SAFETY COLLABORATIVE

SPECIAL BRIEFING PAPER
NOVEMBER 2018

ENERGY STORAGE SYSTEM SAFETY

Final Action on ESS-Related Proposed Changes to the 2018 ICC International Codes that will Make Up the 2021 I-Codes

Introduction

The goal of the DOE OE ESS Safety Roadmap[1] is to *foster confidence in the safety and reliability of energy storage systems* (ESSs). Three interrelated objectives support the realization of that goal: research, codes and standards, and communication/coordination. The objective focused on codes and standards is as follows:

> To apply research and development (R&D) to support efforts that are focused on ensuring that codes and standards are available to enable the safe implementation of ESSs in a comprehensive, non-discriminatory and science-based manner.
>
> The following activities support that objective and realization of the goal:
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> a. Review and assess codes and standards that affect the design, installation, and operation of ESSs.
>
> b. Identify gaps in knowledge that require research and analysis that can serve as a basis for criteria in those codes and standards.
>
> c. Identify areas in codes and standards that potentially need revision or enhancement and can benefit from activities conducted under R&D.
>
> d. Develop input for new or revisions to existing codes and standards through individual stakeholders, facilitated task forces, or through laboratory staff supporting these efforts.

The purpose of this special briefing paper is to support the above objective by providing information about current and upcoming efforts being conducted by U.S. standards and model code developing organizations, specifically code changes associated with the 2018 Group A International Codes (I-Codes) of the International Code Council (ICC) that are relevant to ESSs.

[1] https://www.sandia.gov/ess-ssl/publications/EnergyStorage_safetyroadmap_2017.pdf (PNNL-SA-126115 I SAND2017-5140 R)

Proposed changes to the I-Codes were posted by the ICC on February 28, 2018. Public hearings (committee action hearings) on those changes were held from April 15 to 25, 2018, in Columbus, Ohio. PNNL staff undertook a cursory review of the proposed changes (the code change monograph contained over 2500 pages), identified proposed changes that were relevant to ESSs and provided the results of that cursory review in a Special Briefing Paper in March 2018 (PNNL-SA-133206/SAND2018-2970R). Subsequent to the committee action hearings, PNNL updated the March 2018 Special Briefing Paper in April 2018 to report on the results of the committee action hearings.

The intent of the March 2018 Special Briefing Paper, and subsequent updates to that document, was to reduce the need for those interested in ESSs to review the entire monograph to find ESS-relevant changes, to allow them instead to focus on the assessment of the proposed changes, and, if desired, to participate in the ICC code development process.

The purpose of the April 2018 Special Briefing Paper was to report on the results of those public hearings with respect to the proposed changes identified as being related to energy storage systems. The purpose of the September Special Briefing Paper (PNNL-27897) was to summarize all public comments received on any of the code changes addressed in those prior briefing papers so interested parties will be aware of those public comments and can prepare to participate at the public comment hearings on October 24 to 29, 2018 in Richmond, VA should they choose to do so. This document reports on the final action on these code changes based on the results of the public comment hearings and consensus process conducted after the public comment hearings.

Information Relevant to ESS

The following table identifies and provides a brief synopsis of the ESS-relevant changes *(and where necessary a comment about why the change has been identified as being ESS-relevant),* the results from the April public hearings (note that none of the changes covered received a floor motion at those hearings) and an identification and synopsis of any public comments received to those ESS-relevant code changes.

The table also provides the final action on each of the identified code changes and any public comment(s) received on any code change. *Note that the final action reported is that from the public comment hearings on October 24 to 29, 2018. Those final actions are unofficial subject to online governmental consensus vote, validation of that vote by the validation committee and confirmation by the ICC Board of Directors.*

No attempt to analyze the code changes or public comments has been made nor have the authors indicated a position on any of the changes or public comments. More in-depth review and analysis of the changes, public comments and review of the final actions on each code change or public comment(s) is left to the reader.

Code Change Number	Public Comment Number	Summary of the Code Change/Public Comment	Committee Action Hearing Results April 2018	Final Action
FS26-18	No Public Comments were Submitted	Adds a new exception to code provisions applicable to exterior walls that serve as part of a required fire-resistance-rated separation for exterior walls required to be fire-resistance-rated per Section 1206 of the International Fire Code (IFC) for enclosing ESSs.	As Submitted	As Submitted
G8-18	No Public Comments were Submitted	Adds a new definition of “motor vehicle” to eliminate confusion about what types of vehicles are covered by code sections applying to motor vehicles *(changes related to vehicles MAY be relevant to ESSs where the vehicles are electric or have on board systems that can generate power)*.	Disapproved	Disapproved

G13-18	No Public Comments were Submitted	Proposed changes relate to parking garages and having all public garages meet Section 406.4 of the International Building Code (IBC) as well as Sections 406.5 or 406.6 when open or enclosed respectively; and then having private garages meet Section 406.3 *(changes related to garages MAY be relevant to ESSs where the vehicles are sources of building power).*	As Submitted	As Submitted
G16-18	No Public Comments were Submitted	Adds a new definition of liquid fuel or compressed gas motor vehicle for use in conjunction with parking garage classification as to use group *(classifying motor vehicles in this manner would appear to eliminate application of certain code provisions to electric vehicles, which, without this change, would continue to be considered motor vehicles).*	Disapproved	Disapproved
G17-18	No Public Comments were Submitted	Adds "ESS in dedicated use buildings" to the list of building types that are considered moderate-hazard factory industrial, Group F-1 buildings.	As Submitted	As Submitted
G24-18	No Public Comments were Submitted	Adds "electrical room" to the list of uses included in low-hazard storage Group S-2 occupancies.	Disapproved	Disapproved
G91-18		Adds a new footnote to certain incidental use rooms/areas for the purpose of separation and/or protection requirements. One such room/area is "electrical installations and transformers," which currently refers to selected sections of NFPA 70. The new footnote points to Chapter 6 of the IFC for additional construction requirements for those rooms/areas. Note that the table addresses rooms/areas with stationary storage battery systems but the new footnote is not applied to them.	Disapproved	As Submitted (based on approval of PC 1 below)
	PC 1	Public comment requests approval of the code change on the basis that the reference to Chapter 6 of the Fire Code is intended to be used with Section 509 of the Building Code and without the reference Chapter 6 of the Fire Code might be missed.		
G92-18	No Public Comments were Submitted	Deletes the stationary storage battery system room/area requirement from the table providing required separation and/or protection requirements (the reason is the anticipated revision of Section 1206 of the IFC covering ESSs that will include those separation and protection requirements).	As Submitted	As Submitted
G151-18		Adds a new Section 3114 to the IBC covering intermodal shipping containers that are repurposed for use as buildings or structures or as a part of a building or structure, but includes an exemption for stationary storage battery arrays located in such containers complying with Chapter 12 of the IFC. The modification does NOT impact the exception for stationary storage battery arrays located in such containers complying with Chapter 12 of the IFC	As Modified	As Modified (based on approval of PC 1 and 2 below)

	PC 1	Public comment requests approval of the code change with further modification relating to an exception for those supporting or housing experimental equipment. The modification does NOT impact the exception for stationary storage battery arrays located in such containers complying with Chapter 12 of the IFC		
	PC 2	Public comment requests approval of the code change with further modification. The modification does NOT impact the exception for stationary storage battery arrays located in such containers complying with Chapter 12 of the IFC		
S22-18	No Public Comments were Submitted	Adds new provisions to Chapter 17 about Special Inspections that electrical components, appliances, equipment, and systems governed by NFPA 70 must be inspected by an approved special inspector with expertise in NFPA 70 and electrical construction.	Disapproved	Disapproved
F3-18	No Public Comments were Submitted	Adds water as a component of certain battery types (lead acid and Ni-Cd) in the definition of those battery types.	As Submitted	As Submitted
F18-18		Adds a new section to the IFC to address storage of new or off-specification Li-ion batteries and also to include such storage areas as high-hazard Group H-2.	Disapproved	Disapproved
	PC 1	Public comment requests approval of the code change with further modification. The modifications address changes to address provisions in the initial code change proposal that could have an adverse impact on battery collection and recycling efforts.		
	PC 2	Public comment requests approval of the code change with further modification. The modifications provide a complete rewrite of the original code change proposal to address what the proponent of the public comment considers a broader scope than is needed to regulate every lithium ion and lithium metal battery collection location on the basis that it is unnecessary and not supported by fire loss data.		
	PC 3	Public comment requests disapproval of the code change on the basis that what is proposed is overly restrictive, not practical and not substantiated as necessary by data.		
F42-18	No Public Comments were Submitted	Adds Group F-1 and S-1 occupancies over 500K s.f. to those required to have a fire command center for fire department operations (see G24-18 that adds ESS dedicated use buildings to those considered Group F-1).	As Modified	As Modified
F59-18	No Public Comments were Submitted	Removes Section 601.2 of the IFC related to securing permits for battery systems (because those are in Chapter 12 of the IFC and are therefore a duplication).	As Submitted	As Submitted
F68-18	No Public Comments were Submitted	Requires that electrical equipment, wiring, and systems be installed, used, and maintained in accordance with NFPA 70 and provisions in Sections 604.2 through 604.11 of the IFC.	As Submitted	As Submitted

F137-18	No Public Comments were Submitted	Adds a new exception for normally unoccupied, stand-alone telecommunications structures less than 1.5k s.f. in gross floor area to Section 907.2.22, which requires an automatic smoke detection system in areas containing stationary battery systems.	Disapproved	Disapproved
F168-18	No Public Comments were Submitted	Adds a reference in Section 911.1 to NFPA 68 for deflagration venting and then adds a new special use for ESSs to Tables 414.5.1 and 911.1 listing explosion control requirements and a reference to Section 1206 where explosion control is required (for ESSs barricade construction is not required when deflagration venting or an explosion prevention system is required).	As Submitted	As Submitted
F190-18	N/A	Adds repair, commissioning, and decommissioning to the scope of Chapter 12 (energy systems used for generating or storing energy) and further refines how "the aggregate kWh of energy" in a fire area is determined by changing it to "the aggregate nameplate kWh of all ESSs" in a fire area for the purpose of determining the threshold quantity of an ESS in determining if and to what degree provisions in the IFC apply to the ESS.	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	
F191-18	No Public Comments were Submitted	Includes compliance with Section 604 of the IFC, which contains relevant provisions for electrical wiring and equipment used with energy systems.	As Submitted	As Submitted
F202-18	No Public Comments were Submitted	Adds an exception to Section 1205 covering stationary fuel cell power systems that would allow the temporary use of a fuel-cell-powered electric vehicle to power a Group R-3 or R-4 dwelling, while parked in an attached or detached garage when in conformance to the vehicle manufacturer's instructions and NFPA 70.	As Submitted	As Submitted
F203-18		Represents a complete comprehensive revision of the provisions in the IFC that cover ESSs (developed by the ICC FCAC's ESS work group).	As Modified	As Modified (based on approval of PC 9, 11, 15 and 17 below)
	PC 1	Public comment requests approval of the code change with further modification to require that while covered systems and equipment under the exclusive control are exempt from Chapter 12 of the IFC, any ESS under the exclusive control of an electric utility of lawfully designated agent must provide a level of safety equivalent to that in Section 1206 covering ESS.		
	PC 2	Public comment requests approval of the code change with further modification to increase the size and separation requirements to groups of electrochemical ESS from 50 kWh to 250 kWh.		
	PC 3	Public comment requests approval of the code change with further modification to increase the maximum allowable quantities of electrochemical ESS from 600 kWh to 1000 kWh.		

	PC 4	Public comment requests approval of the code change with further modification to increase the minimum required distance between remote outdoor ESS installations and buildings, lot lines, public ways, stored combustible materials, hazardous materials, high piled stock and other exposure hazards from 100 ft. to 50 ft.		
	PC 5	Public comment requests approval of the code change with further modification to the definition of mobile ESS.		
	PC 6	Public comment requests approval of the code change with further modification to change the title of the section form exhaust ventilation to ventilation.		
	PC 7	Public comment requests approval of the code change with further modification to delete the provisions for vegetation control around outdoor electrochemical ESS.		
	PC 8	Public comment requests approval of the code change with further modification to add that ESS do not include those used to propel rail or wheeled vehicles.		
	PC 9	Public comment requests approval of the code change with further modification to exclude bolt on HVAC and related equipment from the calculation of enclosure size in determining if an outdoor walk-in unit is to be considered an indoor installation.		
	PC 10	Public comment requests approval of the code change with further modification to eliminate the required 10 ft. separation between areas where motor vehicles can be parked and ESS on rooftops and in open parking garages.		
	PC 11	Public comment requests approval of the code change with further modification to eliminate the applicability of thermal runaway provisions to vented (flooded) lead acid batteries.		
	PC 12	Public comment requests approval of the code change with further modification to move the exemption for lead acid and nickel cadmium battery systems operating at less than 50 VAC and 60 VDC located in facilities under the exclusive control of a communication utility and that comply with NFPA 76 and the applicable requirements of the IFC from Section 1206.2.1 on commissioning to Section 1206.2 on commissioning, decommissioning and O&M.		
	PC 13	Public comment requests approval of the code change with further modification to eliminate the applicability of thermal runaway provisions to vented (flooded) nickel cadmium batteries.		
	PC 14	Public comment requests approval of the code change with further modification to the provisions for use of an electric vehicle as a source of power for a dwelling unit or sleeping unit to eliminate compliance with the vehicle manufacturer's instructions, leaving only compliance with NFPA 70.		

	PC 15	Public comment requests approval of the code change with further modification to eliminate UL 1973 as the reference standard to be used as a basis for listing new batteries, battery modules, capacitors and similar ESS components and simply require them to be listed.		
	PC 16	Public comment requests approval of the code change with further modification to exempt lead acid batteries that have flame retardant casings from the size and separation requirements in Section 1206.5.1.		
	PC 17	Public comment requests approval of the code change with further modification to specify that ESS must be listed to UL 9540 but those listed and labeled for utility or commercial use are not to be used in residential applications.		
	PC 18	Public comment requests approval of the code change as submitted on the basis that the code also needs to include a reference to the UL9540A test method.		
	PC 19	Public comment does not take a position on the code change and makes note that the UL 1974 standard referenced in the proposed code change must be completed prior to the public comment hearing.		
F204-18	N/A	Clarifies when construction and operational permits are required for stationary and mobile ESSs. Also exempts lead acid and Ni Cad battery systems less than 50 VAC/60 VDC under the exclusive control of a communications utility.	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	
F205-18	No Public Comments were Submitted	Eliminates the need for a permit to operate stationary storage battery system.	Disapproved	Disapproved
F206-18	N/A	Modifies provisions for ESSs (eliminates consideration of explosions in battery cabinets in occupied work centers when doing a Hazard Mitigation Analysis (HMA), when the fire code official is authorized to approve larger capacities and/or smaller array spacing by adding a reference to UL 9540 and adding an exception to required fire-extinguishing systems when the stationary storage battery system is in an unoccupied, non-combustible container located outdoors housing only ESS equipment).	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	
F207-18	N/A	Changes the reference standard for listing and labeling battery chargers from UL 1564 to UL 1741.	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	

F208-18	No Public Comments were Submitted	Adds an exemption from required smoke detection systems in rooms containing stationary storage battery systems for lead acid and Ni Cad battery systems less than 50 VAC/60 VDC under the exclusive control of a communications utility.	Disapproved	Disapproved
F209-18		Adds additional detail for spill control and neutralization of electrolyte or other hazardous material spills in areas containing stationary storage battery systems. It is specifically for free-flowing electrolytes, making the provision applicable when individual vessels exceed a 55 g capacity or the aggregate capacity is over 1 kg, A spill from the largest individual cell or block would be required to be neutralized to between 5.0 and 9.0 pH.	Disapproved	As Modified (based on approval of PC 1 below)
	PC 1	Public comment requests approval of the code change with modification. The modification is to modify the scope of the spill control and neutralization provisions as they apply to communications utilities to an aggregate over 1000 gallons for lead acid and nickel cadmium battery systems operating at less than 50 VAC and 60 VDC located in facilities under the exclusive control of a communication utility and that comply with NFPA 76 and the applicable requirements of the IFC.		
F210-18	N/A	Adds a new Section 1206.4 that provides criteria for the installation of ESSs on the outside of exterior walls of a building. Also adds a new section to include provisions for a full-scale fire test of ESS in accordance with UL 9540A and including criteria for how the test is to be conducted, witnessed, and reported.	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	
F211-18	N/A	Adds a new section to include provisions for a full-scale fire test of ESSs in accordance with UL 9540A and including criteria for how the test is to be conducted, witnessed, and reported *(appears to be identical to that proposed in F210-18).* Also provides an exemption for ESSs in Group R-3 and R-4 occupancies when they comply with a proposed new section that provides criteria specific to ESS safety in these building types.	Withdrawn – *Since the code change proposal was withdrawn at the committee action hearings in April it is no longer being considered for the 2021 IFC.*	
F249-18	No Public Comments were Submitted	Covers batteries in Chapter 31 relative to their use in conjunction with tents, air-supported structures, and temporary special event structures. The IFC currently requires them to be disconnected in an approved manner and the proposed change would modify the text to require disconnection unless the fire code official requires the batteries to remain connected to maintain safety features.	As Submitted	As Submitted
F251-18	No Public Comments were Submitted	Adds Li-ion batteries as a product in the commodity classifications table (3203.8) and includes a classification of those batteries as high-hazard.	As Submitted	As Submitted

References

1. *Public Comment Agenda,* International Code Council, August 31, 2018 https://www.iccsafe.org/codes-tech-support/codes/code-development/current-code-development-cycle/
2. *Public Comment Hearing Results, International Code Council,* November 14, 2018 https://www.iccsafe.org/wp-content/uploads/2018-Public-Comment-Hearing-Results-Pre-OGCV-compressed.pdf

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