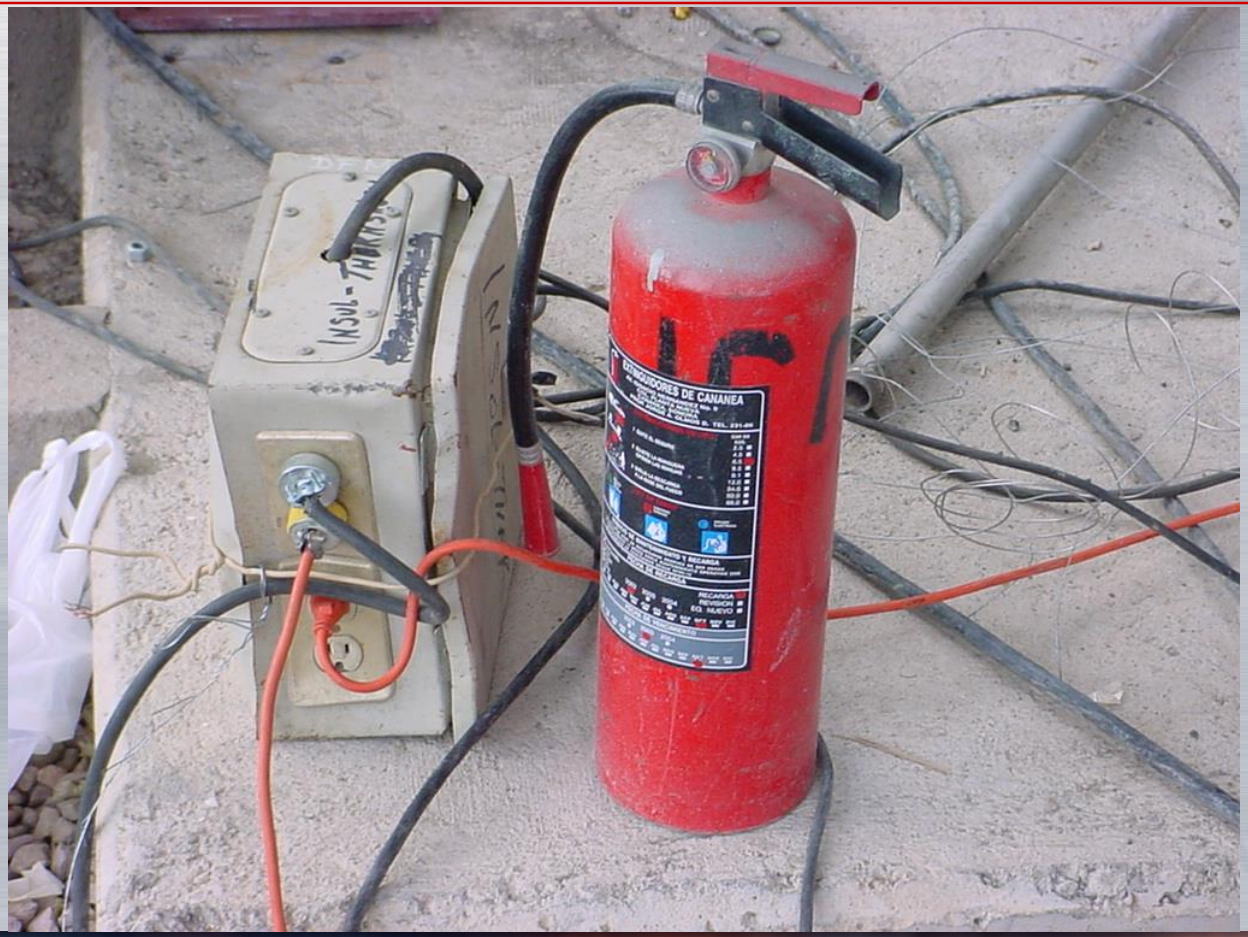

AMERICAN FIRE TECHNOLOGIES
FIRE AND LIFE SAFETY SPECIALIST

Unintended Consequences



NFPA 855- Energy Storage Systems ESS

OUR GOALS

- *Unintended Consequences – NFPA 855 ESS*
  - *Where is it heading?*

- *What does it mean for Utilities*
- *Future Code Requirements*
- *Types of products to meet code*
- *Design Requirements*
- *Standard Sizes*
- *Recommendations*

Risk Based

- A System design is based on reasonably anticipated events to control the fire until an informed party can determine the next course of action.

ESS - Electrical Hazard

- Risk Based hazard
  - What is your/client tolerance for risk.
  - Electrical – Deep Seated Fire
  - Detection vs suppression
- Asset protection
- Turning it off does not eliminate the hazard
  - Life Safety- First responders

Code Cycle

- *1st draft was out for public comment in 10/17.*
- *+550 public inputs*
- *Two draft reviews meetings - 10/17 and 11/17*
- *1st draft out April 11th 2018*
- *Public comment closed June 20th 2018.*
- *+880 Public comments submitted*
- *Second Draft planned Jan 3rd 2019*

Code Cycle

- *Target for NFPA publication - 2019*
- *Possibility of NITMAN will push it out until 2020 for code issue?*

- *Committed Make Up - Manufacures, code enforcement, special knowledge*
- *Limited in installers/utility based*

Code Basis

- *Familiar with NFPA 850? Is a recommend practice or a should code. Most of your property operated under this code.*
- *855 Will be a requirement or a shall code.*
- *May run into conflicts on Utility based property.*

Code Basis

Key Issues

- *Use of UL 9540 will be a listing issue and referenced heavily in the code.*
- *Defined facility code requirements will be by location – Tables*
  - *Dedicated use vs remote location*
  - *Outdoor vs indoor*
  - *Life Safety vs unoccupied*
- *Any thing outside of the defined levels will be allowed by "large Scale Fire Testing"*
- *Covers all energy storage not just Lithium Ion Batteries*

Code Basis -

Chapter 1 – Overall requirements.

- 1.2 Purpose. This standard provides the minimum requirements for the fire prevention, fire protection, design, construction, installation, commissioning, operation, maintenance, and decommissioning of stationary, mobile, and portable ESS.

- 1.3* Application. This standard applies to the following:
- (1) Stationary ESS having capacities exceeding the values shown in Table 1.3
- (2) Mobile ESS used in stationary applications
- (3) Portable ESS interconnected to provide a stationary source of power

- Submitted - 1.3.1 This standard shall not apply to ESS which are an integral part of a generating plant or substation.(failed)

Code Tables

TABLE 1.3 Stationary ESS Threshold Quantities

[a]For ESS units rated in amp-hrs, kWh equals rated voltage times amp-hr rating divided by 1000.

ESS Technology	Aggregate Capacity[a]	
	kWh	MJ
Battery ESS		
Lead acid, all types	70	252
Nickel-cadmium (Ni-Cd)	70	252
Lithium-ion, all types	20	72
Sodium, all types	20[c]	72[c]
Flow batteries[b]	20	72
Other battery technologies	10	36
Batteries in residential occupancies	1	3.6
Capacitor ESS		
Capacitors, all types	3	10.8
Other ESS		
All other ESS	70	252

Code Basis

Chapter 4 will be the driving force behind the your requirements –

4.4.1 ESS installed indoors, outdoors, on rooftops and in open parking garages shall comply with this section.

1st draft copy/draft first revision copy available. First revision not out yet.

4.4.2 Indoor installations.

- **4.4.2.1** Indoor ESS installations shall comply with this section.
- **4.4.2.2 Dedicated use buildings**. For the purpose of Table 4.4.2 dedicated use ESS buildings shall be constructed in accordance with local building codes and comply with all the following. :
- The building shall only be used for electrochemical energy storage, energy generation, and other electrical grid related operations.
- Occupants in the rooms and areas containing ESS are limited to personnel that operate, maintain, service, test and repair the ESS and other energy systems.
- No other occupancy types shall be permitted in the building, and.
- Administrative and support personnel shall be permitted in incidental use areas within the buildings that do not contain ESS, provided:

Indoor Cont

- The areas do not occupy more than 10 percent of the building area of the story in which they are located.
- The areas are separated from the ESS and other energy system rooms and areas by two hour fire barriers and two hour fire-resistance rated horizontal assemblies constructed in accordance with the locally enforced building code, as appropriate.
- A means of egress is provided from the incidental use areas to the public way that does not require occupants to traverse through areas containing ESS or other energy system equipment.
-
- **4.4.2.3 Non-dedicated use buildings.** For the purpose of Table 4.4.2 non-dedicated use buildings include all buildings that contain ESS and do not comply with Section 4.4.2.1 dedicated use building requirements.

TABLE 4.4.2
INDOOR ENERGY STORAGE SYSTEMS (ESS)

COMPLIANCE REQUIRED	DEDICATED USE BUILDINGS [a]	NON-DEDICATED USE BUILDINGS [b]
Chapters 1-3	Yes	Yes
4.1 – 4.3 General	Yes	Yes
4.6 Size and separation	Yes	Yes
4.5 Maximum rated energy	No	Yes
4.4.1 Elevation	Yes	Yes
4.4.3.1 Separation	Not Applicable	Yes
4.7 Smoke and fire detection	Yes [c]	Yes
4.8 Fire control and suppression	Yes	Yes
4.9 Water supply	Yes	Yes
4.11 Signage	Yes	Yes
4.4.6 Occupied work centers	Not allowed	Yes
Chapter 9-17 Technology specific protection	Yes	Yes

a. See Section 4.4.2.2.
b. See Section 4.4.2.3.
c. When approved, alarm signals are not required to be transmitted to an approved location when local fire alarm annunciation is provided and trained personnel are always present.

Recommendations – Submitted – Failed

- **4.4.1** ESS installed indoors, outdoors, on rooftops and in open parking garages shall comply with this section.

- *4.4.1.1 ESS facilities under the exclusive control of the electric utility and meeting all of the conditions shown in 4.4.1.1(1) through 4.4.1.1(4) below shall not be required to meet the Provisions of Chapter 4*
- *(1) The ESS is installed on electric utility property*
- *(2) The ESS is installed in a dedicated use ESS building as defined section 4.4.2.2 complying with the remote location requirements of 4.4.3.2 (1) or the ESS is installed outdoors complying with the remote location requirements of 4.4.3.2(1)*
- *(3) There is controlled access to the property provided by fencing, locked facilities, or manned guard stations*
- *(4) There is restricted access to first responders according the emergency response plan utilized by the electric utility for high voltage facilities*
-

Recommendations – Submitted – Failed

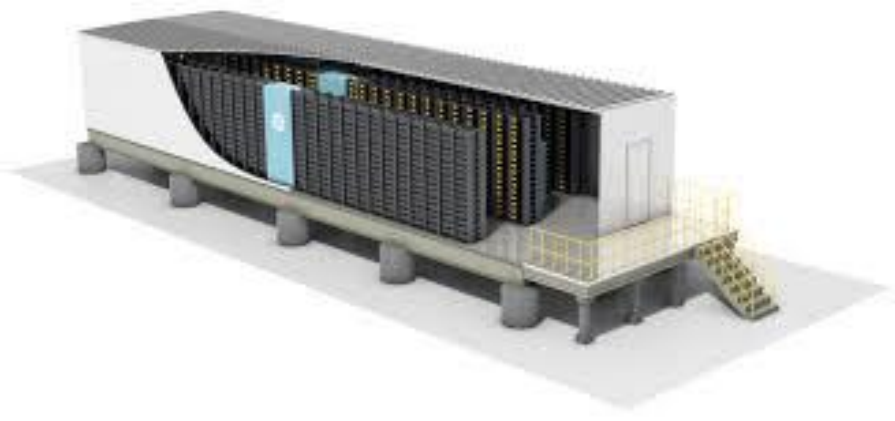
- **4.4.1** ESS installed indoors, outdoors, on rooftops and in open parking garages shall comply with this section.

- *A 4.4.1.1 .Electric utilities should refer to NFPA 850 Chapter 4 for the appropriate fire protection design process for a comprehensive evaluation of risks posed by ESS. As part of the design process, electric utilities should utilize NFPA 855 section 4.4. and subsequent chapters to evaluate risk and determine mitigation factors such as those shown in NFPA 855 Tables 4.4.2 and 4.4.3.*

- Electric utility locations that would meet the definition of remote would be considered asset risks (not risks to the public or first responders) whose protection should be determined by the risk profile of the utility. These locations are characterized by no public access, limitations on access by first responders, and separation from spaces accessible to the public.

Recommendations – Submitted – So Far

- *d. Where dedicated use buildings meet the definition of remote locations shown in section 4.4.3.2 below and where agreeable with the electrochemical energy storage system owner and approved by the AHJ, fire suppression systems and water supply are permitted to be omitted*



4.4.3 Outdoor installations.

- **4.4.3.1** Outdoor ESS installations shall comply with this section.
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- **4.4.3.2.** For the purpose of Table 4.4.3 outdoor ESS installations shall be classified as follows:
- **Remote locations -** Remote outdoor locations include ESS 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. *ADDED . ESS installations on property shared with other electrical infrastructure that is under the same ownership shall not be considered to create an exposure for the purposes of this section .*
- **Locations near exposures –** Include all outdoor ESS locations that do not comply with remote outdoor location requirements.

TABLE 4.4.3
OUTDOOR STATIONARY ENERGY STORAGE SYSTEMS [a](ESS)

COMPLIANCE REQUIRED	REMOTE LOCATIONS [a]	LOCATIONS NEAR EXPOSURES [b]
Chapters 1-3	Yes	Yes
4.1 – 4.3 General	Yes	Yes
4.4.3.3 Maximum size	Yes	Yes
4.4.3.4 Clearance to exposures	Yes	Yes
4.4.3.5 Means of egress	NA	Yes
4.4.3.6 Walk in units	Yes	Yes
4.4.3.7 Vegetation control	Yes	Yes
4.4.3.8 Enclosures	Yes	Yes
4.6 Size and separation	No	Yes [c]
4.5 Maximum rated energy	No	Yes
4.7 Smoke and fire detection	Yes	Yes
4.8 Fire control and suppression	Yes [d]	Yes
4.10 Water supply	Yes [d]	Yes
4.11 Signage	Yes	Yes
4.4.6 Occupied work centers	Not allowed	Not allowed
Chapter 9-17 Technology specific protection	Yes	Yes

NA = Not applicable.
a.. See Section 4.4.3.2, item 1.
b. See Section 4.4.3.2, item 2.
c. In outdoor walk-in units, spacing is not required between electrochemical energy storage units and the walls of the enclosure.
d. When agreeable with the electrochemical energy storage system owner and approved by the AHJ, fire suppression systems and water supply are permitted to be omitted.

4.4.3 Outdoor installations.

- **4.4.3.3 Maximum size.** Outdoor walk-in containers or enclosures housing ESS shall not exceed 45 ft. by 8 ft. by 9.5 ft. high. Units that exceed these dimensions shall be treated as indoor installations and comply with the requirements in Section 4.4.2.
- **4.4.3.4 Clearance to exposures.** ESS located outdoors shall be separated by a minimum ten feet (3048 mm) from the following exposures:
- 1. Lot lines
- 2. Public ways
- 3. Buildings
- 4. Stored combustible materials
- 5. Hazardous materials
- 6. High-piled stock
- 7. Other exposure hazards*(added) not associated with generation of power*

4.4.3 Outdoor installations.

- **4.4.3.4.3**. Clearances to buildings are permitted to be reduced to 3 ft. (914.4 mm) where the weatherproof enclosure of the ESS is constructed of noncombustible materials and it has been demonstrated that a fire within the enclosure will not ignite combustible materials outside the enclosure based on large scale fire testing complying with Section 4.5.

4.6* Size and Separation.

- **4.6.1** ESS in the following locations ~~installed indoors~~ shall comply with 4.6.2 and 4.6.3 unless otherwise permitted by Section 4.6.4 or 4.6.5.
- 1. Indoor ESS installations in accordance with Section 4.4.2.
- 2. Outdoor ESS installations in locations near exposures as described in Section 4.4.3.2 (2).
- 3. ESS installations in open parking garages and on rooftops of buildings as described in Section 4.4.4.2 shall not exceed the maximum rated energy values in Table 4.5
- 4. In mobile ESS equipment in accordance with Section 4.5.

- **4.6.2** ESS shall be comprised of groups with ~~to~~ a maximum energy level of (50) (300) (1,000) 250 kWh each.

4.6* Size and Separation.

- **4.6.3** Each group shall be spaced a minimum 3 ft. (914 mm) from other groups and from walls in the storage room or area.
- **4.6.4** The AHJ shall be permitted to approve ~~listed pre-engineered and prepackaged ESS~~ groups with larger capacities or smaller group~~s~~ spacing based on ~~if~~ large-scale fire and fault condition testing ~~conducted~~ complying with Section x.x ~~or witnessed and reported by an approved testing laboratory is provided showing that a fire involving one array will not propagate to an adjacent array and be contained within the room for a duration equal to the fire resistance rating of the room separation required by 4.4.2.1.~~
- **4.6.5** Section 4.6.2 and 4.6.3 do not apply to lead-acid and nickel-cadmium battery systems less than 50-V ac, 60-V dc in telecommunications facilities and in compliance with NFPA 76.

4.5 Maximum Rated Energy

- ESS in the following locations shall comply with Section 4.5 as follows:
- Fire areas within non-dedicated use buildings as described in Section 4.4.2.3 containing ESS exceeding the maximum rated energy values in Table 4.5 shall comply with all applicable high hazard requirements as identified in 6.2.2 of NFPA *101* and the building code.
- Outdoor ESS installations in locations near exposures as described in Section 4.4.3.2 (2) shall not exceed the maximum rated energy values in Table 4.5
- ESS installations in open parking garages and on rooftops of buildings as described in Section 4.4.4.2 shall not exceed the maximum rated energy values in Table 4.5
- Mobile ESS equipment, as covered by Section 4.5, shall not exceed the maximum rated energy values in Table 4.5

4.5 Maximum Rated Energy

TABLE 4.5 Maximum Rated ESS Energy

ESS Type	Maximum Rated Energy* (kWh)
Lead acid batteries, all types	600
Nickel-cadmium batteries (Ni-Cd)	600
Lithium-ion batteries, all types	600
Sodium batteries, all types	600
Flow batteries†	600
Other battery technologies	200
Capacitors	20

*For batteries and capacitors rated in amp-hrs, kWh should equal rated voltage times amp-hr rating divided by 1000.
†Includes vanadium, zinc-bromine, polysulfide bromide, and other flowing electrolyte-type technologies.

4.5 Maximum Rated Energy

- **4.5.1** Fire areas in telecommunication buildings complying with NFPA 76 that contain lead-acid and nickel-cadmium battery systems operating at lower than 50-V ac, 60-V dc nominal shall be considered ordinary hazard.
- **4.5.2** Where approved by the AHJ, fire areas in non-dedicated use buildings containing ESS that exceed the amounts in Table 4.5 shall be permitted to be treated as an ordinary hazard and not a high hazard classification based on a hazardous mitigation analysis in accordance with Section 4.15 and large-scale fire and fault condition testing conducted complying with Section 4.5.
- **4.5.3** Where approved by the AHJ, outdoor ESS installations, ESS installations in open parking garages and on rooftops of buildings, and mobile ESS equipment that exceed the amounts in Table 4.5 shall be permitted based on a hazardous mitigation analysis in accordance with Section 4.15 and large-scale fire and fault condition testing complying with Section 4.5.
- **4.5.4** Where fire areas within buildings and other installations contain a combination of energy systems covered in Table 4.5, the total aggregate quantities shall be determined based on the sum of percentages of each type divided by the maximum rated energy of each type.
- **4.5.5** Where the sum of the percentages calculated in 4.5.4 exceeds 100 percent, the fire area in non-dedicated use buildings shall be treated as a high hazard classification, or the installation or equipment shall not be permitted.

9.2 Protection features.

- EESS installations shall comply with the technology specific requirements specified in Tables

COMPLIANCE REQUIRED [b]	BATTERY TECHNOLOGY						Other EESS and Battery Techno-logies [b]	Capacitor Energy Storage [b]
	Lead-acid	Ni-Cad or Ni-mH	Lithium	Sodium (high temp)	Sodium ion	Flow		
4.10 ~~9.4.2.1~~ Exhaust v~~V~~entilation	Yes	Yes	No	No	Yes	Yes	Yes	~~No~~Yes
4.3.5 Spill control ~~and neutralization~~	Yes [c]	Yes [c]	No	No	No	Yes	Yes	Yes~~No~~
4.3.6 Neutralization	Yes c	Yes c	No	No	No	Yes	Yes	Yes
~~TBD~~ Safety caps	Yes	Yes	No	No	No	No	Yes	Yes~~No~~
4.2.6~~TBD~~ Thermal runaway	Yes	Yes	Yes [d]	Yes [d]	Yes [d]	No	Yes [d]	~~No~~Yes
4.11 Explosion control	Yes [a]	No	Yes	Yes	No	No	Yes	Yes

a. Not required for lead-acid and Ni-Cad batteries at telecommunications facilities that comply with NFPA 76 and operate at less than 50 VAC and 60 VDC.

b. Protection shall be provided unless documentation acceptable to the AHJ, including a hazard mitigation analysis complying with Section 4.15, ~~is provided that~~ provides justification that~~why~~ the protection is not necessary based on the technology used.

c. Applicable to vented (i.e. flooded) type Ni-cad and lead acid batteries.

d. The thermal runaway protection is permitted to be part of a battery management system that has been evaluated with the battery as part of the evaluation to UL 1973.

Code Requirements

- NFPA/UL/FM
  - Local Requirements
  - Client Requirements
  - AHJ –
    - Insurance
    - Fire Marshall
    - Risk Group

Recommendations

Be prepared to bring in the AHJ – Local Fire Marshal early

Fear of first responders. Urban development have not seen this “hazard” . Cannot compare to substations.

Design Options to meet Code?

- *Insurance and Hazard analysis should direct.*
- *Tiered approach to Fire System*
- *Addenda “C” probably give the best description of options for protection.*
- *Not Retroactive but any change could invoke requirements*
- *Does Clean Agent work? - Discussion/options*

Type of Products

- Products
  - Fire Suppression
  - Fire Alarm
  - Integrated System – BOP
  - Specialty Detection

Detection

- Spot Detection
  - Normal system – least expensive
- Air Sampling System
  - Early Warning System – Extra cost

Suppression – Products

- Clean Agent systems
  - Fike, Kidde, Ansul,
  - CO2 Systems
    - Tomco, Chemetron, Ansul
  - Mist/Hybrid Systems
    - Marioff, Fike, Ansul, Vortex
  - Other options – Stat-x

Suppression – Products

- Stat-x Aerosol
  - Least expensive
- Novec
  - Most common clean agent
- FM200
- CO2
  - Most Dangerous
- Mist??

Suppression – Products Relative cost

- Stat-x Aerosol
  - X .4
- Novec
  - X 1
- CO2
  - X 1
- Mist
  - X 2

Water Mist /Hybrid

- Non-Chemical.
- Micron size water droplets.
- Best used for generator rooms or areas with high leakage.
- Very economical to recharge.
- Has not gained a lot of acceptance in US, widely used in Europe. - Changing
- Hybrid better for Electrical enclosures

Water Mist /Hybrid Systems

- Ansul – Three types of systems
- Marrioff – Used in GE becoming more prevalent
- Securiplex – High pressure – lots of bottles .
- Vortex – wet inerting system
- Fike Duraquench
- More systems on the way.

Design Requirments

- Location in E house
  - Size of E house
  - Available Space Inside
  - Client Requirements?
  - Field Installation – Unit integrity
  - Testing - Certification

Standard Size

- Invest in a standard

- Easy To Buy
- Easy to install
- Take out the Fear Factor

Project

- Install

Critical to a Fire System –

Good installation.

Good Maintenance

Lithium Ion Batteries

- Is that Part of Your Scope?
  - Different Fire Hazard
  - Requires a different Strategy for protection
  - Uncertainty in the market place and code enforcement
  - Utility based verse Mixed use

  - Code Issues coming.

Recommendations

Continuous Improvement

- *Skid base system - OEM protection*
  - *Build to your standard*
  - *Set during fabrication*
  - *Minimal install requirements*
- *One time design – Table for sizing*
- *Optional Pricing list*

Recommendations

- *Skid base system - OEM protection*

Recommendations

Recommendations

- *Keep aware of the code cycle*
- *Submit change or recommendation*
- *Work with the AHJ – a lot of fear in the industry*
- *Incoperate design requirements up front*

Unintended Consequences

Knowledge and proper planning

Collaborative Designed Solutions


DANGER
EAR
PROTECTION
REQUIRED

Questions/Discussion

“Thanks” For Taking The Time To See This!!

We Hope This Will Help.

Contact –

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