



U.S. Codes & Standards for Energy Storage Systems

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Regulatory Update: U.S. Codes & Standards

Agenda

- NFPA 70 (NEC)
- UL 1973 & 9540
- Fire Codes
 - NFPA 1
 - IFC
- Building Codes
- Code Adoption



2014 NFPA 70 (NEC) Article 480



ARTICLE 480 Storage Batteries

480.1 Scope. The provisions of this article shall apply to all stationary installations of storage batteries.

- 2014 NEC Article 480 references lead-acid and nickel-cadmium batteries
- Substantial update was needed for lithium ion batteries and emerging ESS technologies

2014 NFPA 70 (NEC) Article 690 Part VIII



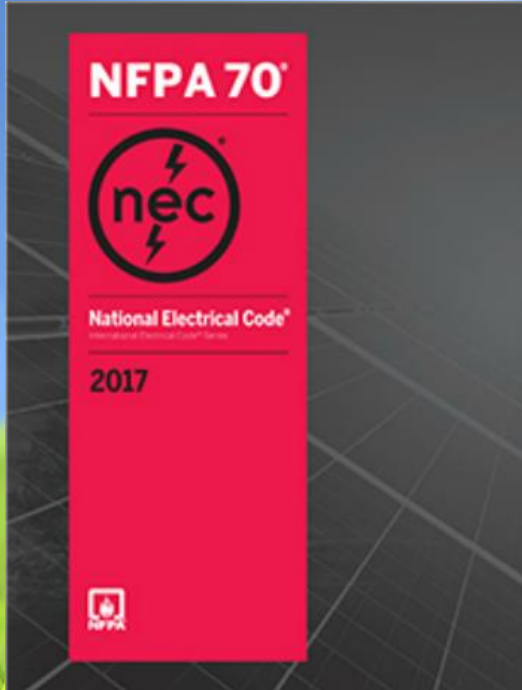
VIII. Storage Batteries

690.71 Installation.

(A) **General.** Storage batteries in a solar photovoltaic system shall be installed in accordance with the provisions of Article 480. The interconnected battery cells shall be considered grounded where the photovoltaic power source is installed in accordance with 690.41.

- Article 690 Part VIII was developed over the years primarily to address off-grid PV and backup systems
- Most content is relocated to new Article 706

2017 NFPA 70 (NEC) Article 706



ARTICLE 706 Energy Storage Systems

Part I. General

706.1 Scope. This article applies to all permanently installed energy storage systems (ESS) operating at over 50 volts ac or 60 volts dc that may be stand-alone or interactive with other electric power production sources.

- Article 480 remains for Storage Batteries
- Article 690 Part VIII references new Article 706

UL 1973

Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications

UL 1973

1. Scope

1.1 These requirements cover electric energy storage systems as defined by this standard for use as energy storage for stationary applications such as for PV, wind turbine storage or for UPS, etc. applications. These systems are to be installed in accordance with the applicable installation codes.



- Ballot for 2nd edition of ANSI UL 1973 completed and voted affirmative
- Publication of 2nd edition ANSI UL 1973 by 2nd quarter of 2016
- Re-open UL 1973 for Bi-National Standard for US and Canada 2016

UL 9540

UL 9540

Outline of Investigation for Energy Storage Systems and Equipment

SCOPE

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1.1 These requirements cover energy storage systems that are intended to store energy from power or other sources and provide electrical or other types of energy to loads or power conversion equipment. The energy storage systems may include equipment for charging, discharging, control, protection, communication, controlling the system environment, fuel or other fluid movement and containment, etc. The system may contain other ancillary equipment related to the functioning of the energy storage system.

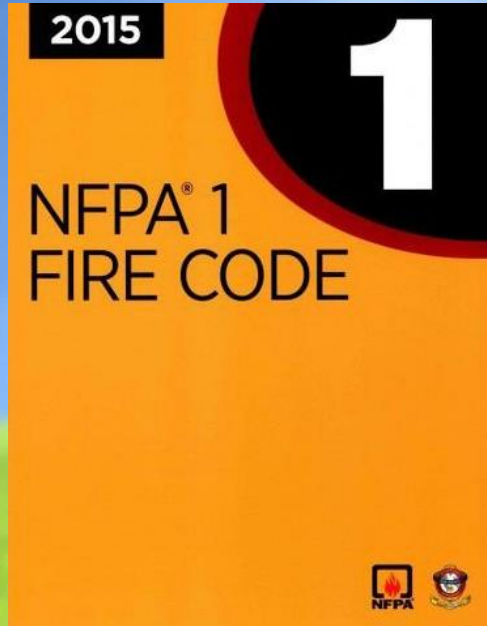


**UL
Standard**

For more information on development of ESS codes & standards, see following UL slide deck:
<http://www.criticalpowershow.com/schaumburg/wp-content/uploads/2016/04/UL.pdf>

- Ballot for 1st edition of ANSI UL 9540 out in November 2016
- Ballot reached consensus
- Recirculation ballot to come out 2nd quarter of 2016
- Planned publication 3rd quarter of 2016
- Bi-national ANSI standard for USA and Canada upon publication

Proposals for 2018 NFPA 1 Fire Code



- Proposals for NFPA 1 Chapter 52 submitted as placeholders early in 2016 during the code development cycle.
- First draft of 2018 NFPA 1 was released in March 2016
- The major effort among stakeholders is in development of 2018 IFC
- Public Input should harmonize 2018 NFPA 1 with final outcome of 2018 IFC
- Second draft of NFPA 1 is expected in January 2017

2015 International Fire Code (IFC)

SECTION 608 STATIONARY STORAGE BATTERY SYSTEMS

608.1 Scope.

Stationary storage battery systems having an electrolyte capacity of more than 50 gallons (189 L) for flooded lead-acid, nickel cadmium (Ni-Cd) and valve-regulated lead-acid (VRLA), or more than 1,000 pounds (454 kg) for lithium-ion and lithium metal polymer, used for facility standby power, emergency power or uninterruptible power supplies shall comply with this section and Table 608.1.



- 2015 IFC Section 608 Stationary Storage Battery Systems includes lithium ion
- Minimum threshold is based on weight (1000 lb)
- Stated use is facility standby power, emergency power, or uninterruptible power supply
- Does not adequately address current ESS systems

Proposal F95-16 for ESS in Future 2018 IFC

F95-16

105.6.44 (New), 202, 202 (New), , [A] 105.7.2, 602.1, 608, (New), 608.1, 608.1 (New), 608.1.1 (New), 608.1.2 (New), 608.1.3 (New), 608.1.3.1 (New), 608.1.3.2 (New), 608.1.3.3 (New), 608.1.4 (New), 608.1.5 (New), 608.1.6 (New), 608.1.6 (New), 608.1.7 (New), 608.2 (New), 608.2.1 (New), 608.2.2 (New), 608.2.3 (New), 608.2.4 (New), 608.2.5 (New), 608.2.5.1 (New), 608.2.6 (New), 608.2.6.1 (New), 608.2.6.2 (New), 608.2.7 (New), 608.2.7.1 (New), 608.2.7.2 (New), 608.2.7.3 (New), 608.2.7.4 (New), 608.3 (New), 608.3.1 (New), 608.4 (New), 608.4.1 (New), 608.4.2 (New), 608.4.3 (New), 608.4.4 (New), 608.4.5 (New), 608.4.6 (New), 608.4.7 (New), 608.4.8 (New), 608.5 (New), 608.5.1 (New), 608.5.1.1 (New), 608.5.2 (New), 608.5.3 (New), 608.5.3.1 (New), 608.5.3.2 (New), 608.5.4 (New), 608.5.4.1 (New), 608.5.5 (New), 608.6 (New), 608.6.1 (New), 608.6.2 (New), 608.6.3 (New), 608.6.4 (New), 608.6.5 (New), 608.6.6 (New), 907.2.23 (IBC [F] 907.2.23); IBC [F] 307.1.1, 509

Proponent : Michael O'Brian representing the Fire Code Action Committee (FCAC@iccsafe.org)

- Proposal F95-16 includes sweeping revisions for regulation of ESS
- F95-16 seeks to revise the 2018 IFC and 2018 IBC
- Many stakeholders were engaged; proposal evolved during process
- Many modifications were heard by the ICC Fire Committee
- Public Comment (final) Hearings are October 19-25, 2016 in Kansas City, MO. Code changes are not finalized until mid-November 2016.

Pending Modifications to Proposal F95-16

F95-16

Committee Action:

Approved as Modified

Modification:

~~105.6.44 Stationary storage battery systems. A permit is required for the operation of a stationary storage battery system regulated by Section 608.~~

~~608.1.1 Permits. Permits shall be obtained for the installation and operation of stationary storage battery systems in accordance with Sections 405.6.44 and Section 105.7.2.~~

~~608.2.1 Location. Stationary storage battery systems shall not be located in areas where the floor is located more than 75 feet (22 860 mm) above the lowest level of fire department vehicle access, or where the floor level is more than 30 feet (9144 mm) below the finished floor of the lowest level of exit discharge.~~

~~Exception~~Exceptions:

~~1. Lead acid and nickel cadmium stationary storage battery systems.~~

~~2. Installations on noncombustible rooftops of buildings exceeding 75 feet (22 860 mm) in height that do not obstruct fire department rooftop operations shall be permitted where approved by the fire code official.~~

- Many “Floor Modifications” were approved by Fire Committee
- Strike-out of 105.6.44: Construction permit; no operating permit



Pending Modifications to Proposal F95-16

608.2.3 Stationary battery arrays. Storage batteries, prepackaged stationary storage battery systems and pre-engineered stationary storage battery systems shall be segregated into stationary battery arrays not exceeding 50 KWh (180 Mega joules) each. Each stationary battery array shall be spaced a minimum three feet (914 mm) from other stationary battery arrays and from walls in the storage room or area. The storage arrangements shall comply with Chapter 10.

Exceptions:

1. ~~Lead acid and nickel cadmium storage battery arrays shall not exceed 250 KWh (900 Mega joules) each.~~
2. ~~Listed pre-engineered lithium ion battery arrays shall not exceed 250 (900 Mega joules) each.~~
3. Listed pre-engineered stationary storage battery systems and prepackaged stationary storage battery systems shall not exceed 150 KWh (540 Mega joules) each.
4. The fire code official is authorized to approve listed pre-engineered and prepackaged battery arrays with larger capacities or smaller battery array spacing if large scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving one array will not propagate to an adjacent array, and be contained within the room for a duration equal to the fire resistance rating of the room separation specified in Table 509 of the International Building Code

- Stationary battery arrays not exceeding 50 KWh (180 M Joules)
- Each stationary battery array shall be spaced a minimum of 3 feet (914 mm) from other ... arrays and from walls
- Exception 4: larger arrays or smaller spacing possible by testing



Pending Modifications to Proposal F95-16

608.2.6 Signage Approved signs shall be provided on doors or in locations near entrances to stationary storage battery system rooms and shall include the following or equivalent.

- 0.1. The room contains energized battery systems.
- 0.1. The room contains energized electrical circuits.
- 0.1. AUTHORIZED PERSONNEL ONLY, if required by Section 608.4.
- 0.1. The additional markings required in Section 608.6 for the types of storage batteries contained within the room.
- 0.1. Hazard identification markings in accordance with NFPA 704.

Exception: Existing stationary storage battery systems shall be permitted to include the signage required at the time it was installed.

- 0.1. A minimum 8 in. (200 mm) wide and 6 in. (150 mm) high sign with CAUTION, WARNING or DANGER
 - 0.1.0.1. BATTERY ROOM,
 - 0.1.0.1. AUTHORIZED PERSONNEL ONLY, and
 - 0.1.0.1. The additional markings required in Section 608.6 for the types of storage batteries contained within the room.

Exception: ~~AUTHORIZED PERSONNEL ONLY markings are not required for entrances to occupied work centers complying with Section 608.2.5.~~

- 0.1. ~~Hazard identification markings in accordance with NFPA 704.~~

608.2.6.2 Cabinet signage. Battery storage cabinets provided in occupied work centers in accordance with Section 608.2.5 shall have exterior labels that indicate ~~CAUTION, BATTERY STORAGE CABINET, AUTHORIZED PERSONNEL ONLY,~~

identify the manufacturer and the additional markings required in Section 608.6 for model number of the typesystem and electrical rating (voltage and current) of storage batteries, the contained battery system. There shall be signs within the cabinet that indicate the relevant electrical, chemical and hazards, as required by Section 608.6.



Pending Modifications to Proposal F95-16

608.2.7.1 Separation. Stationary storage battery systems located outdoors shall be separated by a minimum five feet (1524 mm) from the following:

- 0.1. Lot lines
- 0.2. Public ways
- 0.3. Buildings
- 0.4. Stored combustible materials
- 0.5. Hazardous materials
- 0.6. High-piled stock
- 0.7. Other exposure hazards

Exception: The fire code official is authorized to approve smaller separation distances if large scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving the system will not adversely impact occupant egress from adjacent buildings, or adversely impact adjacent stored materials or structures.

608.2.7.2 Means of egress. Stationary storage battery systems located outdoors shall be separated from any means of egress as required by the fire code official to ensure safe egress under fire conditions, but in no case less than 10 feet (3048 mm).

Exception: The fire code official is authorized to approve smaller separation distances if large scale fire and fault condition testing conducted or witnessed and reported by an approved testing laboratory is provided showing that a fire involving the system will not adversely impact occupant egress.

- Battery systems located outdoors: min. 5 feet from buildings
- Exception: Smaller separation possible by testing



Pending Modifications to Proposal F95-16

TABLE 608.3
MAXIMUM ALLOWABLE BATTERY QUANTITIES

| BATTERY TECHNOLOGY | MAXIMUM ALLOWABLE QUANTITIES ^a | GROUP H OCCUPANCY |
|-----------------------------|---|--|
| Lead acid, all types | 600 KWh <u>unlimited</u> | Group H-4 <u>Not Applicable</u> |
| Nickel cadmium (Ni-Cd), | 600 KWh <u>unlimited</u> | Group H-4 <u>Not Applicable</u> |
| Lithium, all types | 600 KWh | Group H-2 |
| Sodium, all types | 600 KWh | Group H-2 |
| Flow batteries ^b | 600 KWh | Group H-2 |
| Other battery technologies | 200 KWh | Group H-2 ^c |

a. For batteries rated in Amp-Hours, Watt-hours (Wh) shall equal rated battery voltage times the Amp-hour rating divided by 1000

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

c. Shall be a Group H-4 occupancy if the fire code official determines that a fire or thermal runaway involving the battery technology does not represent a significant fire hazard

- If greater than 600 KWh total in room, then H-2 hazardous occupancy
- See Section 608.2.3 for max. array size



Pending Modifications to Proposal F95-16

Other major subsections IFC proposal for ESS include:

- Energy management systems shall be provided for battery technologies other than lead acid and nickel cadmium
- Fire suppression systems
- Ventilation
- Gas detection
- Spill control and neutralization



F95-16 proposed changes to 2018 IBC

TABLE 509
INCIDENTAL USES

| ROOM OR AREA | SEPARATION AND/OR PROTECTION |
|--|--|
| <p>Stationary storage battery systems having <u>an energy a liquid electrolyte capacity greater than the threshold quantity specified in Table 608.1 of the International Fire Code, of more than 50 gallons for flooded lead acid, nickel cadmium or VRLA, or more than 1,000 pounds for lithium ion and lithium metal polymer used for facility standby power, emergency power or uninterruptible power supplies</u></p> | <p>1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies.</p> |

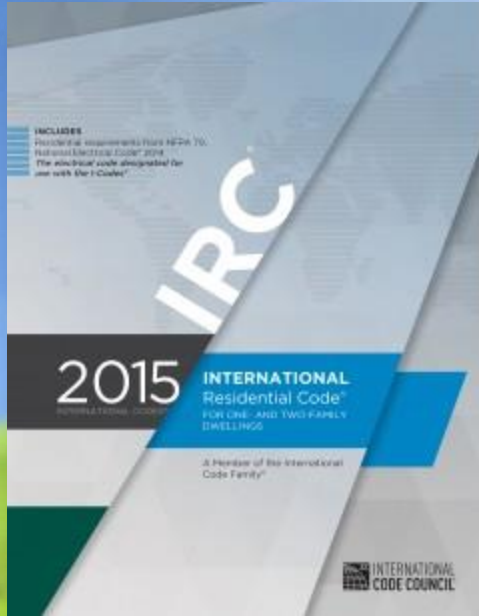
For SI: 1 square foot = 0.0929 m², 1 pound per square inch (psi) = 6.9 kPa, 1 British thermal unit (Btu) per hour = 0.293 watts, 1 horsepower = 746 watts, 1 gallon = 3.785 L, 1 cubic foot = 0.0283 m³.

For fire separation of incidental use, F95-16 changes threshold to “energy capacity” rather than physical characteristic such as gallons or pounds

- Proposed language: “Stationary storage battery systems having an energy capacity greater than the threshold quantity specified in Table 608.1 of the International Fire Code”
- Required fire separation: 1 hour in Group B, F, M, S and U occupancies; 2 hours in Group A, E, I and R occupancies



Proposal RB171-16 for Future 2018 IRC



RB171-16 by introduces Stationary Storage Battery Systems into the IRC for the first time

- Provides definition of Stationary Storage Battery Systems
- Requires listing to UL 9540 and adds UL 9540 as a referenced standard in the IRC
- “... shall not be installed within a dwelling unit” (but see “floor modification”)
- Includes provisions for ventilation and protection from vehicle impact
- Unlisted Battery 2nd Use (B2U) outdoors only

Modification to IRC Proposal RB171-16

RB171-16

Committee Action:

Approved as Modified

Modification:

R327.3 Installation. *Stationary storage battery systems shall be installed in accordance with the manufacturer's instructions and their listing, if applicable, and shall not be installed within the habitable space of a dwelling unit.*

Committee Reason: The modification limits the application to areas other than habitable spaces in dwelling units. This technology already exists and we need something to move it forward in a safe way.

- RB171-16: “... shall not be installed within a dwelling unit”
- Modification allows installation in non-habitable rooms such as laundry rooms or mud rooms – if listed for those locations
- Approved as Modified (AM) at Committee Action Hearings
- Public Comment (final) Hearings in October in Kansas City



Statewide and Local Adoptions

- Code adoption is by State Adoption or “Home Rule”
- Many states amend the model codes (for example, the 2015 IBC becomes the 2016 California Building Code)
- 2015 Codes and 2014 NEC will be in effect in most of U.S. by January 1, 2017;
- 2018 codes & 2017 NEC in effect by January 1, 2020
- As guidance for ESS is greatly improved, expect to see early adopters of these codes
- Early adoption could be by State adoption or local policy

Questions?

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Thank you for attending!

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