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Energy Storage Codes and Standards for Decisionmakers

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Devyn W. Powell
Jeremy B. Twitchell
Prathit B. Dave

2026 OE Energy Storage Program Peer Review

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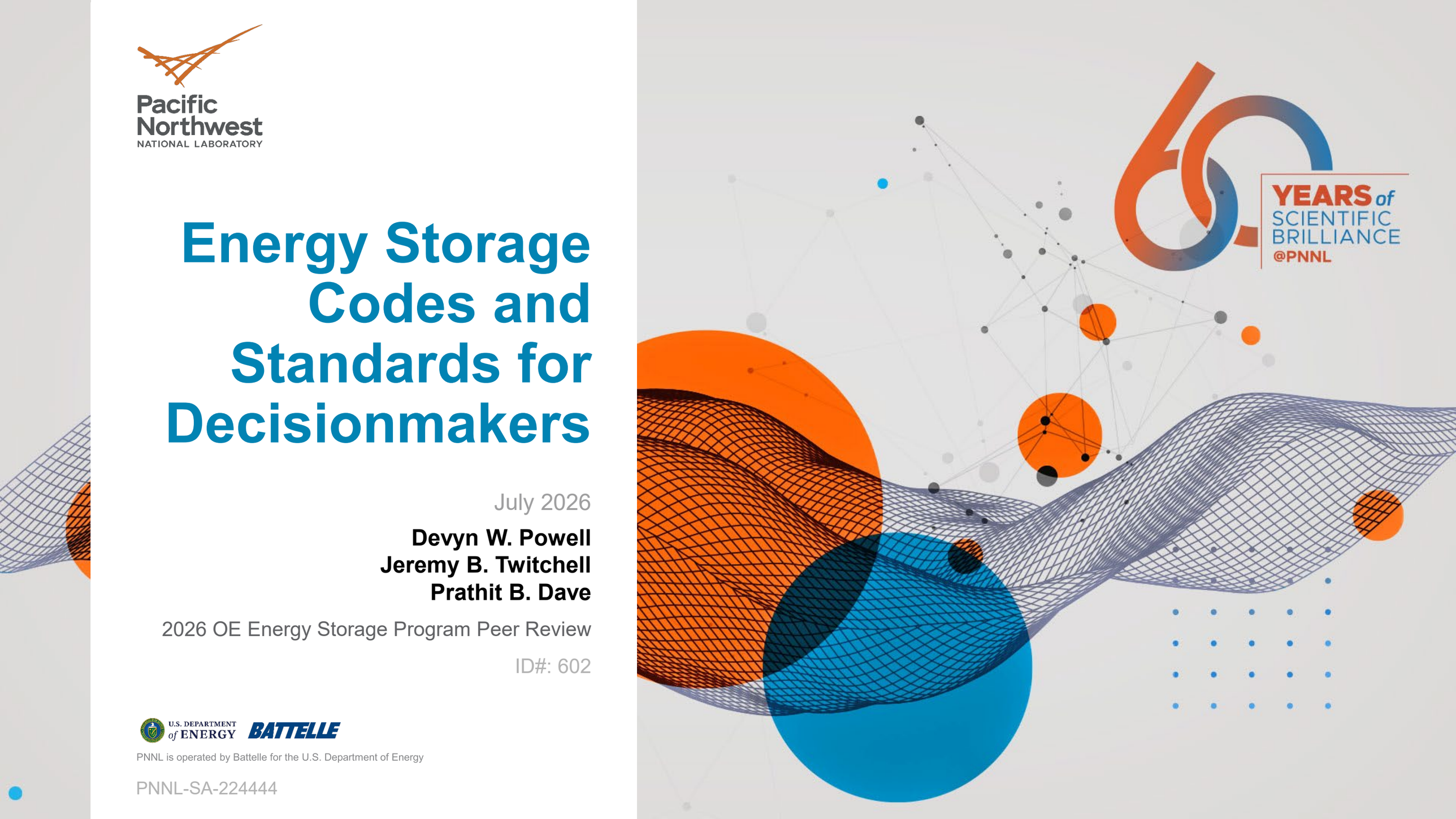

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Agenda

- Project overview
- Context: why do codes and standards matter for regulators and the public?
- Key codes and standards for battery storage and impact areas for decisionmakers
- Code update challenges and strategies
- Q&A

Project Overview

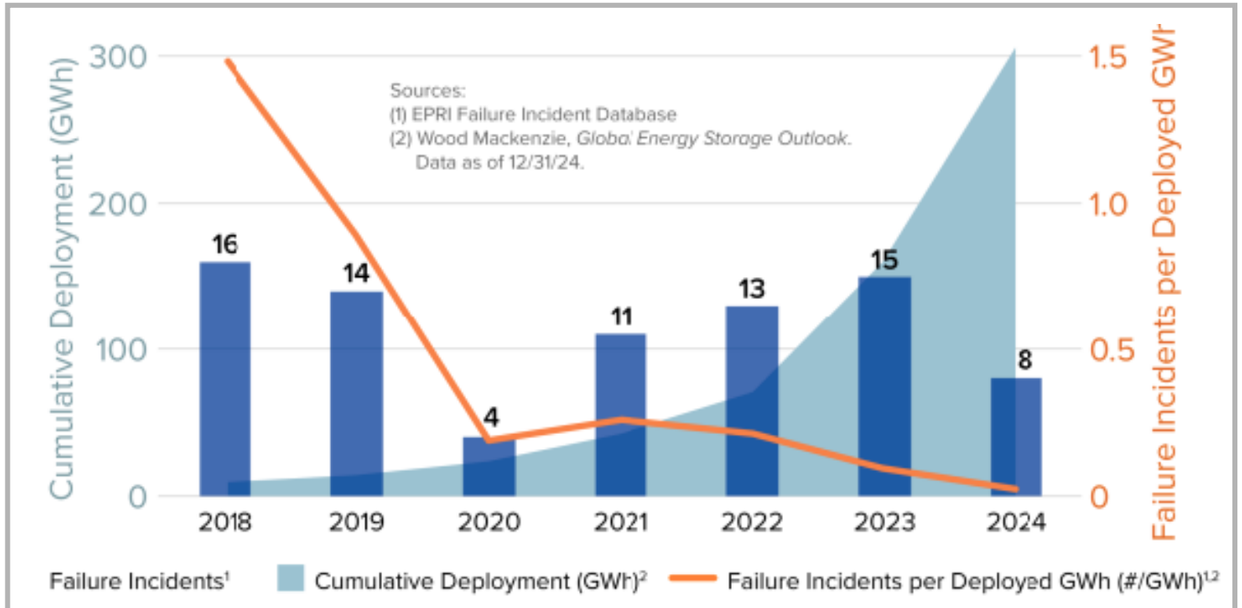
- **Goal:** Offer accessible resources that explain the value of key codes and standards in ensuring safer energy storage deployment and strategies for encoding updated versions to state and local regulators and policymakers.
- **Current Practice:** Understanding by non-technical audiences of key codes and standards related to battery safety is limited. Many states and local authorities having jurisdiction over project permitting (AHJs) lag in adoption of current best practices. These gaps impact safety and local trust.
- **Why PNNL:** PNNL has proven expertise in energy storage regulation and has built relationships with state and local policymakers. Drawing from a body of publications, technical assistance offerings, and key partnerships, the lab is regarded as a trusted source of technical knowledge on energy storage topics with skills at effective communication for a wide range of audiences by decision-makers regionally and nationwide.
- **Innovation:** Work on energy storage siting, permitting, and safety has not focused on the role of codes and standards in deliverables aimed toward AHJs and other non-technical audiences. This work addresses an information gap.

Project Overview

- **Duration:** FY 2025-2026, built on programmatic efforts from previous fiscal years.
- **Impact**: Enabling non-technical stakeholders (AHJs, members of the public) to understand key aspects of BESS codes and standards and strategies to efficiently adopt current versions can help address local safety concerns and ensure current expertise is embedded in relevant regulations and policy.
- **Vertical/Investment Area:** Safety and Reliability
- **Alignment/Supports strategic pathways:** Grow grid capacity by addressing siting and permitting barriers to deploying energy storage to meet grid needs; optimize processes for siting and permitting by providing valuable resources to support key decisionmakers navigate complex considerations around an emerging set of technologies.

Why has Energy Storage Gotten Safer as Deployment has Increased? Codes and Standards.

- Key lessons from major incidents are incorporated into codes and standards updates and industry best practices. The result: **safer grid-scale batteries.**
- However, moratoria enacted by AHJs and concerns from members of the public have risen even as incident rates have **declined.**
- Socializing understanding of how **codes and standards lead to improved safety outcomes** can help address concerns and uncertainties, leading to better project outcomes.



BESS failures per GWh of deployed capacity worldwide have dropped dramatically in just a few years. (Source: EPRI)

150+ Local Governments Have Moved to Block Battery Storage Development, New Database Reveals

U.S. NEWS

Fears of massive battery fires spark local opposition to energy storage projects

AES pulls out of San Diego area battery project after local opposition

Public sentiment does not reflect safety improvements.

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Case Study: Why Codes and Standards Matter for Safety

- Codes and standards do not eliminate the risk of thermal runaway
- Codes and standards reduce the risk of thermal runaway and its severity

Impact of Codes and Standards: A Tale of Two Failure Events

Moss Landing, California, is the site of three separate energy storge projects that, collectively, formed the largest energy storage site in the world at 750 MW/3,000 MWh. One project was designed and built **before** NFPA 855 and UL9540A were published and another was built **after** their publication. Both projects have experienced major thermal runaway events, but the intensity and outcomes of those events were different.

Pacific Gas & Electric

LA Times

Fire contained: September 2022

Project Description: 182.5 MW/730 MWh consisting of 128 individual, cabinet-style containers (Tesla Megapacks) **built subject to NFPA 855 and UL9540A**.

- On Sept. 22, 2022, water penetration into one of the cabinets caused a fire
- The fire was contained to the unit, which burned for six hours and then emitted smoke for 12 more hours
- First responders assumed a defensive perimeter, but did not actively engage the fire
- The lost unit accounted for about 0.5% of the facility's capacity
- The project returned to service about three months after the fire

Destructive fire: January 2025

Project Description: 300 MW/1200 MWh consisting of racks of batteries housed in the former powerhouse of a retired power plant **that were built prior to NFPA 855 and UL9540A**.

- On Jan. 16, 2025, a thermal runaway event spread through the full project
- The cause remains under investigation
- The fire burned for two days and then briefly reignited about a month later
- The project will be a complete loss, while ash and debris damaged neighboring BESS projects and kept them offline for months
- Metal fragments from the fire have been detected miles away from the facility

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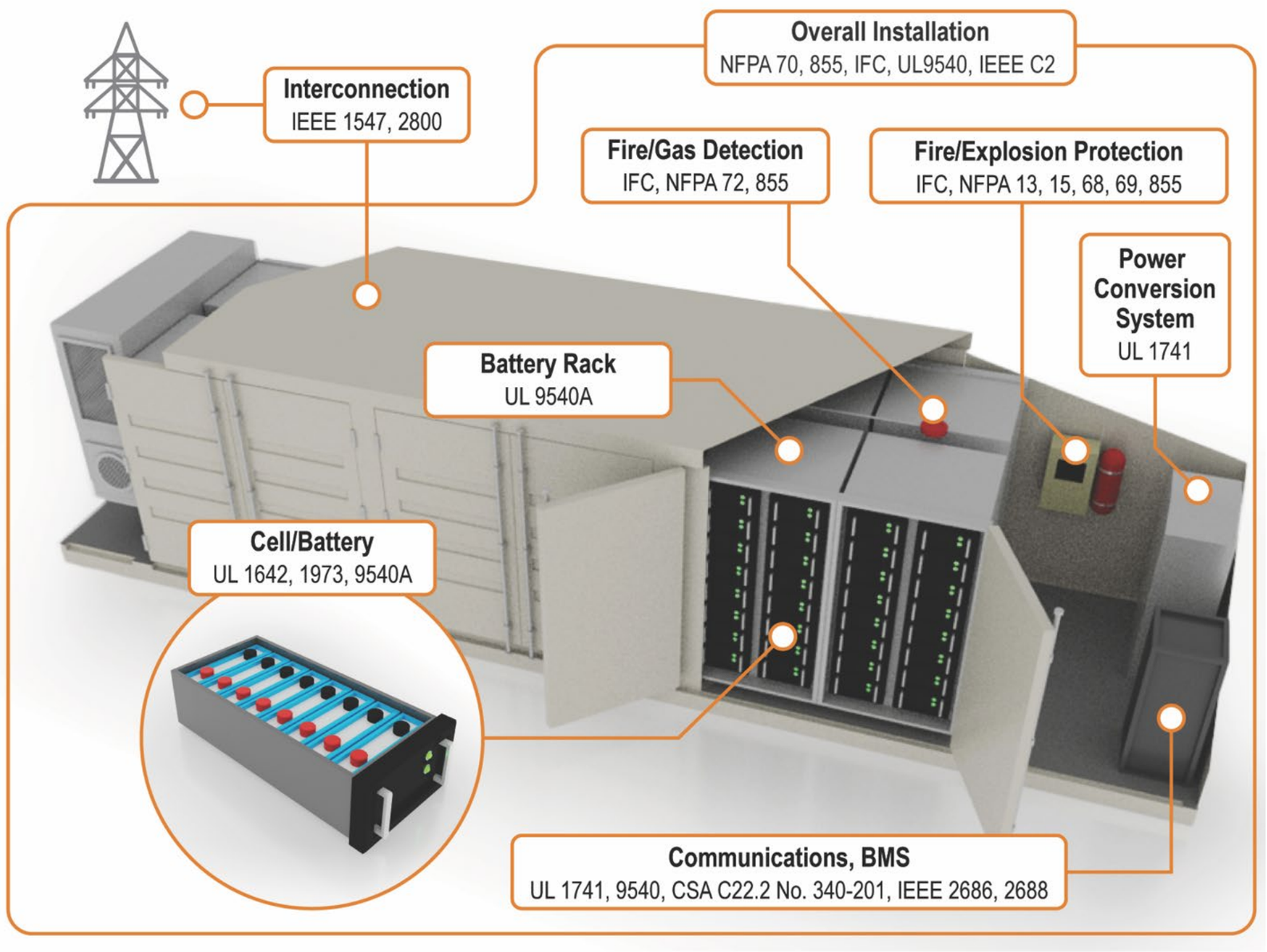
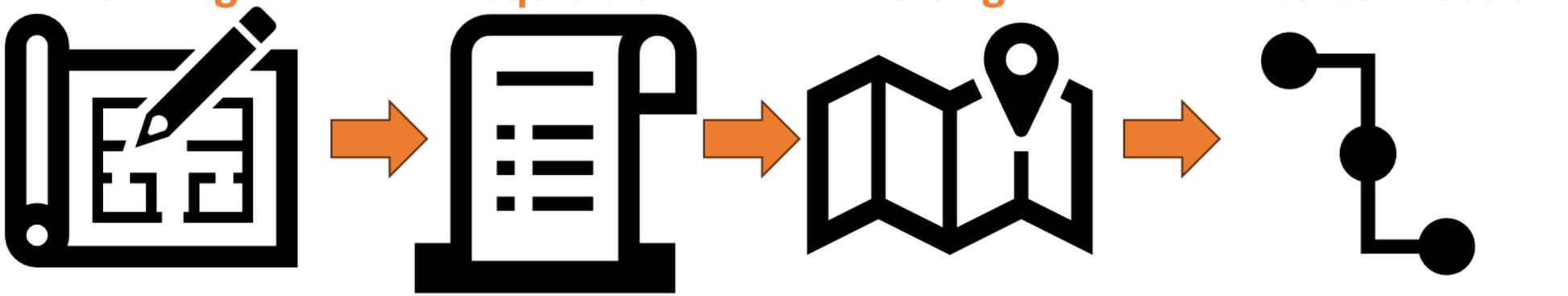
There are many battery storage safety standards

- If you are designing a system, you need extensive knowledge of them all
- But if your role is to review or approve a project (such as regulator, local zoning official, or member of the public), a working knowledge of a few key standards is sufficient



Storage Deployments Involve Many Stakeholders (And Many Codes and Standards)



UL 9540 & 9540A

- Plan review
- Planning input and comments
- Investment review and approval

NFPA 855

- Certificate of Public Convenience and Necessity
- Permitting
- Project review
- Ordinance drafting
- Project review and input

IEEE 1547 & 2800

- Approval of interconnection processes

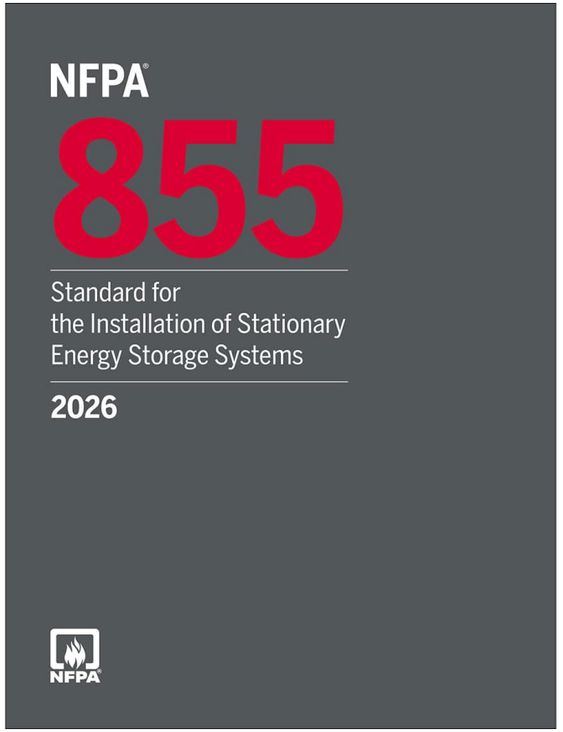
Key
- Relevant codes and standards
- Regulatory role
- Local jurisdiction role
- Public Role

Key codes and standards: Implications for Siting and Permitting Stakeholders

	Implications for:		
Code/Standard	**Regulators**	**AHJs**	**Public**
UL 9540/9540A	• Is the utility modeling UL-compliant technologies?	• How did the proposed technology perform in UL9540A testing? • How did the UL9540A test outcome inform the design of this project?	• Will a thermal runaway event require shelter-in-place or evacuation orders?
NFPA 855	• Should local engagement requirements be attached to approvals?	• What is the emergency plan for a proposed project? What training has been provided? • What is the decommissioning plan for the project? • Would a decommissioning bond be appropriate?	• What is your thermal management strategy? • How will you mitigate facility noise?
IEEE 1547/2800	• Do regulations and utility tariffs reflect best practices for safe, reliable interconnection?	• Where does the project stand in the utility's interconnection process? • How long is project commissioning expected to take?	• What will traffic and noise be like during the commissioning process? How long will it last?

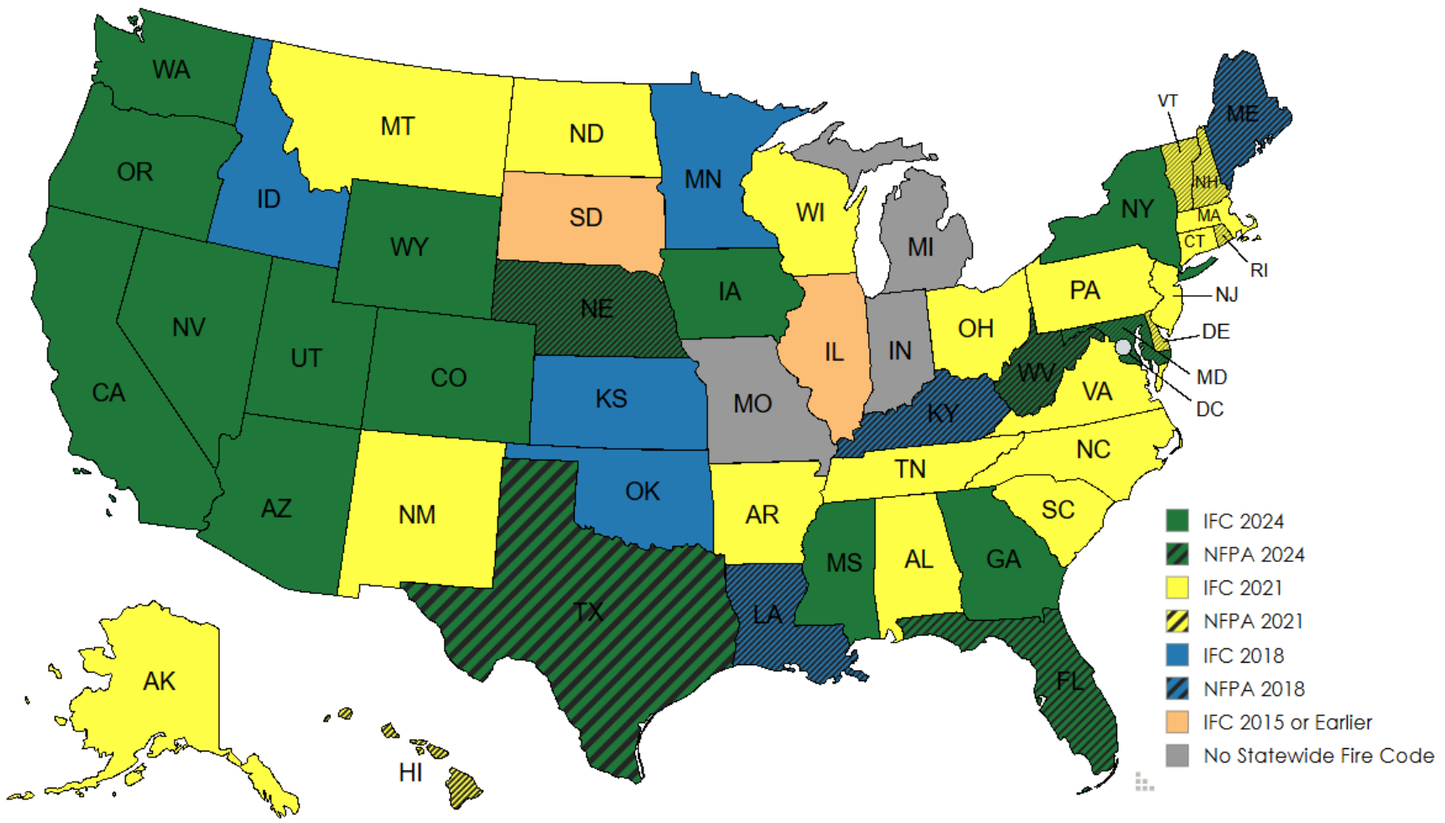
NFPA 855: Why it Matters for AHJs and the Public

- NFPA 855 establishes guidelines to ensure that energy storage systems across battery types are installed, operated, maintained, and decommissioned safely.
- Some key elements:
  - Siting best practices, including distance from equipment and buildings, signage, ventilation
  - Fire resistance, suppression, and testing (large-scale fire testing is mandatory in 2026 edition)
  - Safe electrical wiring
  - Operations & maintenance guidelines
  - Decommissioning plans and end of life guidance
- **Notable 2026 addition: required emergency response must be developed in coordination with and submitted to local AHJ.**
  - This requirement improves stakeholder collaboration and contributes to first responder readiness.
- Common concerns from the public: fire safety, local engagement, pollution and other local impacts, end of life
- Adoption of current version of NFPA 855 can offer reassurance to AHJs, members of the public, and first responders that projects are built, tested, and maintained in accordance with safety best practices.



Code Update Challenges

- Fire code updates are time-consuming and expensive, and many states are one or more cycles behind as a result.
- *Example:* IFC Chapter 12 on Energy Systems, including energy storage, was added in 2018 and updated in 2021. The 2024 edition mandates compliance with NFPA 855.
- For a dynamically evolving code like NFPA 855, using an older version means your jurisdiction is not using current safety best practices.



Code Update Processes

- States vary in how, and how often, they update fire and building codes.
- Some states devolve fire code authority to local jurisdictions and do not have state-level code adoption. Others allow local jurisdictions to amend or modify state codes.
- Update processes often involve many stakeholders, committees, extensive review to determine impacts to public and industry, needed amendments, etc.
- Updating codes and complying with updates can impose costs on taxpayers and businesses.

Code Update Strategies

- **Authority Vested in State Agency:** Allows agency to more nimbly adopt new versions of the codes through simple rulemakings
  - Michigan (Public Service Commission), Indiana (Department of Homeland Security)
- **Emergency Temporary Rule:** Places new battery standards in effect until full code update process is completed
  - Washington: “emergency” adoption of 2023 NFPA 855 despite delays in full process
- **Supplemental Code Cycle:** Enables timely adoption of codes and standards on different cycles (such as IFC and NFPA)
  - California: midpoint code updates allowed between three-year cycles
- **Adoption by Reference:** Places most current version of code in state statute, removing the need for updating each cycle
  - Nevada: law requires compliance with “most recently published version” of NFPA 855, automating updates

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Summary

- Codes and standards provide a framework for managing the safety risks of energy storage.
- Socializing the benefits of codes and standards with regulators, local jurisdictions, and the public is critically important in providing a stable permitting environment for energy storage.
- For technologies evolving as quickly as battery energy storage, using updated versions of codes and standards is critical to ensure adoption of best practices for safety and reliability.
- Code updates can involve extensive processes, and many states lag behind. Some states offer models of innovative strategies to enable faster updates.

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Thank you

Devyn Powell
devyn.powell@pnnl.gov
(509) 375-6543