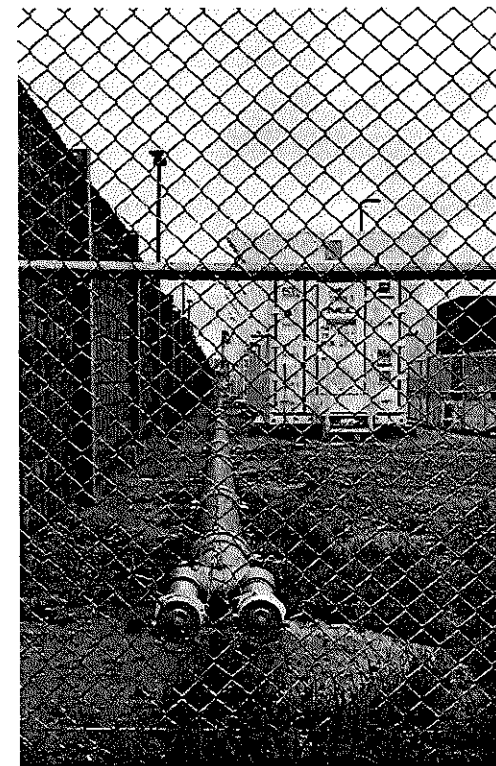


Electrochemical BESS Protections

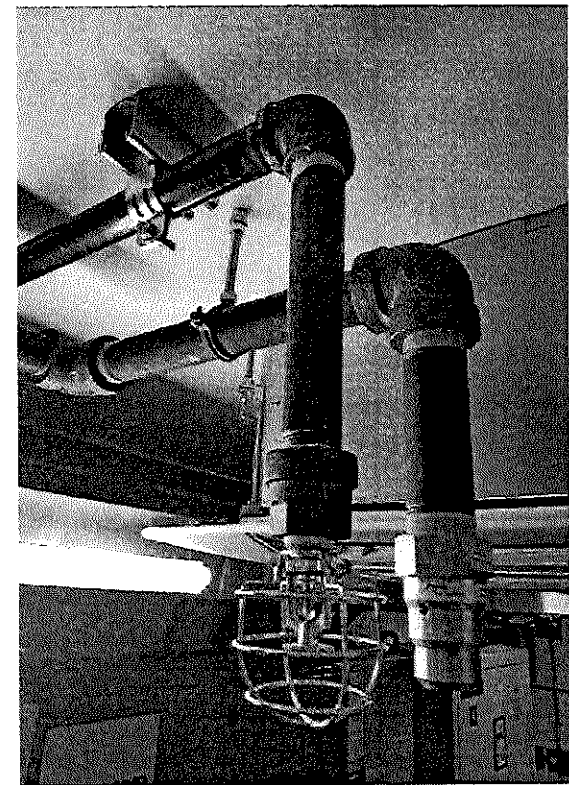
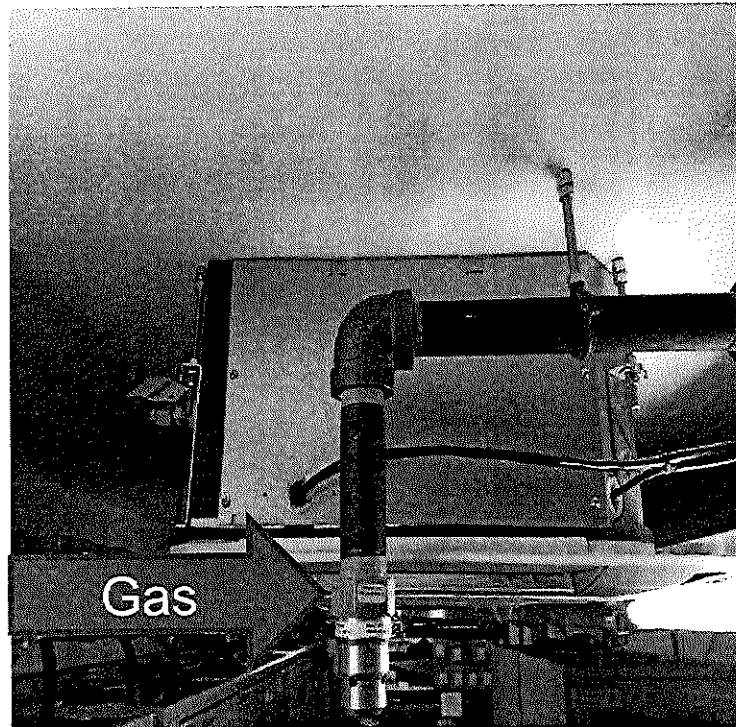
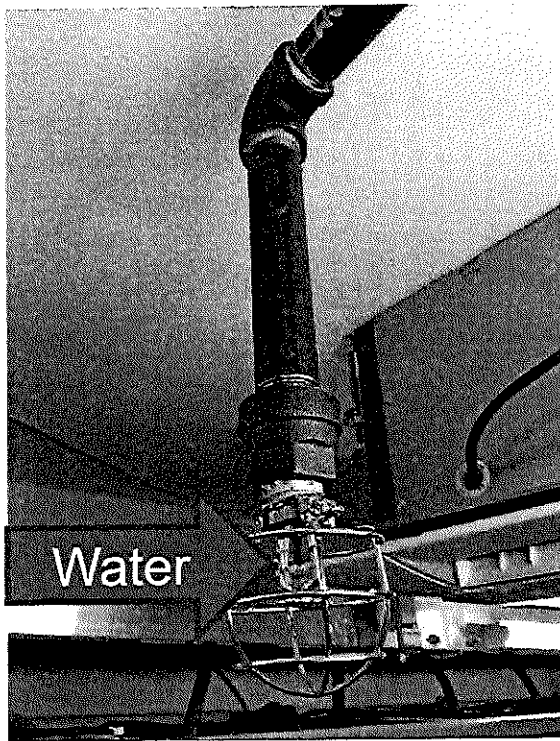
Fire suppression systems

1. Automatic sprinkler system with minimum density of 0.3gpm/ft² 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

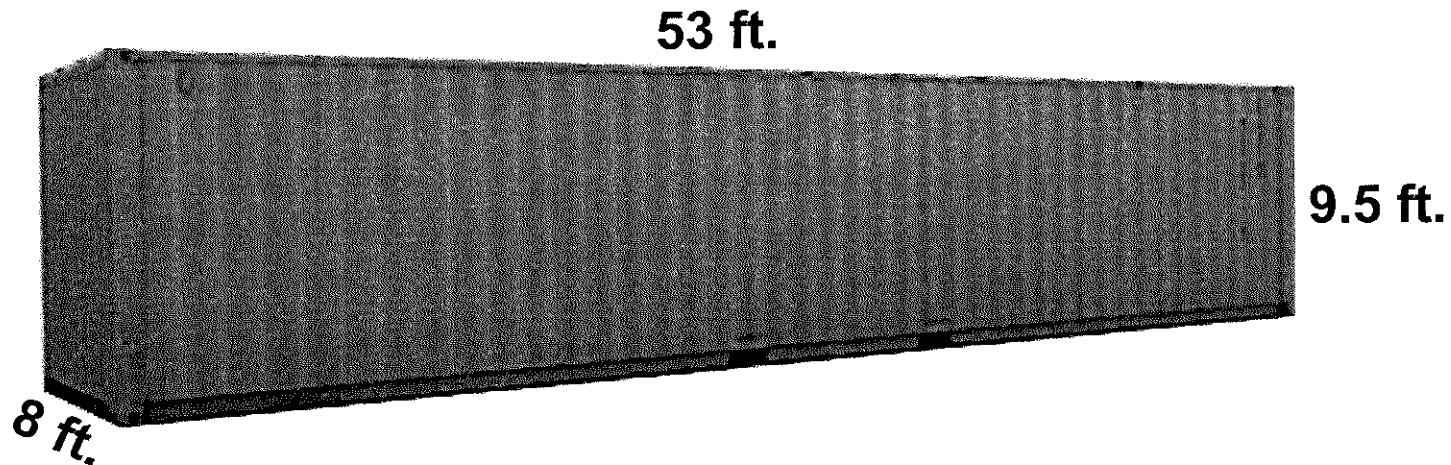


Fire Suppression



Electrochemical BESS Protections

Maximum enclosure size

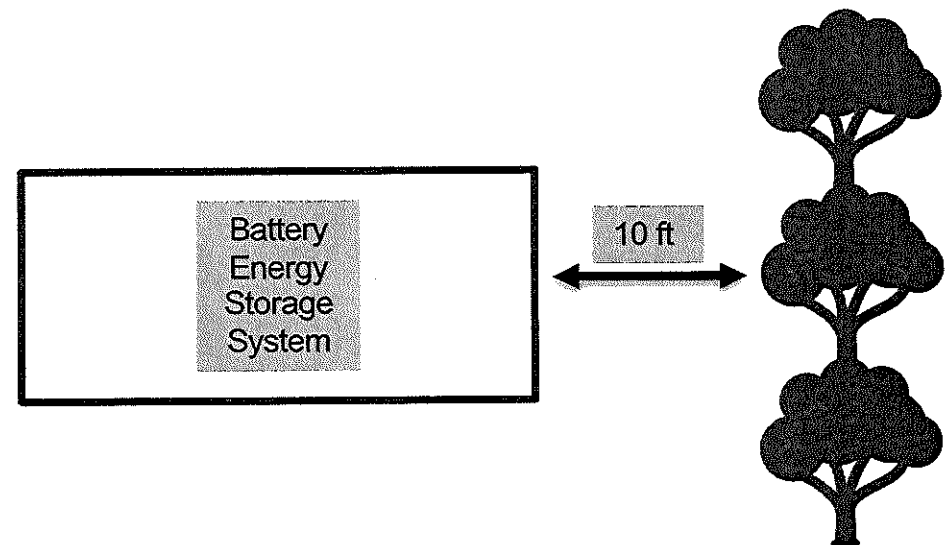


Outdoor walk-in units shall not exceed 4,028 cubic feet, not including bolt-on HVAC and related equipment.

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

BESS Cabinets

- NYSERDA recommends that all energy storage systems exceeding the applicable maximum allowable quantities (MAQ) in aggregate (Table 1206.12 of the Fire Code), ***regardless of location and/or enclosure type***, be required to complete a hazard mitigation analysis and large-scale fire testing in compliance with Sections 1206.5 and 1206.6 of the Fire Code, respectively. For lithium-ion systems, the MAQ is 600 kilowatt-hours (kWh).
- Exceptions to this requirement should be limited to those listed in Section 1206.12.2 of the Fire Code.

Fire Safety Compliance: Technology Specific

Electrochemical BESS Tech Specific Protections

Compliance Required	Battery Technology				Other Energy Storage System and Battery Technologies	Capacitor Energy Storage System
	Lead-acid	Ni-Cad and Ni-MH	Lithium-ion	Flow		
1206.13.1. Exhaust ventilation	Yes	Yes	No	Yes	Yes	Yes
1206.12.2 Spill control and neutralization	Yes ^c	Yes ^c	No	Yes	Yes	Yes
1206.12.3 Explosion control	Yes ^a	Yes ^a	Yes	No	Yes	Yes
1206.12.4 Safety caps	Yes	Yes	No	No	Yes	Yes
1206.12.5 Thermal Runaway	Yes ^d	Yes	Yes ^e	No	Yes ^e	Yes

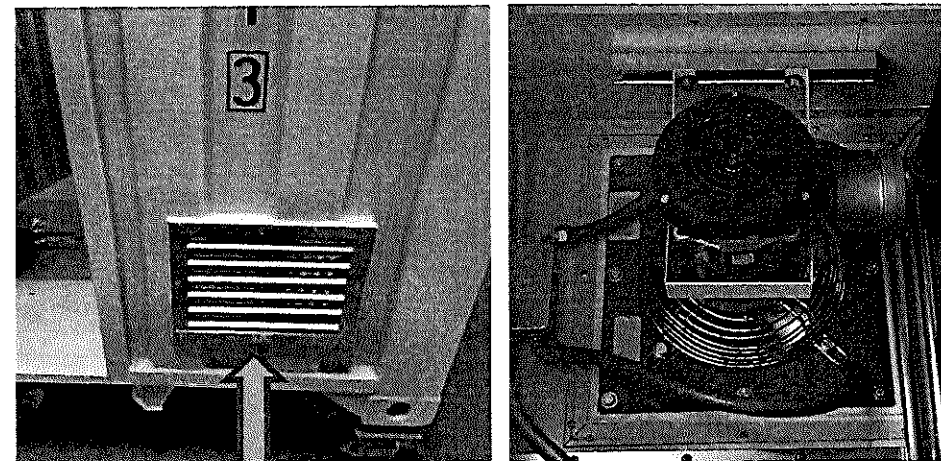
- Not required for lead-acid and nickel cadmium batteries at facilities under the exclusive control of communications utilities that comply with NFPA 76 and operate at less than 50 VAC and 60 VDC.
- Protection shall be provided unless documentation acceptable to the *fire code official* is provided that 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.



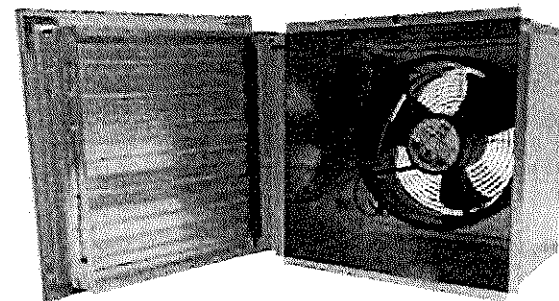
Electrochemical BESS Tech Specific Protections

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

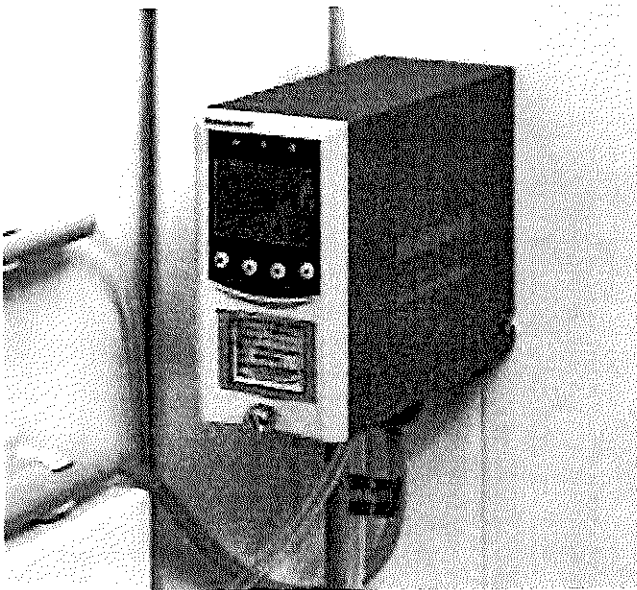


Intake port



Electrochemical BESS Tech Specific Protections

Gas detector

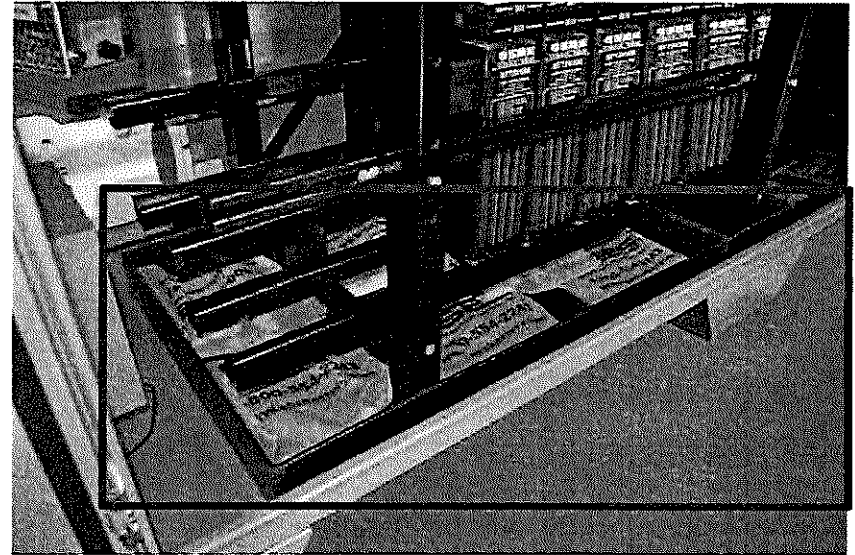


- Gas detection system designed to activate the ventilation system where the flammable gas exceeds 25% of the LFL and remain activated until the flammable gas detected is less than 25 % of the LFL
- Initiate distinct audible and visible alarms, transmit an alarm to an approved location, de-energizing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



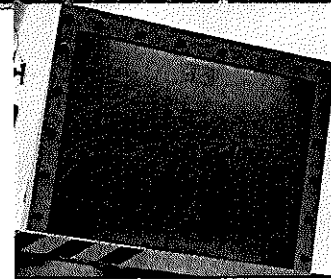
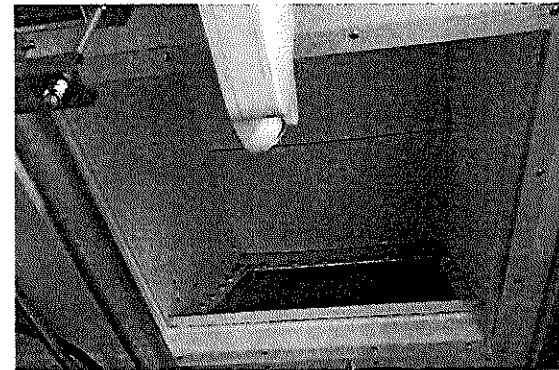
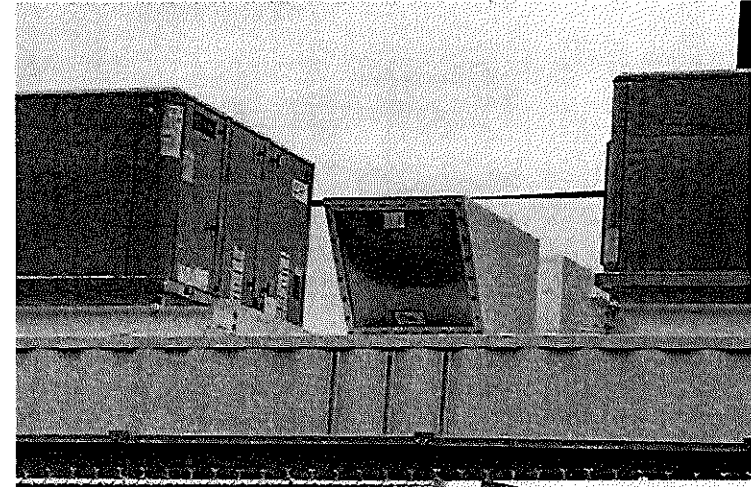
Battery Spill Containment. (n.d.). Retrieved June 07, 2019, from <https://www.sbsbattery.com/products-services/by-product/spill-containment-systems.html>

Electrochemical BESS Tech Specific Protections

Explosion control

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

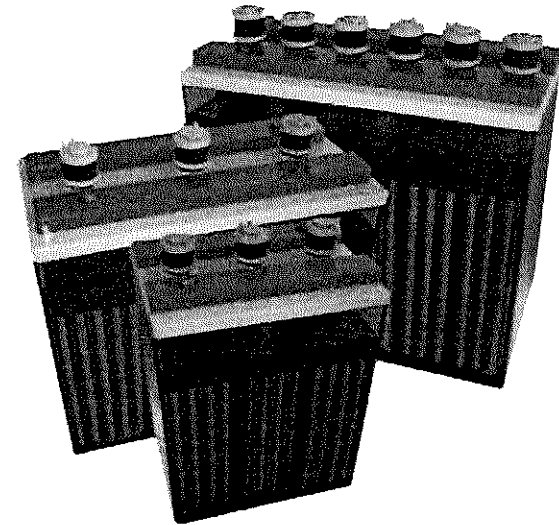
1. Deflagration venting
 - Pressure panels
2. Deflagration prevention
 - Exhaust fans
 - 25 % of LFL



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

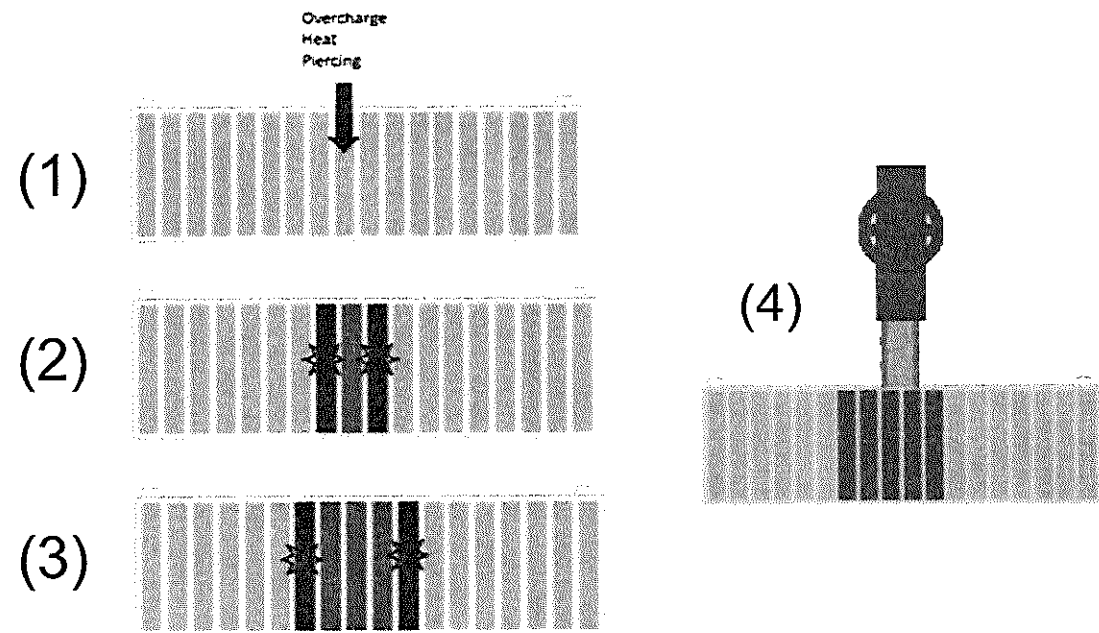


Stationary/Utility Flooded Battery Vent Caps™ Storage Battery Systems, Inc. 2018.

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.

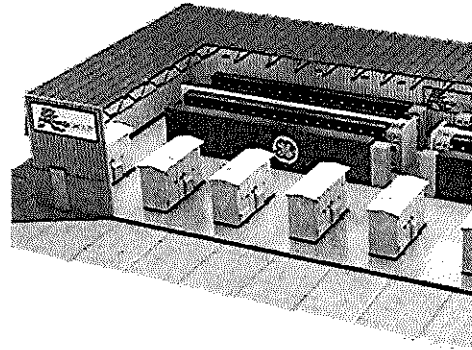


*Opening and A strategy for fighting lithium-ion battery fires. Marko Hassinen, Emergency Services College, November 2018

Fire Safety Compliance: Location Specific

Modern Battery Installations Scenarios

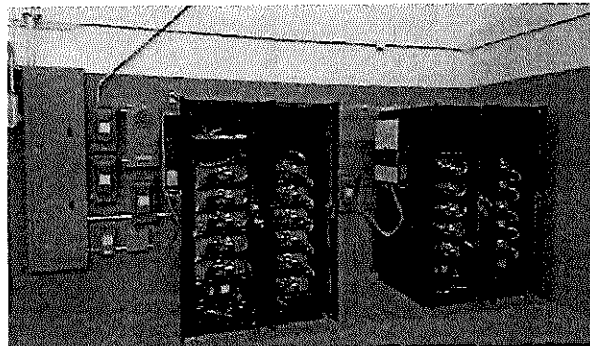
Dedicated Use Building



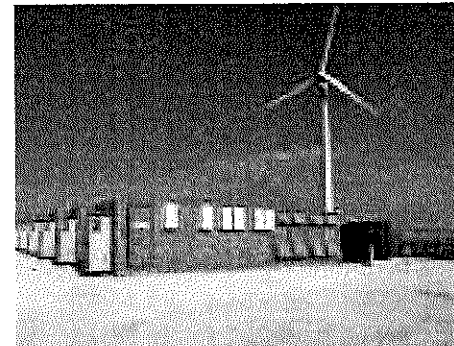
Outdoors Near Exposures



Non-Dedicated Use Building



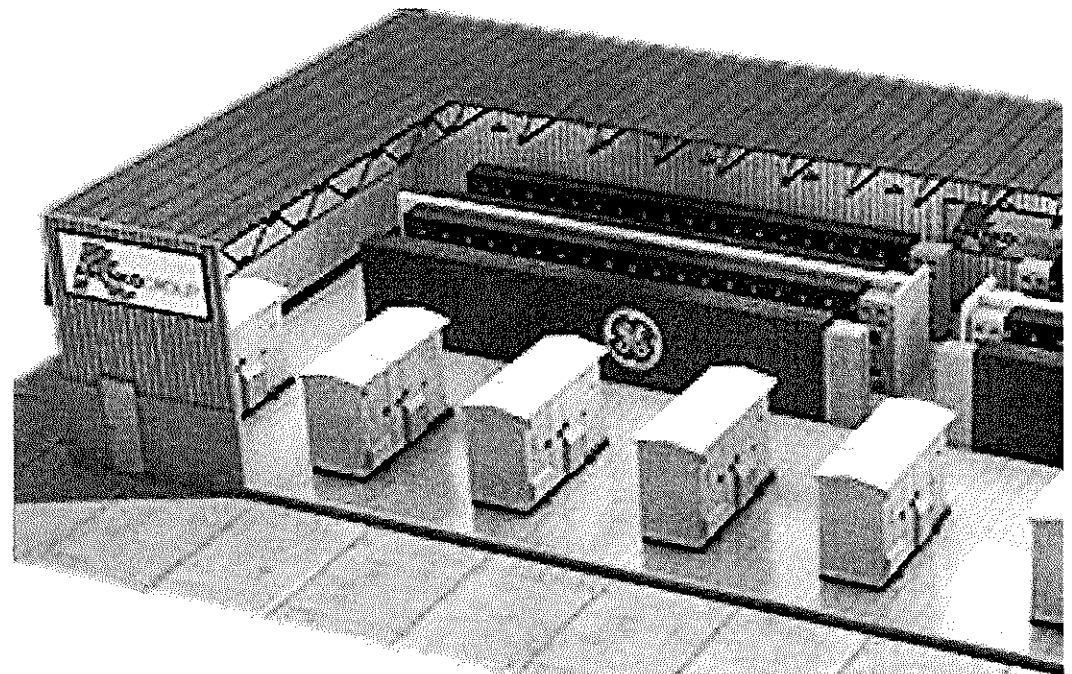
Outdoors Remote



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

Compliance Required	Dedicated Use Buildings	Non-Dedicated Use Buildings
1206.11 General Installation Requirements	Yes	Yes
1206.12.1 Size and separation	Yes	Yes
1206.12.2 Maximum allowable quantities	No	Yes
1206.12.3 Elevation	Yes	Yes
1206.12.4 Smoke and automatic fire detection ^e	Yes ^c	Yes
1206.12.5 Fire suppression systems	Yes ^d	Yes
1206.14.3 Dwelling units and sleeping units	NA	Yes
1206.14.4 Fire-resistance rated separations	Yes	Yes
1206.13 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.

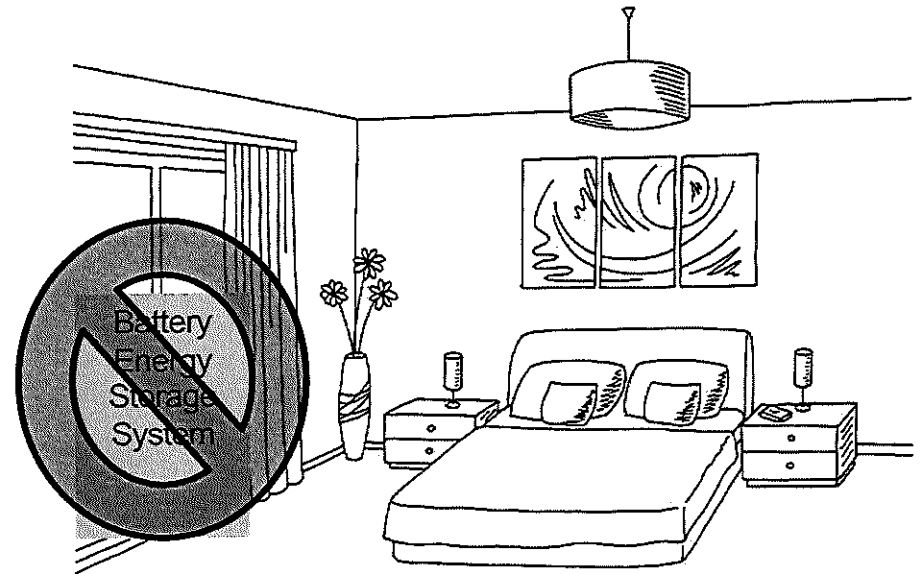
d. Where *approved* by the *fire code official*, fire suppression systems are permitted to be omitted in dedicated use buildings located more than 100 feet (30.5 M) from buildings, lot lines, public ways, stored combustible materials, hazardous materials, high piled stock and other exposure hazards.

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

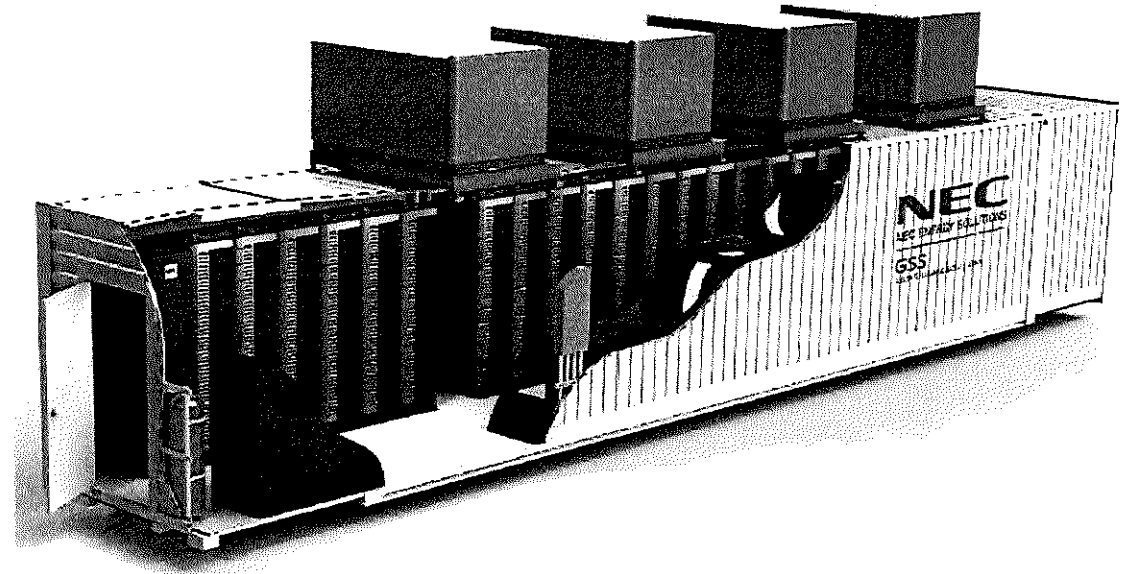
Fire-resistance rated separations

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
1206.11 General Installation Requirements	Yes	Yes
1206.12.1 Size and separation	No	Yes ^c
1206.12.2 Maximum allowable quantities	No	Yes
1206.12.4 Smoke and automatic fire detection	Yes	Yes
1206.12.5 Fire suppression systems	Yes ^d	Yes
1206.12.6 Maximum enclosure size	Yes	Yes
1206.12.7 Vegetation control	Yes	Yes
1206.12.8 Means of egress separation	Yes	Yes
1206.15.3 Clearance to exposures	Yes	Yes
1206.13 Technology specific protection	Yes	Yes

a. See Section 1206.15.1.

b. See Section 1206.15.2.

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

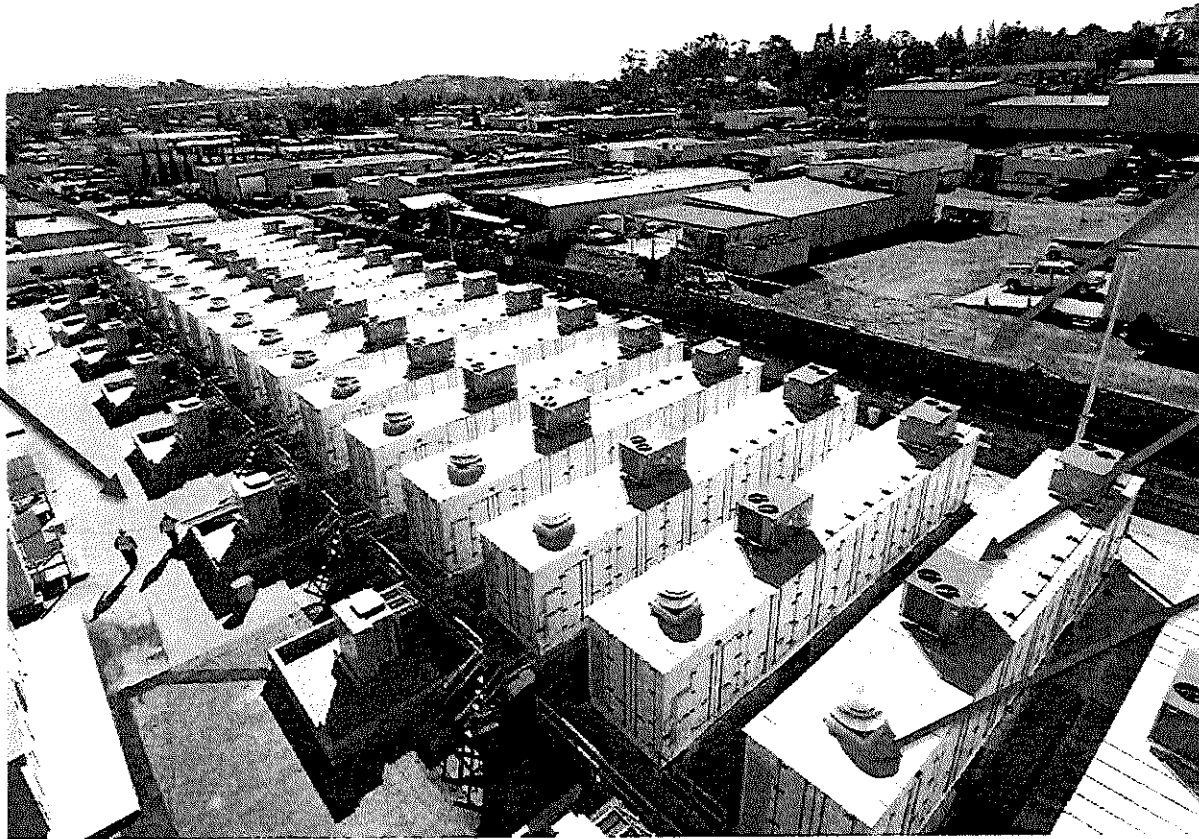
Max Enclosure Size

Means of Egress

Security of Installations

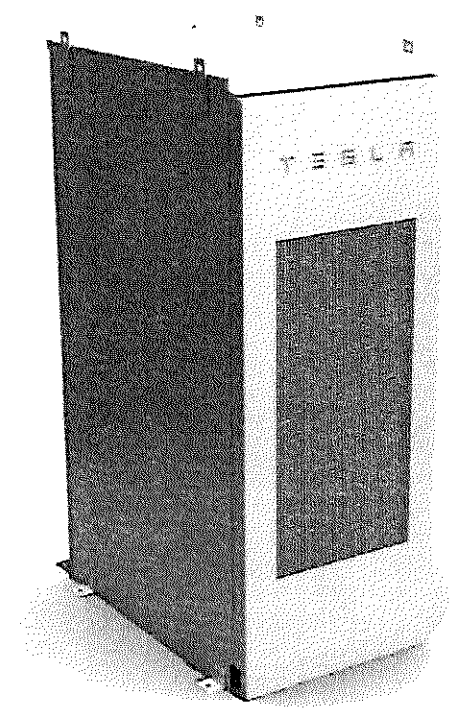
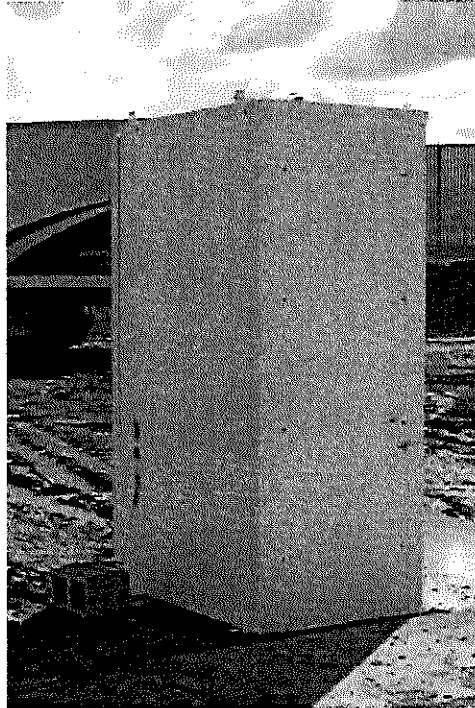
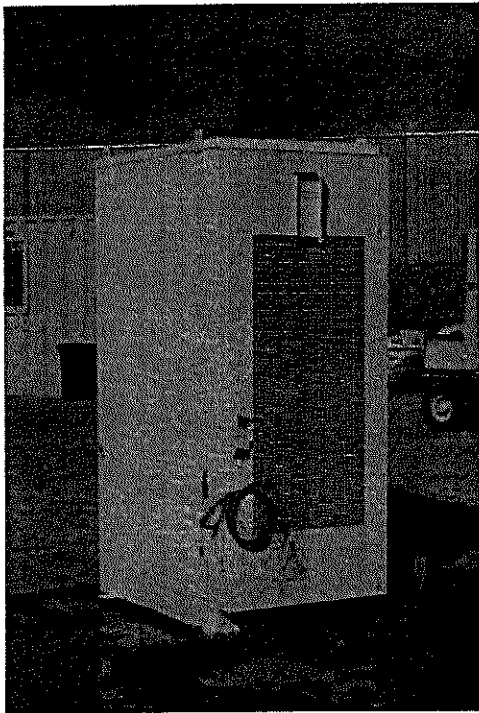
HVAC units

Exhaust ventilation

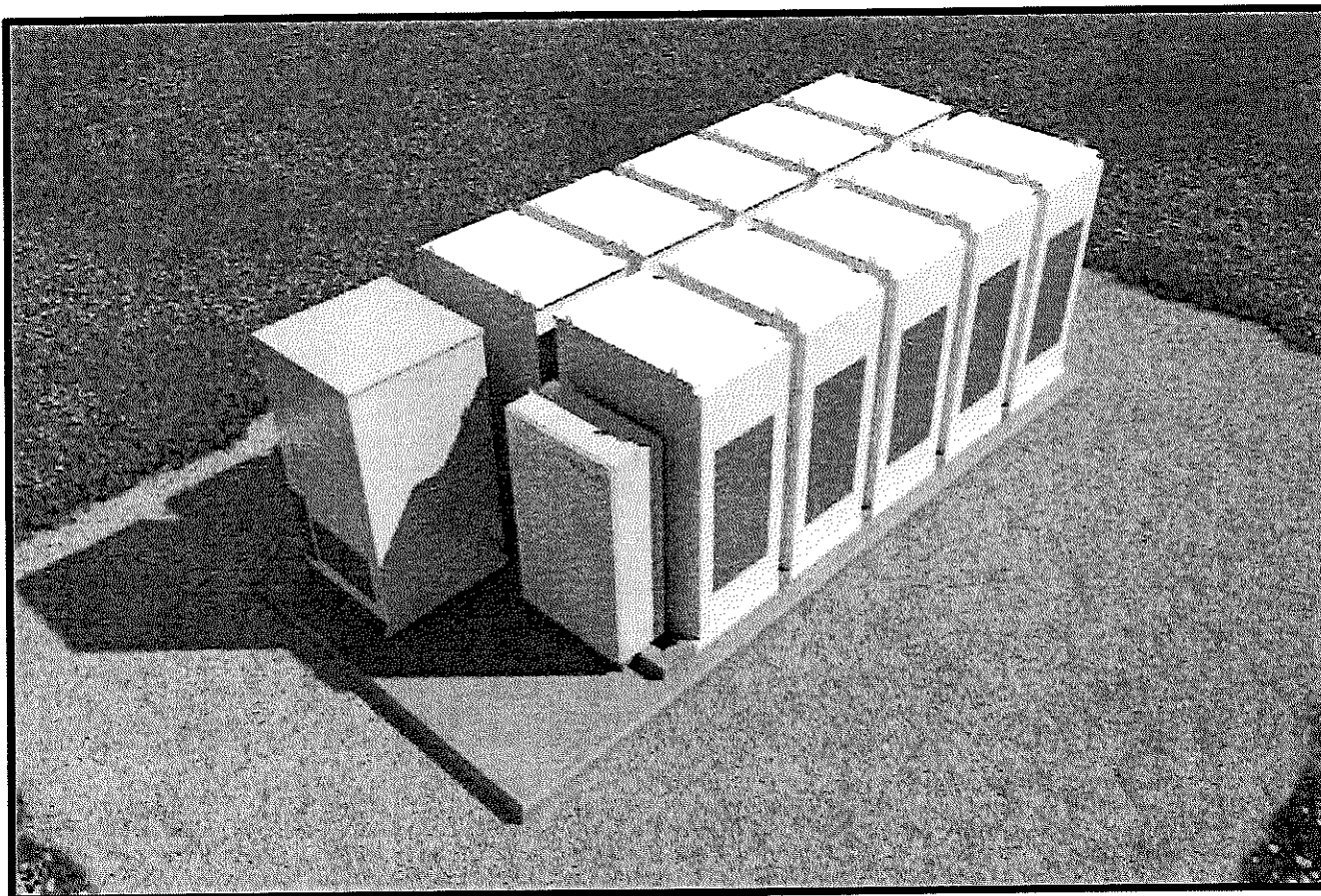


SDGE, Escondido 120 MW installation

BESS Cabinets



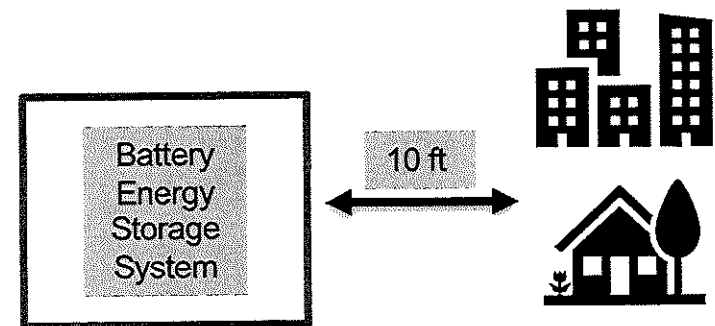
Cabinet Systems



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

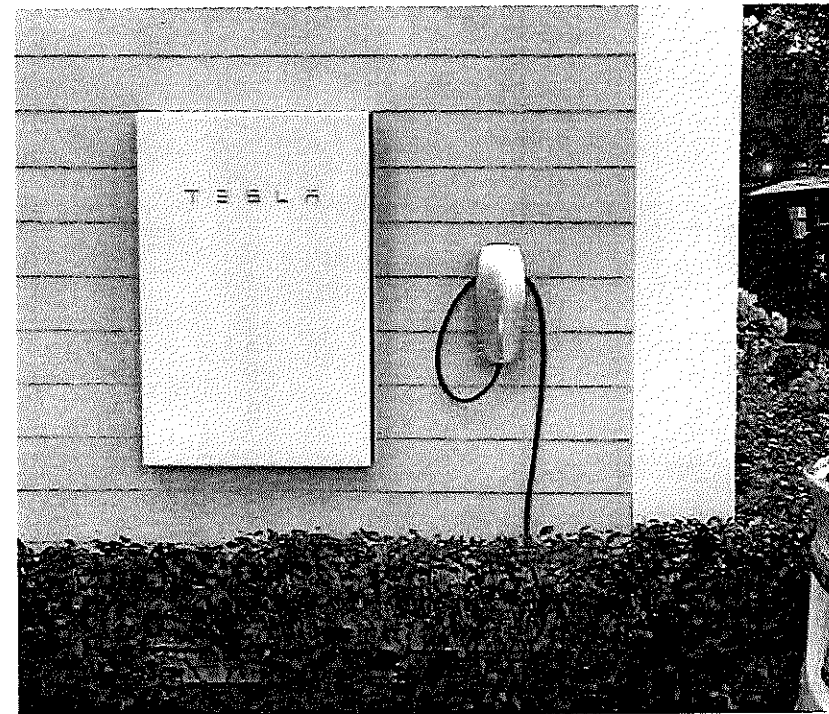
Outdoor Installations

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 Fire Code
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
1206.11 General Installation Requirements	Yes	Yes
1206.12.1 Size and separation	Yes	Yes
1206.12.2 Maximum allowable quantities	Yes	Yes
1206.12.4 Smoke and automatic fire detection	Yes	Yes
1206.12.6 Maximum enclosure size	Yes	Yes
1206.12.8 Means of egress separation	Yes	Yes
1206.16.3 Clearance to exposures	Yes	Yes
1206.16.4 Fire suppression systems	Yes	Yes
1206.16.5 Rooftop installations	Yes	No
1206.16.6 Open parking garage installations	No	Yes
1206.13 Technology specific protection	Yes	Yes

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



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



NYSERDA

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

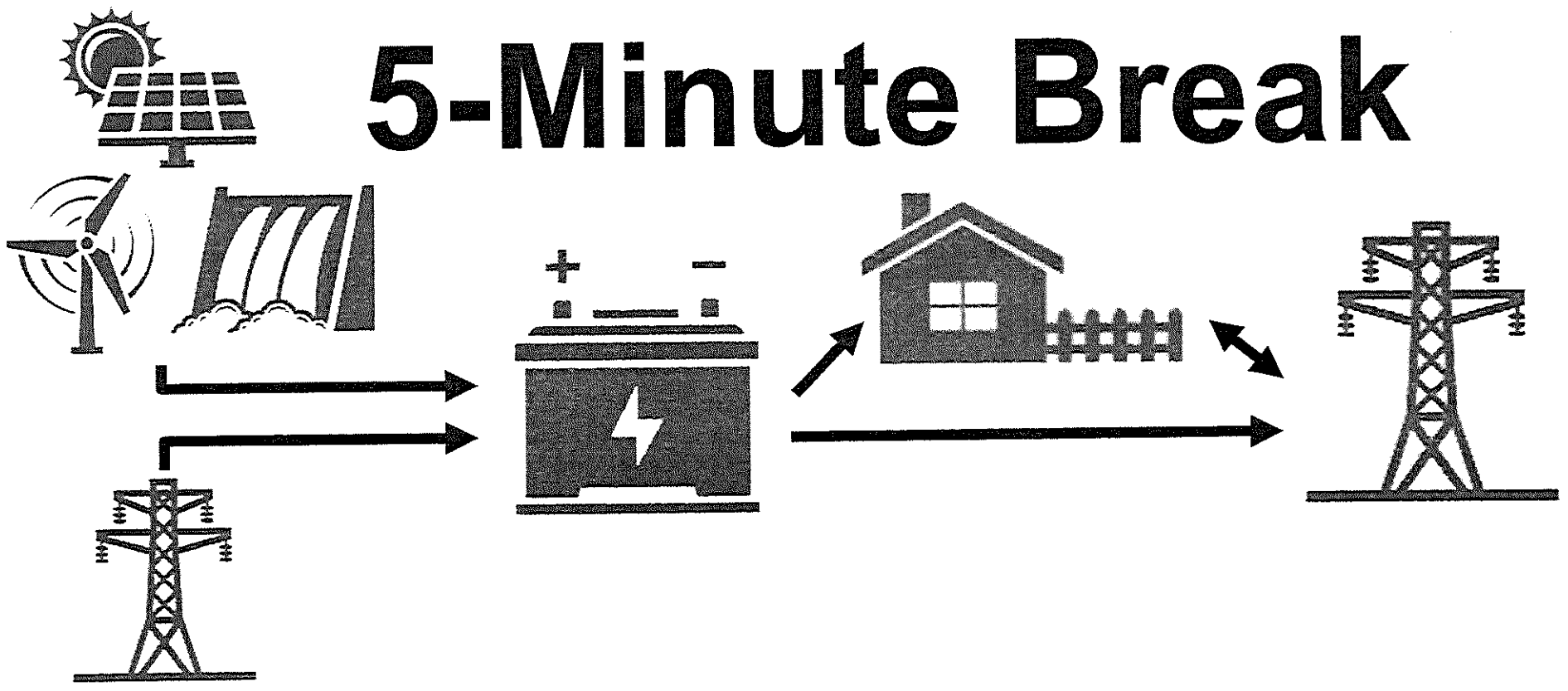
Special BESS Installations

Rooftops and Open parking garages

≥ 50 ft 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

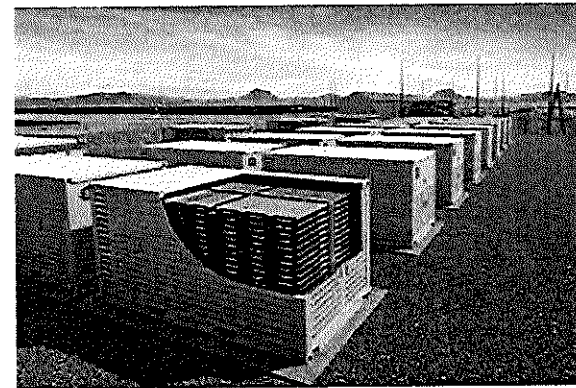
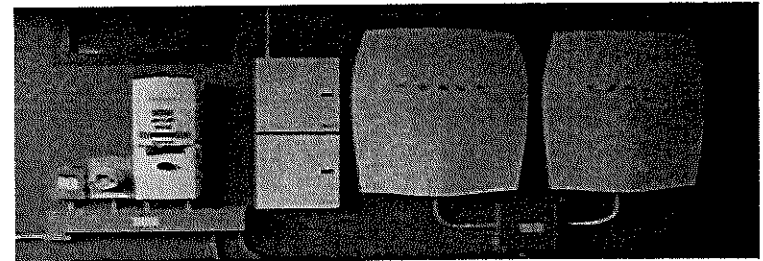
5-Minute Break



Incident Management

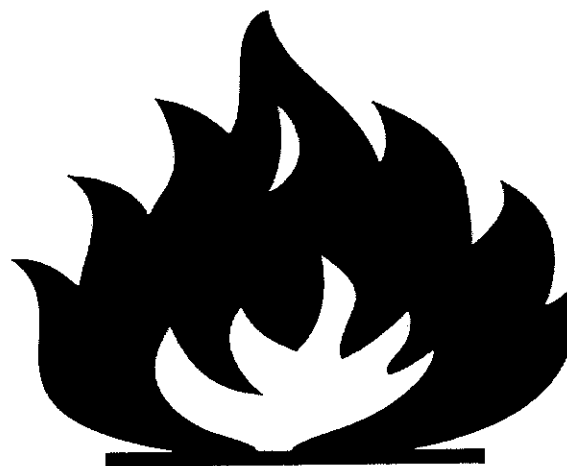
Failure Modes of ESS

- All Chemistries
 - Over charge
 - HEAT
 - Component failure
 - Environmental issues
 - Mechanical/Impact
 - Factory Defects
 - END OF LIFE
 - Lack of maintenance
 - Improper Installation



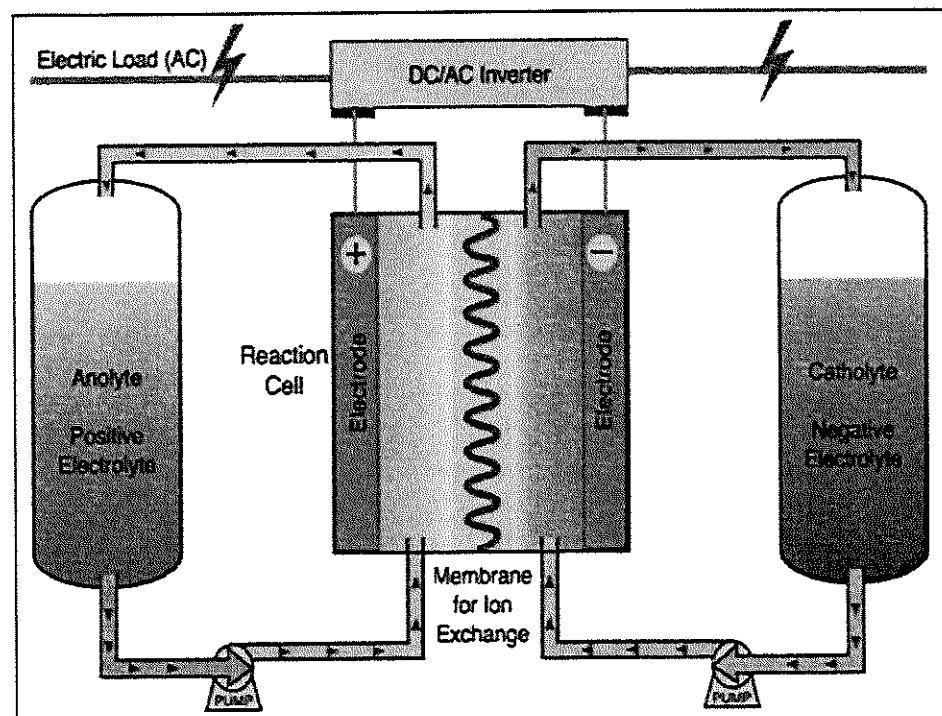
Lead Acid and Ni Cad Hazards

- Corrosive spills
- Toxic gases
- Hydrogen Gas
- Explosion
- Arc Flash
- Stranded Energy



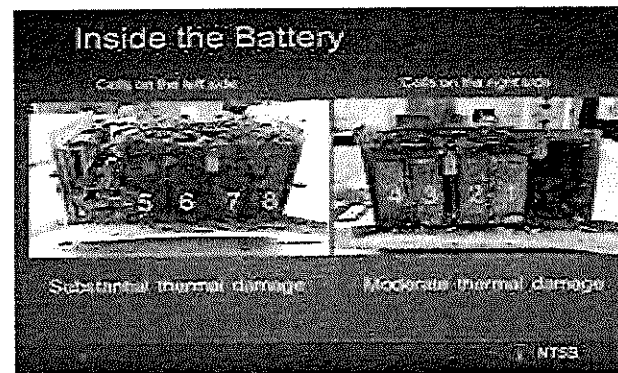
Flow Batteries Hazards

- Corrosive spills
- Hydrogen gases releases
- Very little fire concerns
- Explosion if not vented probably
- Arc flash
- Wires degradation
- Stranded Energy



Lithium Ion Failure

- Thermal Abuse
 - (thermal runaway)
- Electric Abuse
 - (over/under charge)
- Mechanical abuse
 - Separator puncture
- Factory defects
 - Dendrites
- Components



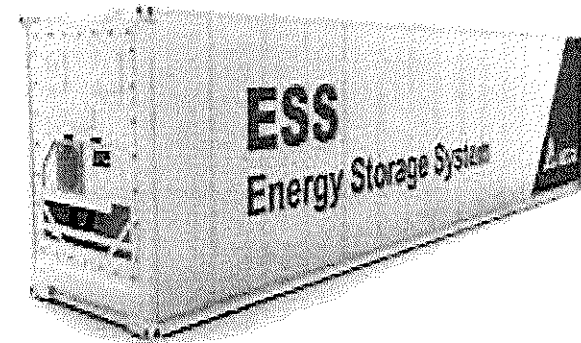
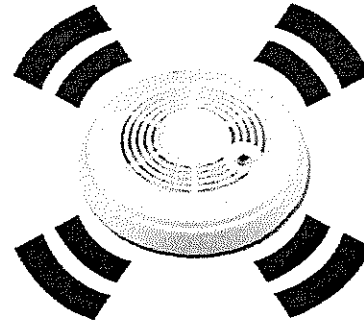
Lithium Ion Hazards

Preliminary testing data

- Toxic/Corrosive gases liberated
- Flammable cocktail
- Deep Seated Fire
- Delayed ignition
- Re-ignition Concerns
- Stored\Stranded Energy after burn

No Fire Showing

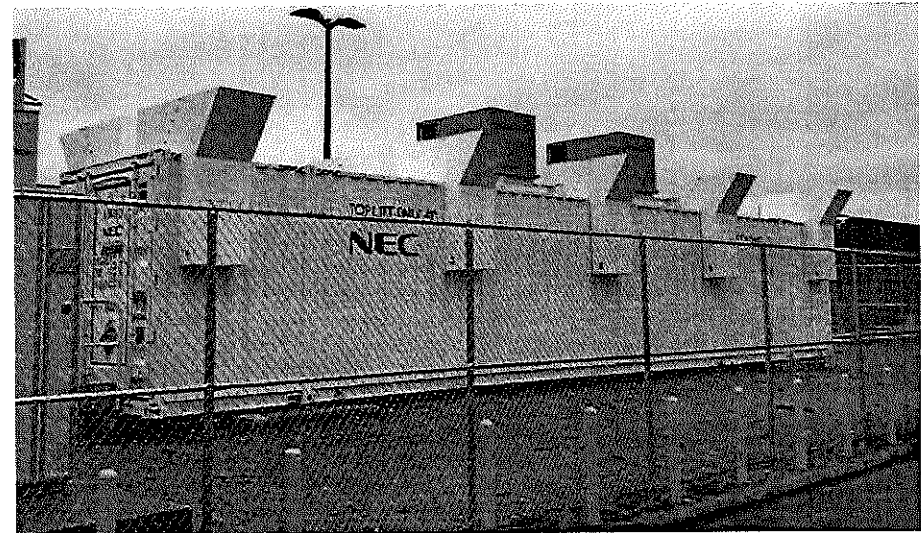
- Alarms
 - Smoke Alarm
 - Other Alarm
- Electrolyte vapor released?
- Overheated batteries?
- Environmental= floods or earthquake
- Ventilation needed?
- SME reach back



If there is fire or smoke present

Initial Actions

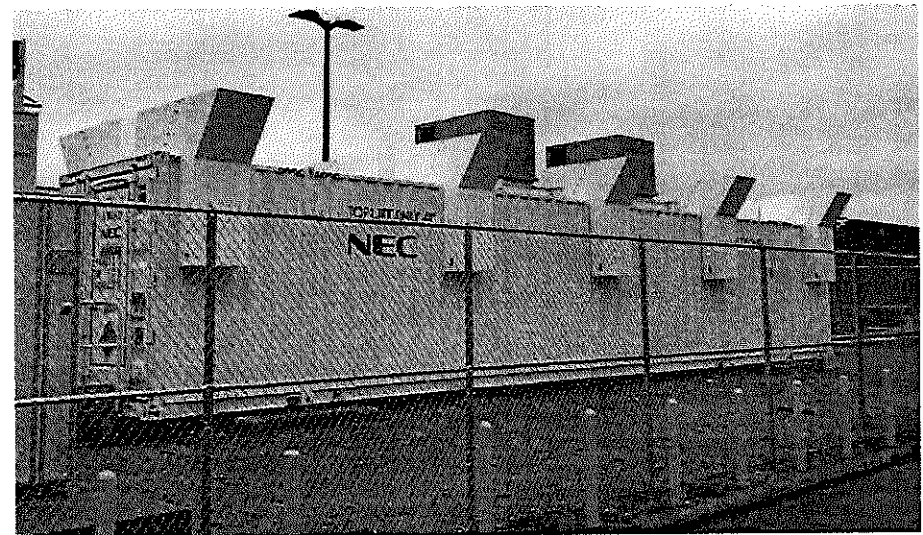
- Control fire spread
- Smoke no fire = explosion concern
- Keep away from container
- Proper PPE and reduce smoke exposure
- Find a water source
- Make sure no life hazards exist
- Do not open or enter container/cabinet
- Do not stand in front of doors or openings
- Call SME/Help Line



If there is fire or smoke present

Control fire

- Use a hand line fog nozzle 10 degree
- Stop the spread of fire
- Use reach of the stream
- Do not use foam or additives
- Keep your distance
- Do not stand in water pool
- Watch water run off
- Water Environmental issues
- NO LITH X

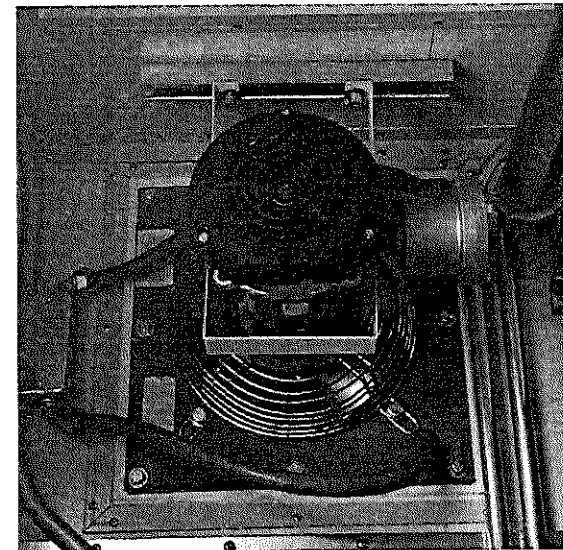


Ventilation and Exhaust

Exhaust container or cabinet *

- Wait for SME to respond if possible
- Remote access switch
- Removes clean agent
- Introduce O₂
- Delayed explosion is possible
- Stay away doors or openings
- Ventilation + Sprinkler
- Building air inlet concerns

* May not exist as part of installation



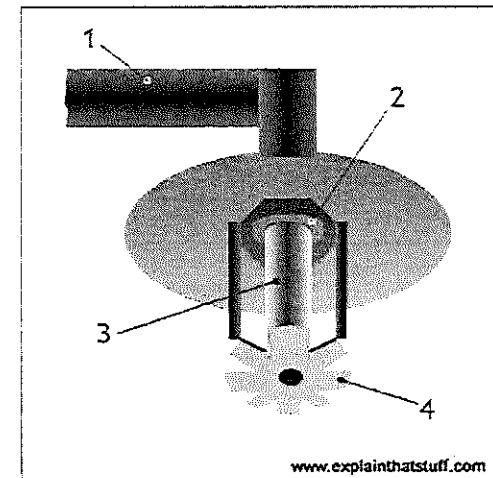
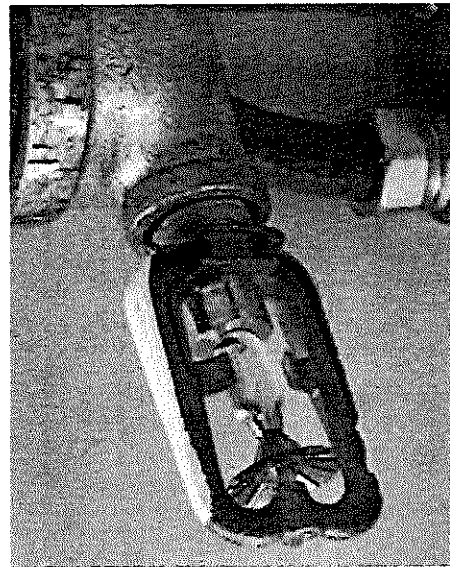
Extinguishment Agents

Clean Agent

- Displaces O₂
- Does not stop reaction
- Hold time is important

Sprinkler system

- Automatic
- Dry Pipe Systems
- Closed heads
- NONE



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.

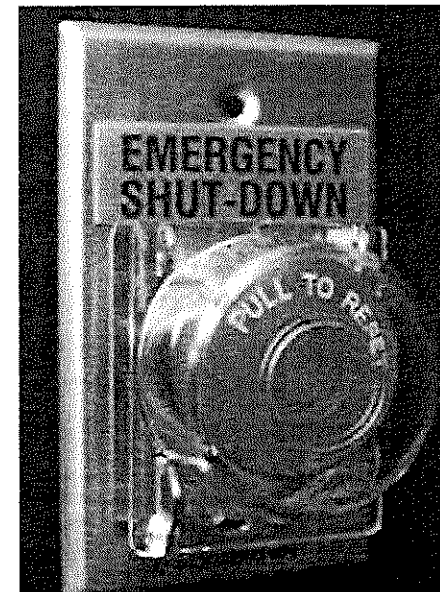
Shut Down

Shut Down (E-Stop)

- Remote and labeled
- Arc Flash
- Shuts down entire system
- Loss of data
- HVAC off

Shut down (BMS Automatic)

- Part of safety
- Isolates the container\Cabinet
- No charging or discharging



Subject Matter Expert

- Signage
- Telephone #
- May respond
- Will advise on shut down procedures
- Will advise on ventilation
- Shall call the decommissioning company
- Advise the Incident Commander



Incident Management

Indoor installations



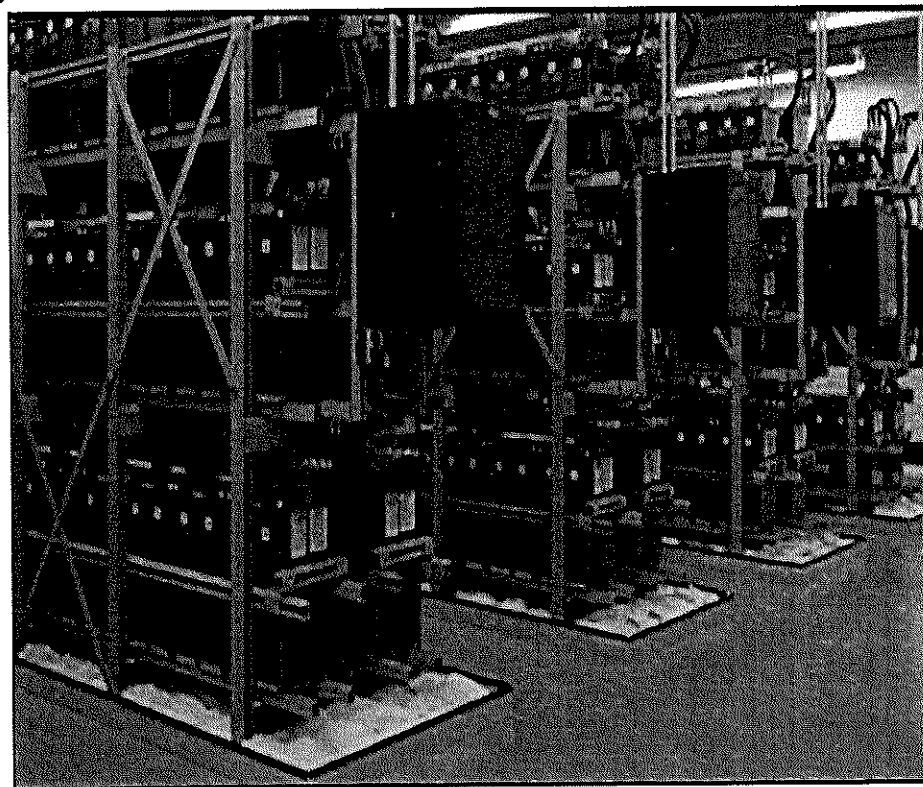
Inside buildings

- **Fire/Smoke**
 - Evacuate Building
 - DO NOT ENTER ROOM
 - When LEL sensor is sounding
 - When smoke and no fire
 - During ventilation of room
 - Make sure sprinkler is working
 - Check Exhaust exit ports
 - Call SME
 - Stay out of doorway



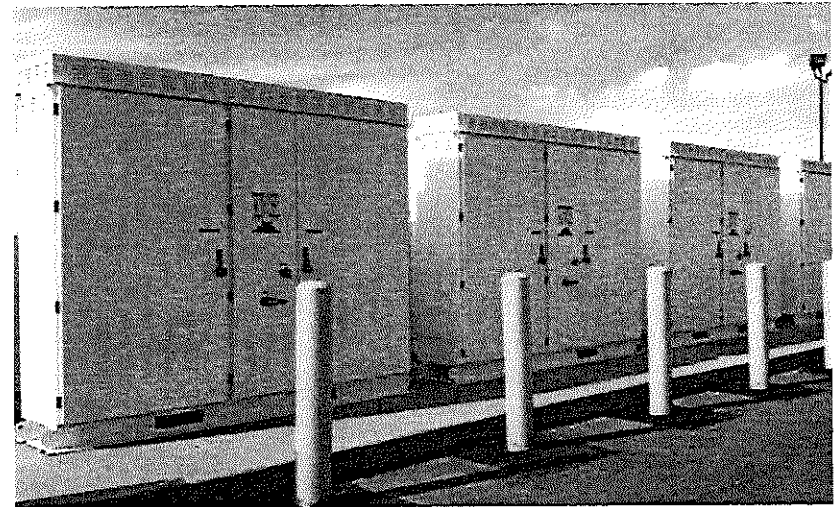
Dedicated Use Building

- Ensure no life hazards
- Only enter for KNOWN VIABLE LIFE
- Fire/Smoke do not enter
- Information from battery company
- Call SME to respond
- Water extinguisher system



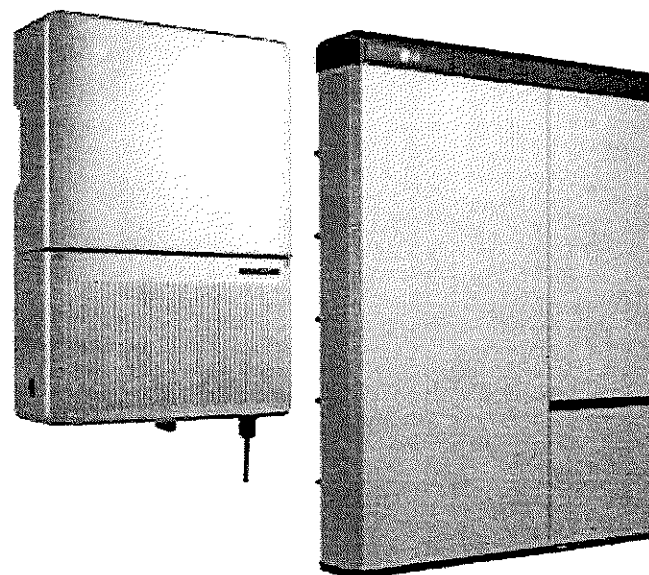
Rooftops Install

- Shut down system
- Exhaust if available
- FD roof access
- Water access at roof
- Hand line off Standpipe
- Automatic sprinkler
- Augment the water supply
water run off (weight)



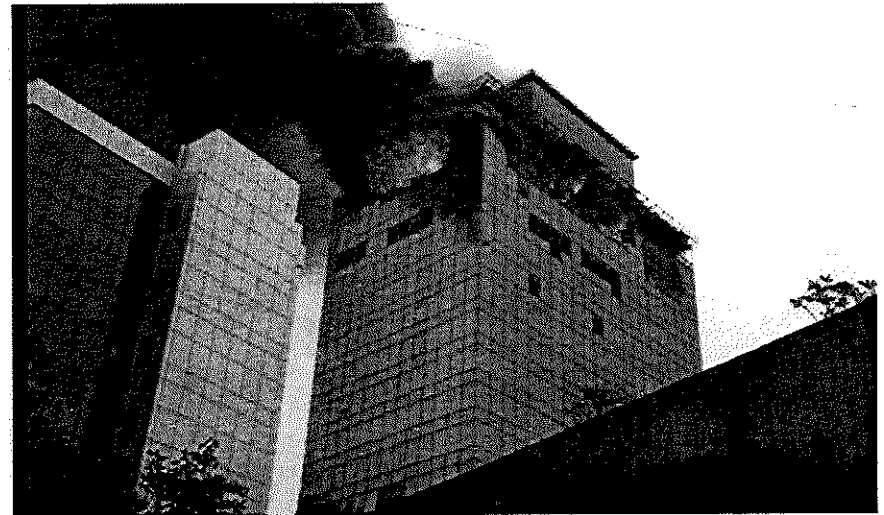
Residential

- Extinguish immediately
- Locations
 - Inside Garage
 - Outdoors
 - Indoors
 - Away from the house
- Can be several ESS
- No fire suppression
- May need smoke alarm or IR



Post Fire Event Concerns

- What do I need to be concerned about?
- Who is going to safe guard the scene?
- When can we investigate the origin?
- What's my role as a Fire Commander
- When can we re-occupy a building?
- How will this be transported?
- How do you remove these systems from a building safely?



Post Fire Considerations

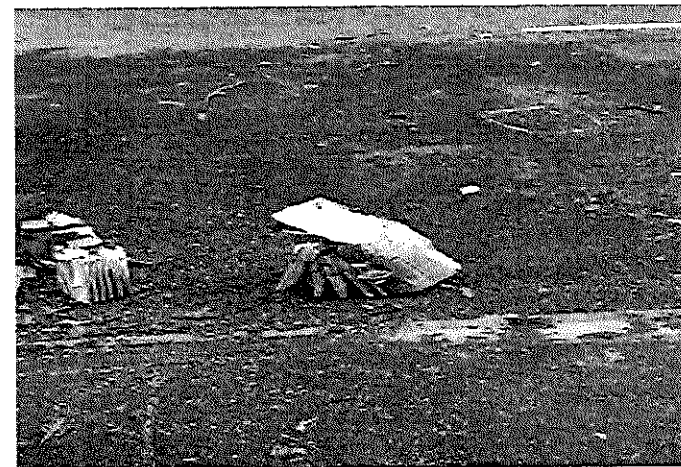
- Re-ignition
- Compromised safety features
- Stranded energy
 - Assume SOC 100%
 - How can we remove the SOC safely?
 - What is needed for safety?
 - Monitoring devices
 - Right type of PPE
 - What is the BMS saying ?
 - On or OFF
 - What's a safe way to transport the ESS?



Post Fire

Fire Chief Responsibilities

- Review the decommissioning procedures
- Acceptance criteria
- Review the transportation plan
- Acceptance criteria
- Inquire about the recovery location
- Proper protections in your jurisdiction



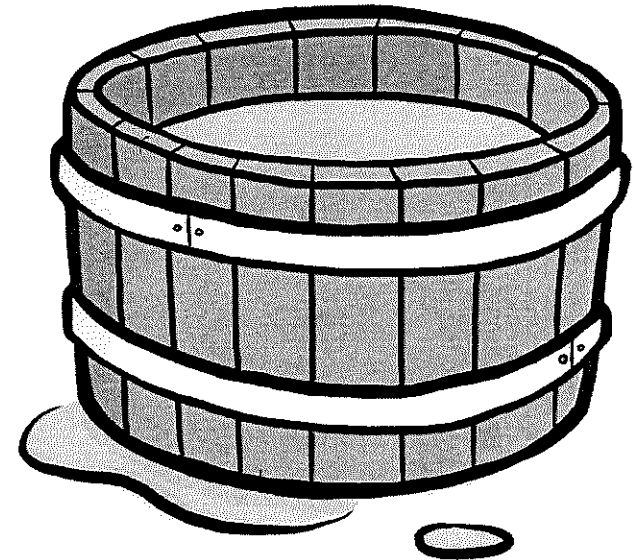
Post Fire Decommissioning

- Fire Commander Role
- Narrative of removal process
- Listing of contingencies
- Fire Mitigation personnel
 - Safe guard of scene
 - Continuously on duty
 - Keep watch for fire
 - Contact FD if needed
 - Follow Decommissioning plan
 - Evacuate public structures
 - Stays till full removal
 - Must be qualified



Post Fire Removal

- Considerations
 - Salt bath for modules for safety
 - Remove to outdoor after each module removal
- Proper packaging for transport
 - Should be secured
- DOT Regulations
- What type of vehicle
 - Open back Transport
 - Closed back Transport



Energetic Hazardous Material

- DOT > Transport Haz Mat
- OSHA > Worker Safety
 - SDS > needed ?
- EPA > Environment
 - Water runoff
 - Similar to structure fires for corrosive

SAMSUNG SDI Co., LTD
Date: Dec. 10, 2014
MODEL: BA03C

Revision No.: 02

SAMSUNG SDI

The International Air Transport Association (IATA), Dangerous Goods Regulations, Packing Instruction 965, Section 1.8 of 1, 8th Edition (2013);
The International Maritime Dangerous Goods (IMDG) Code 2014 Edition, (Special provision 182, 201);
US Hazardous Materials Regulations 49 CFR (Code of Federal Regulations), Sections 173.185 Lithium batteries and cells;
The ILO Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria 28.2 Lithium batteries, Annex 2, Amendment 1 or any subsequent revision and amendment applicable at the date of the type label version & Revision 1, Amendment 2; UN No. 3480

If these lithium-ion batteries are packed with or contained in an equipment, then it is the responsibility of the shipper to ensure that the equipment are packed in compliance to the latest edition of the IATA Dangerous Goods Regulations section 17.1 of either Packing Instruction 965 or 967 in order for the equipment to be declared as NOT RESTRICTED (non-hazardous) or Dangerous; if these lithium-ion batteries are packed with or contained in an equipment, UN No. 3480 is UN3481

Our products are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation according to all applicable international and national governmental requirements, not limited to the above mentioned. We further certify that the enclosed products have been tested and fulfill the requirements and conditions in accordance with ILO, UN Recommendations 17.1 - 17.6 on the Transport of Dangerous Goods Model Regulations and the Manual of Tests and Criteria

Test results of the UN Recommendation on the Transport of Dangerous Goods Manual of Test and Criteria (28.2 Lithium battery)

Test No.	Test Name	Test Results	Remarks
T1	Initial Inspection	Pass	
T2	Thermal Test	Pass	
T3	Vibration	Pass	
T4	Shock	Pass	
T5	External Short Circuit	Pass	
T6	Propagating Spikes	Pass	
T7	Overcharge	Pass	For UN3480 and single cell battery only.
T8	External Discharge	Pass	

13. Regulatory Information

U.S. Regulatory

National Inventory TSCA
All of the components are listed on the TSCA inventory.
SARA
To the best of our knowledge the product contains no toxic chemicals subject to the supplier and custom requirements of Section 313 of the Superfund Amendments and Reauthorization Act (SARA), EPCRA, and the requirements of 40 CFR Part 372.

Regulatory Information EU

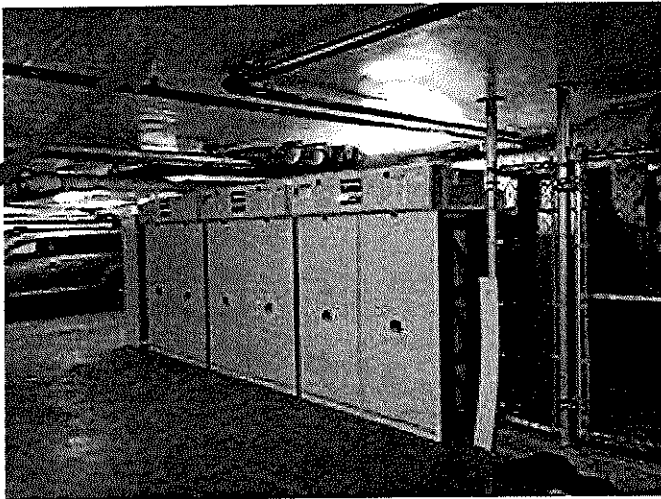
Labeling

Operational Review

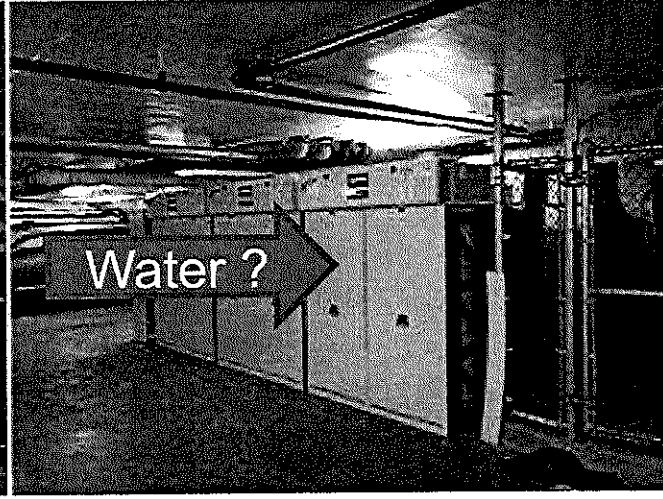


ESS installation

Sprinkler

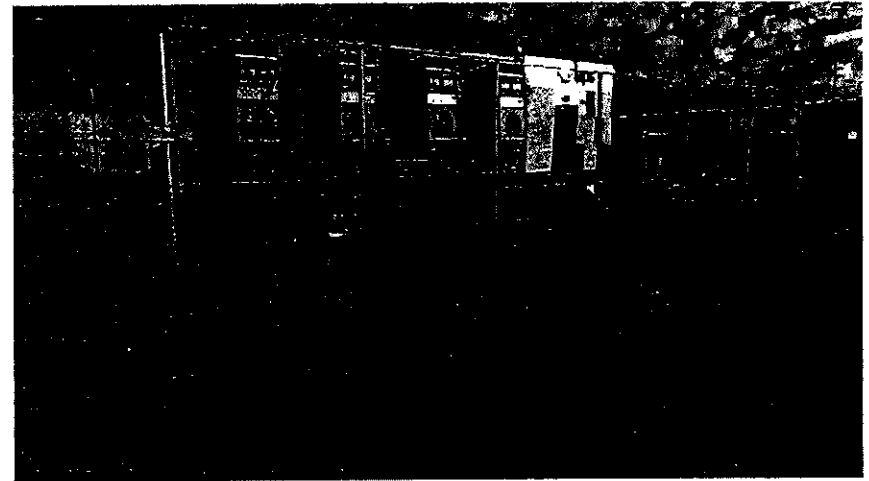


Water ?



Case Study Arizona APS

- 8 firefighters hurt
- 2 critical
- Response information
- What they saw on arrival
- What they were told on the scene
- Size up information
 - 2 hours
 - Hose line stretched
- Door opened to the structure
- Explosion
 - FF thrown
 - Debris thrown
- Post fire Events



Questions?

For additional questions,
please contact:

CleanEnergyHelp@nyserra.ny.gov

