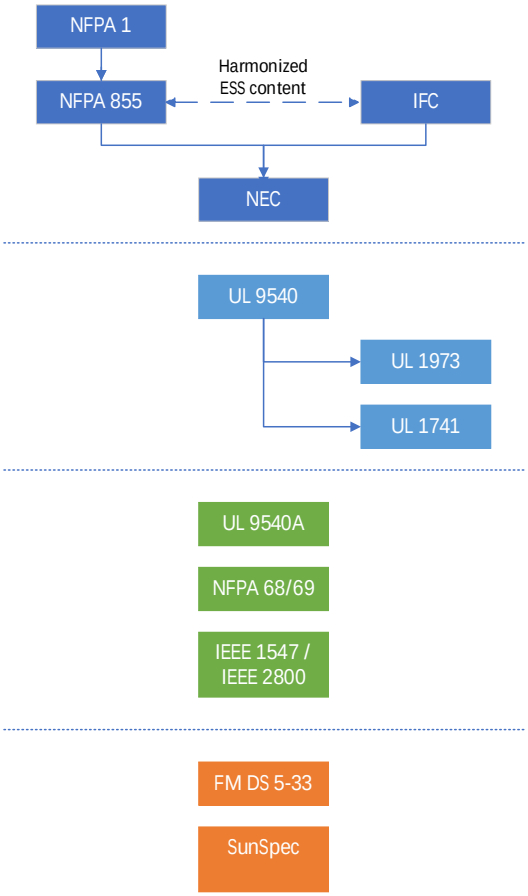
This document provides an overview of current codes and standards (C+S) applicable to U.S. installations of utility-scale battery energy storage systems. This overview highlights the most impactful documents and is not intended to be exhaustive. Many of these C+S mandate compliance with other standards not listed here, so the reader is cautioned not to use this document as a guideline for product compliance.

This guide provides a graphic to show the hierarchy and groupings of these C+S, followed by short descriptions of each. Annex 1 summarizes some significant changes in the 2023 edition of one of the most important standards, NFPA 855, and Annex 2 provides a more detailed bibliography of the featured documents.

The following figure covers the main C+S and groups them by their applicability.



No explosion hazard

Acceptable level of heating in the accessible means of egress

UL 9540A testing is required if: group (unit) energy exceeds 50 kWh; separation between groups is less than 3 ft (0.9 m); or stored energy exceeds the maximum value in Table 9.4.1 of NFPA 855 (600 kWh for lithium-ion). These deviations from the standard are subject to approval by the authority having jurisdiction (AHJ).

Section 9.6.5.6.3 of NFPA 855 requires design provisions for either explosion prevention in compliance with [B9] or explosion management according to [B8]. NFPA 69 compliance requires that the concentration of flammable gas generated from battery failure be maintained below 25% of the lower flammable limit (LFL), typically via system ventilation. NFPA 68 compliance requires a potential deflagration of battery gases to be managed via explosion venting panels or specially engineered system doors to maintain potential overpressures at safe levels. While NFPA 855 requires compliance with either NFPA 68 *or* NFPA 69, these standards are not mutually exclusive and battery systems may be designed to meet both standards.

Interconnection standards have been published by IEEE, with [B5] applying to ESS connected at transmission and sub-transmission levels, and [B3] for distributed energy resources (DER). IEEE recently published a new guide, [B4] for using IEEE Std 1547 with energy storage DER.

FM Global published its [B2] on lithium-ion ESS in 2017. Them0 g0 G[( )] TJETQq0.00000912 0 612 792 reW*n

This commentary is not intended to cover all changes in the 2023 revision of NFPA 855 but to highlight some changes that are likely to impact ESS designs and interactions between developers, integrators, and AHJs.

: While the 2023 document cannot generally be applied retroactively to existing installations, it allows an AHJ to request a hazard mitigation analysis for existing installations that are not UL 9540 listed, and to retroactively apply any portions of the new standard 'deemed appropriate to mitigate any hazards' identified as unacceptable. (See 1.4.2, 4.4.1, A.1.4.2)

Details on firewalls, fire suppression, smoke or fire detection, gas detection, thermal management, ventilation, exhaust, and deflagration venting systems, if provided, are to be submitted to the AHJ for approval (see 4.2.1.1).

Fire and explosion testing data are to be provided where required (see 4.2.1.3).

There is a catch-all provision that empowers an AHJ to request a Hazard Mitigation Analysis 'to address a potential hazard … that is not addressed by existing requirements' (see 4.4.1).

The device that manages charging and discharging within safe limits during normal operation (normally the BMS but could be the Energy Storage Management System) must be evaluated as part of the listing of the ESS (see 9.6.5.5. A.9.6.5.5)

Chapter 14 previously covered storage areas for ‘used or off-specification’ batteries, and now covers ‘lithium metal or lithium-ion’ units, whether new or used. Areas are exempt if cells are <30% SOC. There may also be an exemption for areas with factory-assembled enclosures, although the text is unclear: ‘Areas where new or refurbished batteries are installed for use in the devices, equipment, or vehicles they are designed to power.’