THE ESS SAFETY CODES ROAD MAP –

How Complex is the Way?

Presented by:
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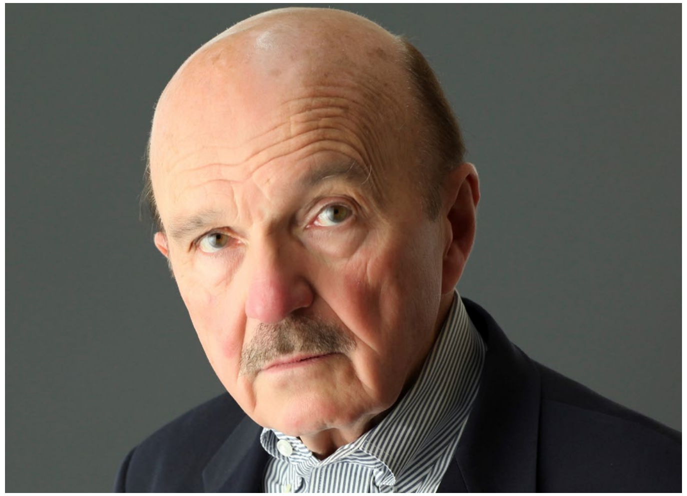
Let Me Introduce Myself

- 40+ year Veteran in Vdc Power and Stationary Battery Industry.
- Chair Emeritus of IEEE PES Energy Storage and Stationary Battery (ESSB) Committee
- Recent Co-Chair of the IEEE ESSB Safety Codes and Standards Working Group and IEEE IAS/PES Joint Technical Codes Council (JTCC) Co-Chair.
- Inducted into the Battcon Hall of Fame in 2016
- Active member of NFPA 855 2026 Committee
- Active member of NFPA 70 CMP 13 2026 Committee
- Active participant in the ICC BESS Ad Hoc Committee
- Advisory Consultant to Sandia National Laboratories



Christopher (Chris) Searles

A Series of Presentations that Explain Current Safety Codes and Standards for Energy Storage Systems (ESS)

- Presentation 1: *The ESS Safety Codes Road Map* – an overview of the ESS safety environment and the Bellwether ESS Safety Standard (NFPA 855) guiding ESS installations.
- *Other Presentations that can be provided: These sessions would be virtual unless contracted otherwise. Intended for interested parties that desire a basic overview of the relative safety standards affecting energy storage systems.*
- Presentation 2: *An Extensive Look into Fire Protection Standards* – a much more detailed look into the various National and some regional fire codes (NFPA 1, IFC, NYFD, CA) and their relationship to NFPA 855.
- Presentation 3: *A Further Look into the Electrical Codes* – an examination of the National Electrical Code (NFPA 70) and it's ancillary standards NFPA 70B and NFPA 70E plus the National Electrical Safety Code (NESC) and the CSA Electrical Code and their effect on ESS.
- Presentation 4: *A Closer Look into the Building Codes* – the history of the IBC and its comparison to NFPA 5000 vis a vis the fire codes and how they relate to ESS.
- Presentation 5: *A Serious Look into Applications and Markets* – an examination of the various ESS applications – grid-scale vs. BTM and REN Energy, market differences between utility grid-scale, commercial/industrial Microgrid and Residential – safety codes and reliability comparisons.

Note: These presentations are under development. Contact CGSandAssociates for more information.

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All Energy Sources have Associated Risk

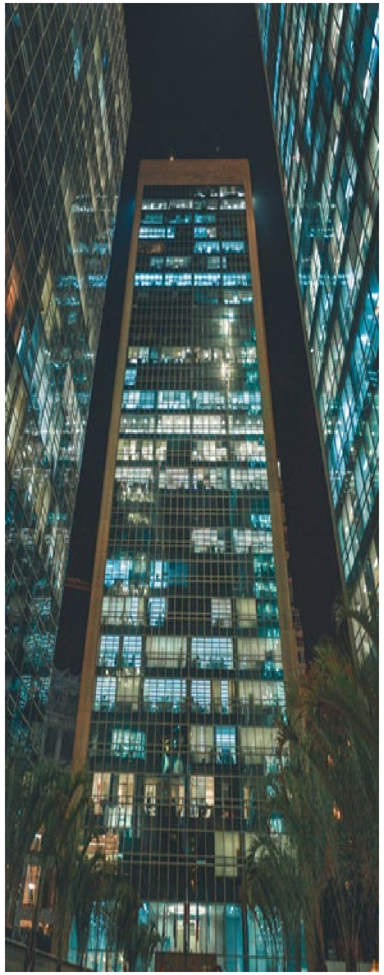
- *In 2023, there were 210,500 highway vehicle fires reported in the United States which caused property damage worth of 1.9 billion U.S. dollars.* NFPA: A Fire Loss Report, 2024

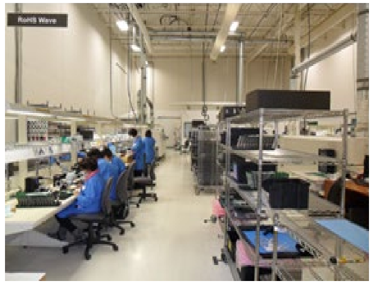
- *"Heating equipment is the number one cause of household fires in the US. It is estimated that 333,000 residential fires are caused by space heaters every year."* Housegrail, February 2024

  Note: Conforms closely to NFPA report on average number of house fires with corresponding deaths.

- *"Fire departments in New York City and San Francisco report handling more than 660 fires involving lithium-ion batteries since 2019. In New York City, these fires caused 12 deaths and more than 260 injuries from 2021 through early 2023.* The Conversation, September 2023

General Categories of Current Safety Codes and Standards





- **Fire Protection and Safety**
  - Includes fire suppression
  - Includes explosion control
- **Occupational risks and hazards**
  - Includes worker safety
  - Includes workplace safety
- **Design & Materials Safety**
  - Components are safe and products are reliable
  - Inspection, Testing & Maintenance (ITM) Requirements & Audits
- **Building & Environmental safety**
  - Infrastructure and Buildings
  - Transportation over highways and by air

An Anomaly With a Safety Standard

A Major Accident with Fatalities Occurred

A Safety Action Resulted from the Tragic Event

And so, it is with Safety Standards . . . .
more often it is a reactive result than a proactive action.

For Battery Energy Storage Systems (BESS), #1 Issue –

Should be . . . .

SAFETY

Tesla Battery Fires, Washington, resulting from a highway accident

2019 A fire in an ESS in Surprise, AZ leads to an explosion injuring first responders

2013 Storage Battery Fire, The Landing Mall, Port Angeles, (reignited one week after being "extinguished")

2011 NGK Na/S Battery Explosion, Japan (two weeks to extinguish blaze)

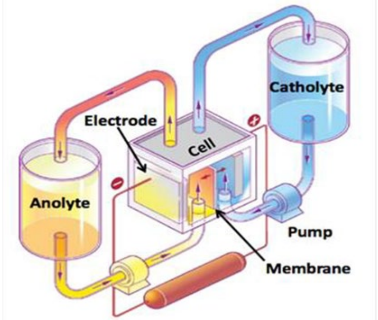
2018-2019 A string of 21 energy storage system fires in South Korea leads to suspension of new projects

Photos, Courtesy of Sandia National Laboratories

Current & Future Focus for ESS Safety Codes R&D

- **Li-ion batteries have been the focus for most R&D efforts until recently.**
  - ✓ Lead-acid/Ni-cd safety issues largely addressed and proven basically safe.
  - ✓ Safer Li vis a vis materials and electrolyte improvements
  - ✓ Safety issues for EV and large utility-scale BESS just beginning to be addressed – including V2G and G2V.

- **Newer technologies introduced** (e.g., Flow batteries, Li-Metal, Sodium-ion, Zinc, Hydrogen Fuel Cells, etc.) pose different sets of concerns.



Redox Flow Battery

- Large long-duration storage systems (LDES) targeting non-traditional locations.
  - ✓ Required in high population dense areas – LDES systems are much more complex.
  - ✓ Includes large battery systems with sophisticated high-power electronics (IBR/DER).

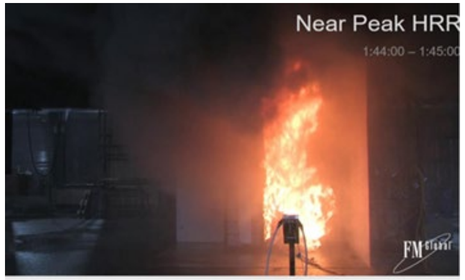
- Questions needing answers :
  - ✓ Can we identify safety issues ahead of the experience curve?
  - ✓ Is full-scale system-level testing necessary instead of current cell/unit level testing?
  - ✓ How do we get SDO's, Regulatory bodies and AHJ's to fast-track codes and standards to validate new technologies while ensuring their integrity?


SAFT 10 MWh storage system

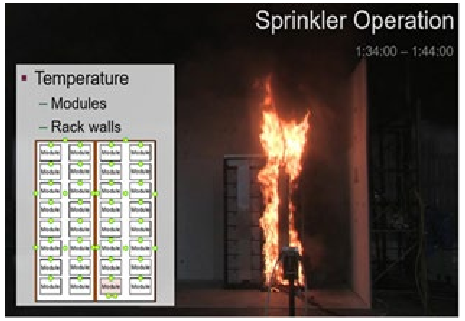
Unfortunately, we can't answer everything today, but let's transition to what safety codes can provide today!

Behind Recent Fire Codes Battery Safety Changes

1. Advancing safety measures against fire and explosions due to a rash of incidents in many parts of the world in the last several years (especially but not exclusively w/Lithium-ion).



2. New applications such as DER, micro-grids, V2G.
   - ✓ Density of energy storage in residential homes, community commercial complexes and high-rise buildings.
   - ✓ Islanding (both standalone and grid-connected)
   - ✓ Utility interconnected (parallel ESS/Bulk Power systems serving common loads)



3. First Responder Safety

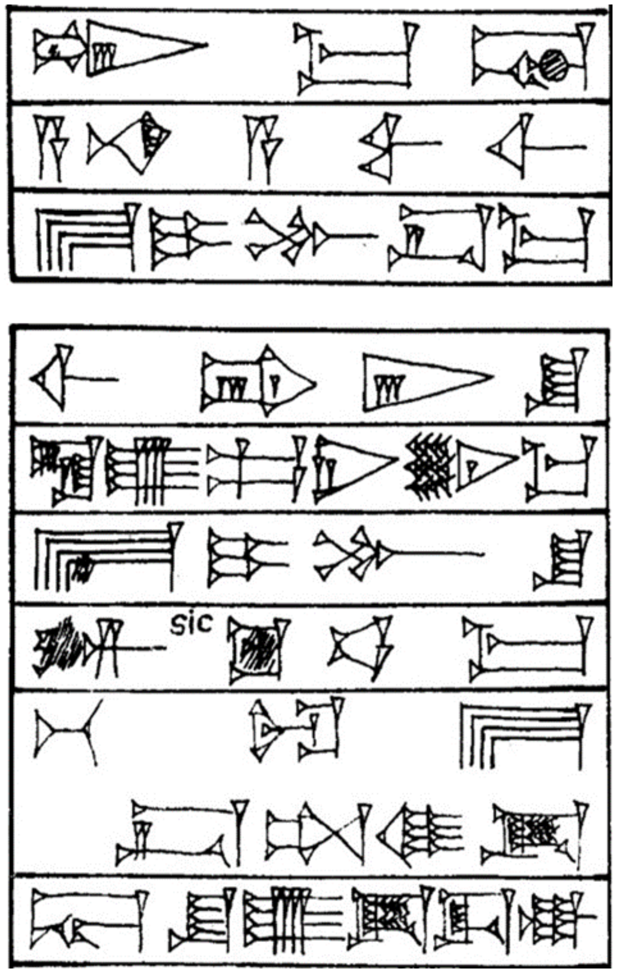
ORIGINS OF [BUILDING] SAFETY CODES

§ 229

Law § 229 of Hammurabi's Code

If a house builder built a house for a man but did not secure/fortify his work so that the house he built collapsed and caused the death of the house owner, that house builder will be executed..

One of 282 laws developed to govern that Babylonian society in the 18th Century BC.

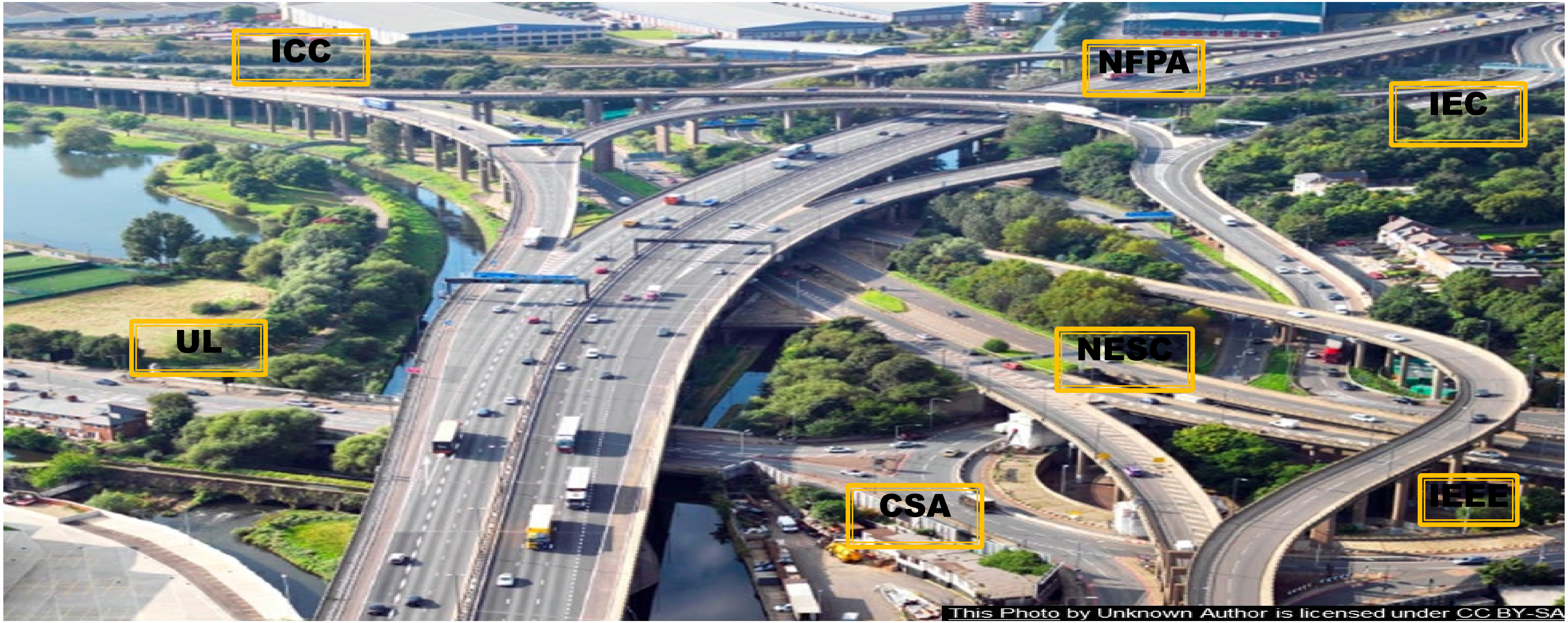


ORIGINS OF [FIRE] SAFETY CODES

The Great Fire of Rome in 64 AD

- Common history of fires destroying major edifices prior to 64 AD.
- The water supply into Rome came via nine (9) aqueducts and a license fee required to use.
- Firefighters relied on blankets, buckets of water, vinegar and "let it burn" demolition of buildings to extinguish a fire.
- Varying historical accounts on how the fire began and the extent of Nero's involvement.
- Resulted in new rules for fire safety.

WHICH CODES/STANDARDS ROADS SHOULD I FOLLOW?



ALL OF THE ABOVE – REALLY ?? ***Answer: They all are Important in Individual Contexts***

WHICH CODES/STANDARDS ROADS SHOULD I FOLLOW?

Oh, Did I Forget to Mention . . . .

FERC

DOT

OSHA

NERC

NHTSA

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SAE

FM GLOBAL

OTHERS

ESS SAFETY CODES & STANDARDS

- Safety Codes and Standards have become increasingly important to the stationary battery community.
- Let's define the difference between a Safety Code and a Safety Standard.
  - "Code: A code is a model, a set of rules that knowledgeable people recommend for others to follow. It is not a law although "it can be adopted into law." [the *'what'*]
  - "Standard: A standard tends to be a more detailed elaboration, i.e. "the nuts and bolts of meeting a code." [the *'how'*]

from NFPA - Reporter's Guide: About codes and standards

How Codes (and Standards) Get Administered

Safety (Model) Code

- **NFPA 1**
- **IFC**

Let's use for example the two most well-known codes that employ chapters dealing with Energy Storage Systems:

- ***NFPA 1 Fire Code*** **– Chapter 52**
- **ICC *International Fire Code* – Chapter 1207**

How Codes (and Standards) Get Administered

Safety (Model) Code
- **NFPA 1**
- **IFC**

References a Standard
- **NFPA 855**

A standard (or group of standards) become part of the code when referenced as such in the Code, e.g. *NFPA 1 2024, Chapter 2, Referenced Publications.*

Note[1]: These are different from References noted in the Bibliography [Annex F – Informational References of NFPA 855 2026]

Note[2]: There are 25 NFPA standards. 13 UL standards, 25 other standards referenced in NFPA 855: Section 2.2 and 91 UL standards plus 8 CAN/ULC standards in NFPA 1 2024. By contrast there are 21 other codes or standards and 11 UL standards or publications in Chapter 2 of 855 2023, including UL 9540 and 9540A.

How Codes (and Standards) Get Administered

Safety (Model) Code
- **NFPA 1**
- **IFC**

References a Standard
- **NFPA 855**

AHJ or Regulatory Agency Adopts

A Code (or standard) is only enforceable when adopted by the AHJ or Regulatory Agency!

Map Showing Code Alliances

Adding Layers of Complexity

1. All states do not follow the same revision level.
2. Many cities have their own code.
3. Some adopt only a portion or limited sections of the IFC or NFPA codes

The New Mix of Pb, Li, Ni, Zn, Flow, Na, Other BESS . . . .

- The traditional technologies now face increased concerns with various stakeholders . . . . along with the newer emerging technologies and new application areas – Key areas of concern include:

- Thermal Runaway vs. Thermal Walkaway
- Gas Detection & Ventilation
- Various Minimum Threshold requirements
- Physical Separation Requirements
- Building/Container Restrictions (internal/external/setbacks)
- Energy Management System Criteria (Including BMS and ESMS requirements)
- Operational Permitting
- Effective Hazard Mitigation Analysis
- Proper Equipment Listing/Certification

Note: Includes 1 and 2 family dwellings.

Summary of Current Battery Hazards . . . .

Electrical

- Shock – Current passing through the body.
- Arc Flash/Blast – Current passing through the air.
- Thermal Burn – Inadvertent skin contact with hot conductive metals including uninsulated tools.

Mechanical

- Batteries can be very heavy.
- Lifting/hosting/moving batteries can create pinch/crush/cutting forces that can lead to an accident or defective malfunction.

The biggest safety concern with Li-Ion (and NaS) is thermal runaway fire hazard as it may be to the uninitiated the least well understood and most difficult to control.

Fire / Explosion

- Aqueous batteries release small amounts of hydrogen gas which can combust if not ventilated properly.
- A battery spark can ignite nearby flammable materials.
- Some battery types go into thermal runaway, catching fire and/or generating combustible gas.

Chemical

- Battery electrolyte can be highly acidic.

What is Thermal Runaway ?

NFPA 855 defines Thermal Runaway as a *"Self-heating of an electrochemical system in an uncontrollable fashion [NFPA 855 2023 3.3.26*]"*. In Annex A it adds *"Thermal runaway progresses when the cell's generation of heat is at a higher rate than the heat it can dissipate."*

Note: See previous Copyright Note at beginning of presentation.

UL Research explains it this way for Li-Ion cells:

> *"In ideal conditions, the heat is able to dissipate from the cell. However, in thermal runaway, the lithium-ion cell generates heat at a rate several times higher than the rate at which heat dissipates from the cell.*
>
> *"The cell reaches thermal runaway when its temperature rises uncontrollably at a rate greater than 20° centigrade per minute with maximum temperatures reaching greater than 300°C accompanied by gas and/or electrolyte venting, smoke or fire or a combination of all."*

What Is Thermal Runaway? | UL Research Institutes – https://ul.org/research/electrochemical-safety/getting-started-electrochemical-safety/what-thermal-runaway.

Correlated with an article in the Journal of The Electrochemical Society on 3 different testing methods and conclusions:
Matthew Sharp *et al* 2022 Journal of Electrochemical. Society 169 020526

IEEE 1881 defines it as *"a rapid uncontrolled and uninterruptible rise in temperature resulting in a catastrophic failure of a cell, unit or battery. See also thermal walkaway."*

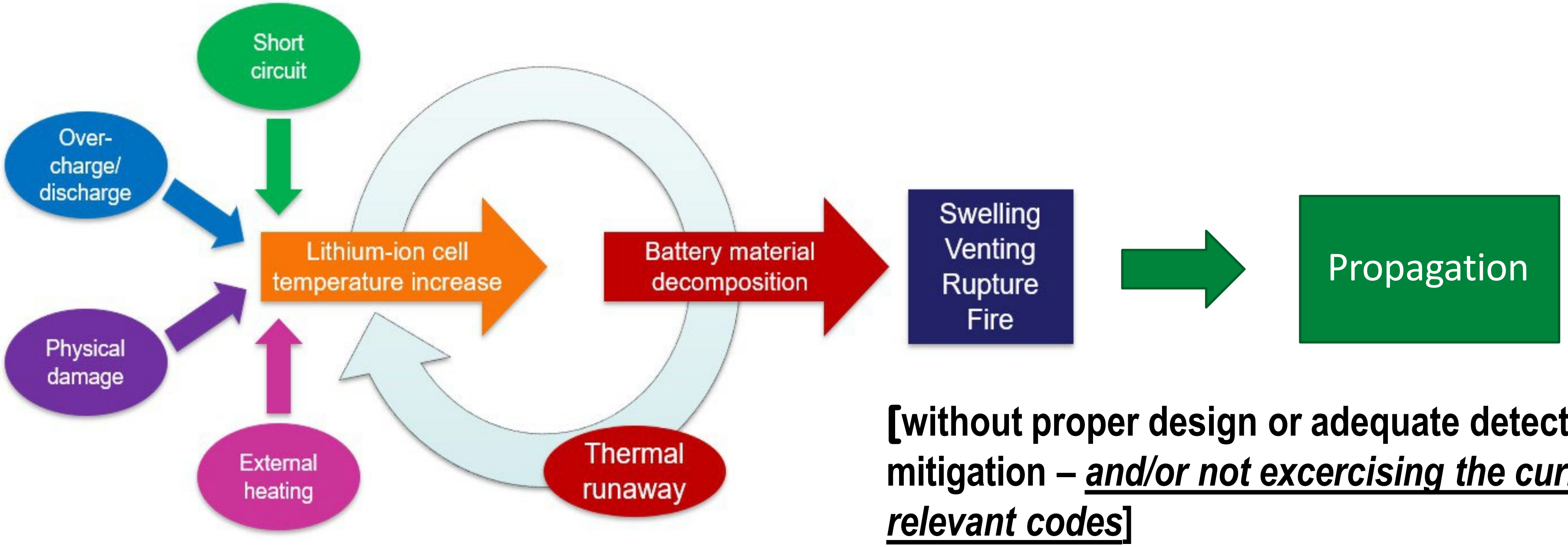
What are the Causes of Thermal Runaway?

Abuse Conditions

- Electrical abuse
- Mechanical abuse
- Thermal abuse

Latent Failures

- Contamination during manufacturing
- Material impurities
- Improper design
  Lack of Quality Control in production



[without proper design or adequate detection and mitigation – *<u>and/or not excercising the current relevant codes</u>*]

Note: Used by permission from David Rosewater, PhD. Sandia National Laboratories

What is the Process of Thermal Runaway?

At cell-level: challenges of conventional Li-ion batteries

Li-ion batteries represent >90% of new electrochemical energy storage and are expected to continue as majority BESS for at least next several years.

Thermal runaway in a Li-ion battery:

(1) Heating starts

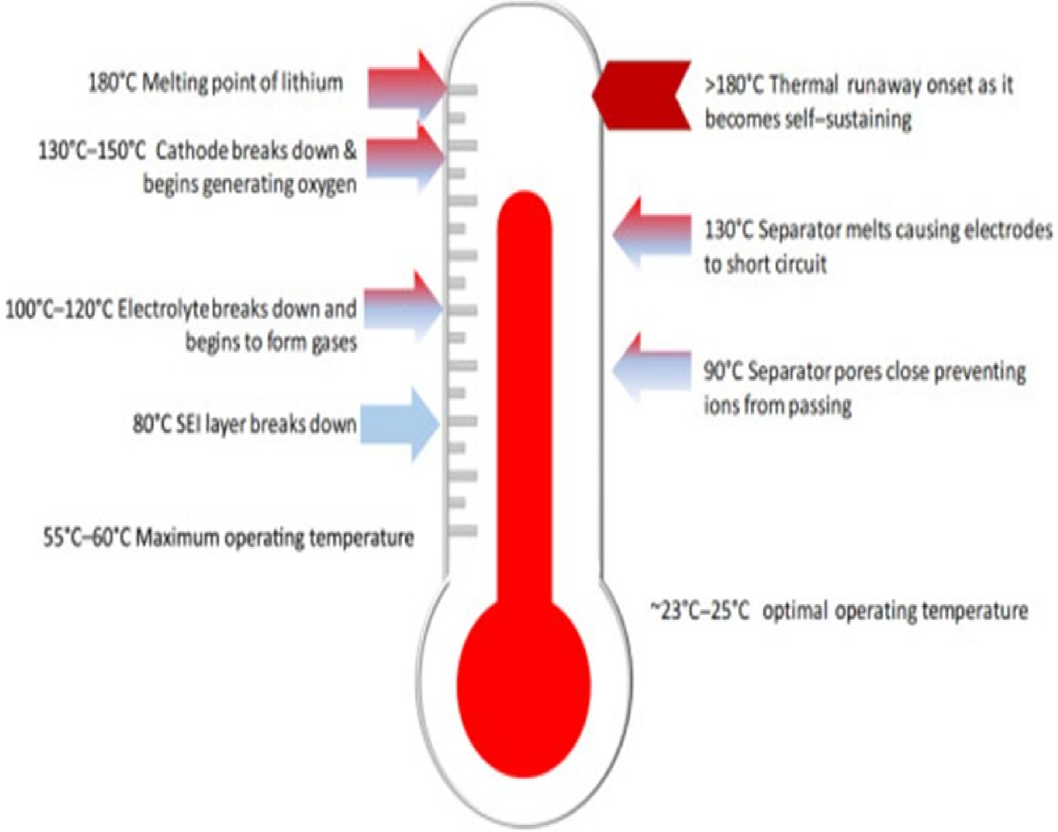
(2) Negative electrode protective layer (SEI) breaks down (~80℃)

(3) Negative electrode breaks down with electrolyte ($\geq 100^{\circ}C$) ***Note: LTO breaks down about 375˚C.***

(4) Separator melts, possibly causing short circuit ($\geq 120^{\circ}C$)

(5) Positive electrode breaks down, generating oxygen (130-150℃) ***Note: the LFP electrode breaks down ~275˚C***

(6) Oxygen reacts with electrolyte (>150-180℃)



Reference: John T Warner, Lithium Battery Chemistries 2009

What is the Process of Thermal Runaway?

A Second Way to Look at it:

Thermal runaway in a Li-ion battery:

(1) Heating starts
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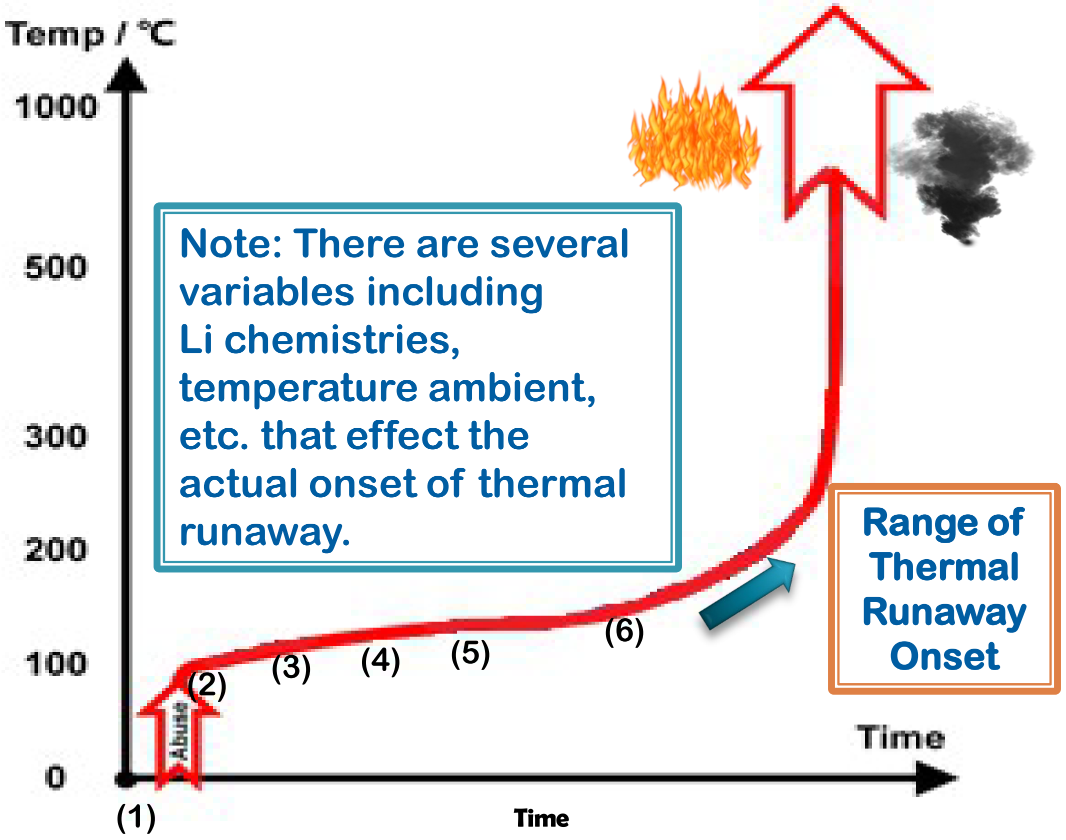


During this process gasses (some toxic) are released, and fire can ignite inside the cell, but not in all cases.

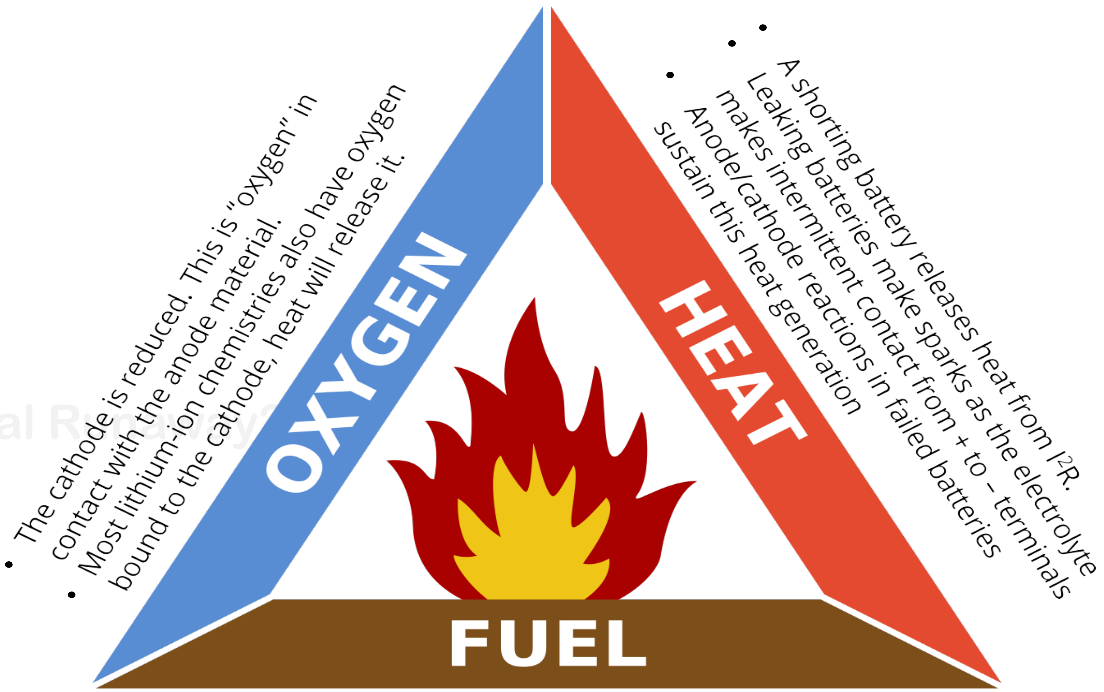
Why a Battery Fire can Occur in a Lithium-ion (or NaS) Battery

Li batteries contain the complete elements of the fire triangle – therefore, the fire cannot self-extinguish. Fire suppression involves cooling the battery to ensure the fire does not spread, internally within the battery or to adjacent cells outside the battery.

- **Water and CO_2 absorb a lot of heat, so even though they react with lithium, they are the preferred extinguishers for lithium battery fires.**

DO NOT !!

- **Attempt to use dry chemical extinguishers on the battery – they do not work.**
- **Use a Class D fire extinguisher – a lithium-ion battery is not burning metal, so a fire extinguisher will not fully extinguish a fire (and will create a huge mess).**
- **Breathe smoke. Batteries are burning plastic, and the smoke is very hazardous.**

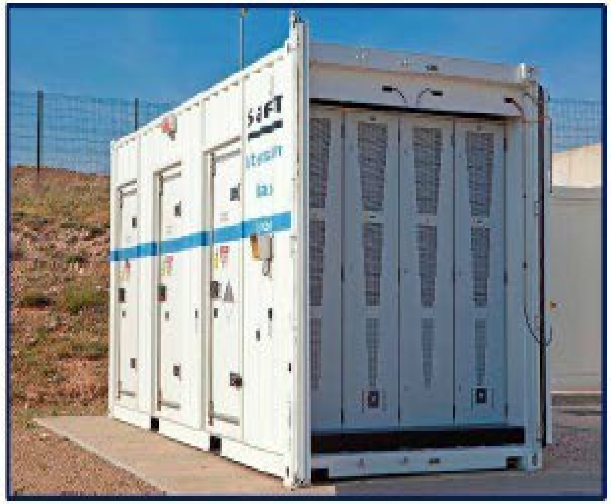


- **The cathode provides internal oxygen when it breaks down during a battery heating event.**
- **The flammable solvents (fuel) will burn after the battery vents. This is MOST of the energy in a thermal runaway.**

The best approach is to leave the area; immediately implement the emergency action plan; call 911 or point of contact. First Responders – apply H_2O to outside of container; consider the "Let it burn" alternative where practical. Be aware of possible gas buildup. Be aware that reignition can be a remaining concern.

Impact of Scale on Safety

Safety issues and complexity increase with battery size



Consumer Cells (0.5-5 Ah) → Large Format Cells (10-200 Ah) → Transportation Batteries (1-50 kWh) → Utility Batteries (MWh)

Major BESS Technologies Overview (1)

Note: Chart put together by Curtis Ashton and Chris Searles. All values should be confirmed by the OEM you are working w

	General Specifications[1]				Applications				Monitoring			
BESS TYPE	Wh/kg	Wh/L	Cycles to 80% DOD	Yrs on Float	Data Ctr UPS	Utility	Telco	PV Micro-grid	BMS	ESMS	Thermal Runaway	$ per KWh
LFP	100	105	5,000	13	YES	YES[2]	YES[3]	YES[3]	YES	YES	YES	$400
LMO	100	120	1,500	13	YES	YES[2]	YES[4]	NO	YES	YES	YES	$550
LNMC	135	120	2,000	13	YES	YES[2]	YES[4]	NO	YES	YES	YES	$550
LTO	80	80	15,000	20	YES	YES[2]	YES	YES	YES	YES	YES[5]	$600
NaNiCl	90	110	2,000	20	YES	YES[2]	YES	YES[3]	YES	YES	NO	$800
Na-Ion	90	100	2,000	13	YES	YES[5]	YES[5]	YES[6]	YES	YES	NO	$600
NaS	200	350	4,500	15	NO	NO	YES	YES	YES	YES	NO[7]	$300
NiMH	50	35	3,000	13	YES	YES	YES	YES	YES	YES	YES[5]	$450
NiZn	70	115	700	13	YES	YES	YES	NO	YES	YES	NO	$650
Ni-Cd	55	80	1,500	25	YES	YES	YES	YES	NO	Option	NO	$625
VLA	25	50	3,000	20+	YES	YES	YES	YES	NO	Option	NO[8]	$300
VRLA (AGM)	40	90	2,500	15+	YES	YES	YES	YES	NO	Option	NO[9]	$200
VRLA (Gel)	40	90	3,000	15+	YES	YES	YES	YES	NO	Option	NO[8]	$200

Major BESS Technologies Overview (2)

Footnotes:

[1] **Variables exist that can alter general results incl temperature, care & maintenance.**

[2] **High currents** are limited by the BMS.

[3] Requires heater for colder climates.

[4] Indoor only due to temperature constraints.

[5] Limited usage but thermal runaway is less likely with this particular Li technology.

[6] Battery will work in this application, but cost makes it impractical.

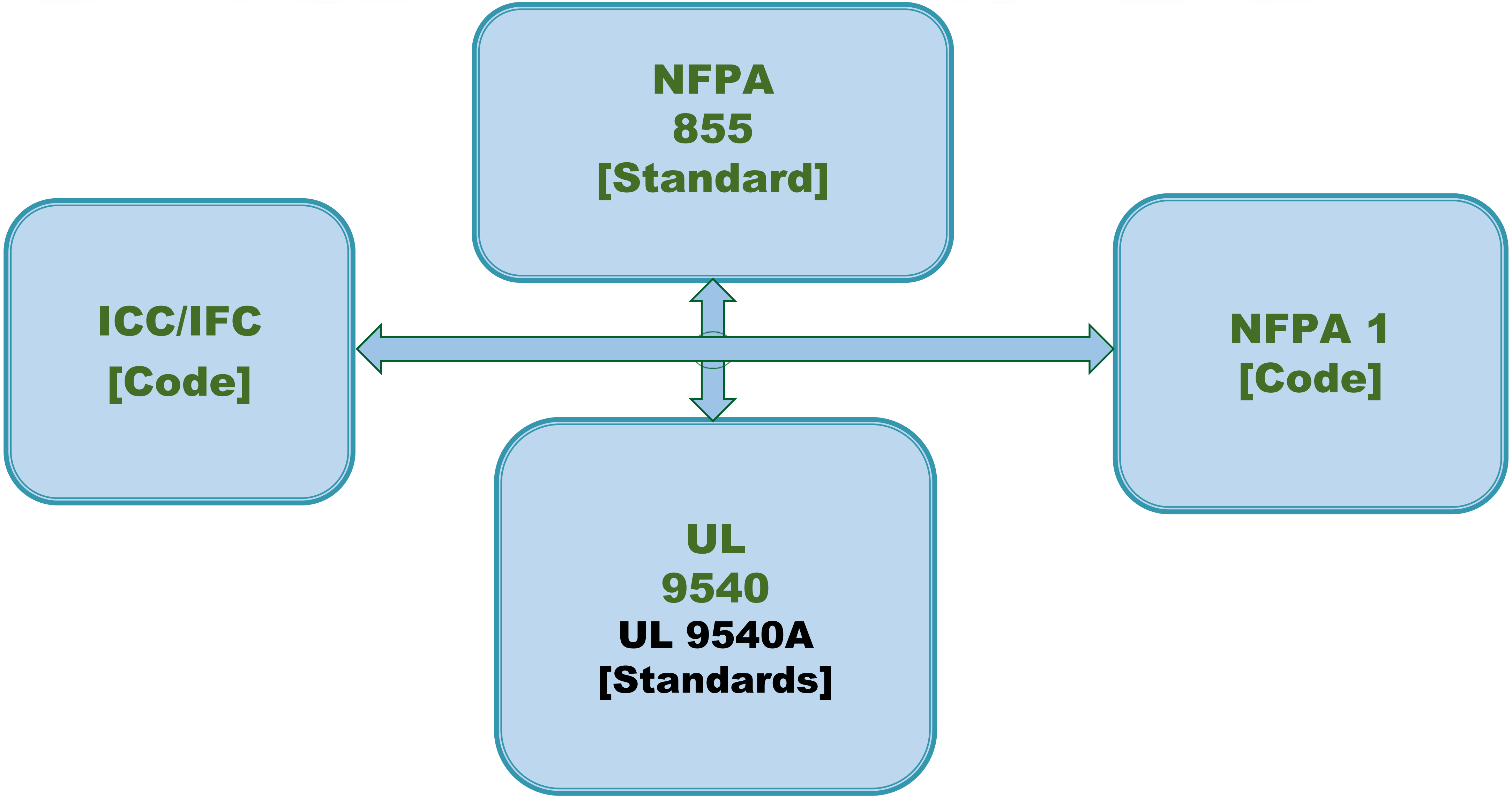
[7] Recent technology improvements are purported to have fixed fire issues. Time will tell.

[8] No internal cell generation of a fire possible; rare instances of thermal walkaway.

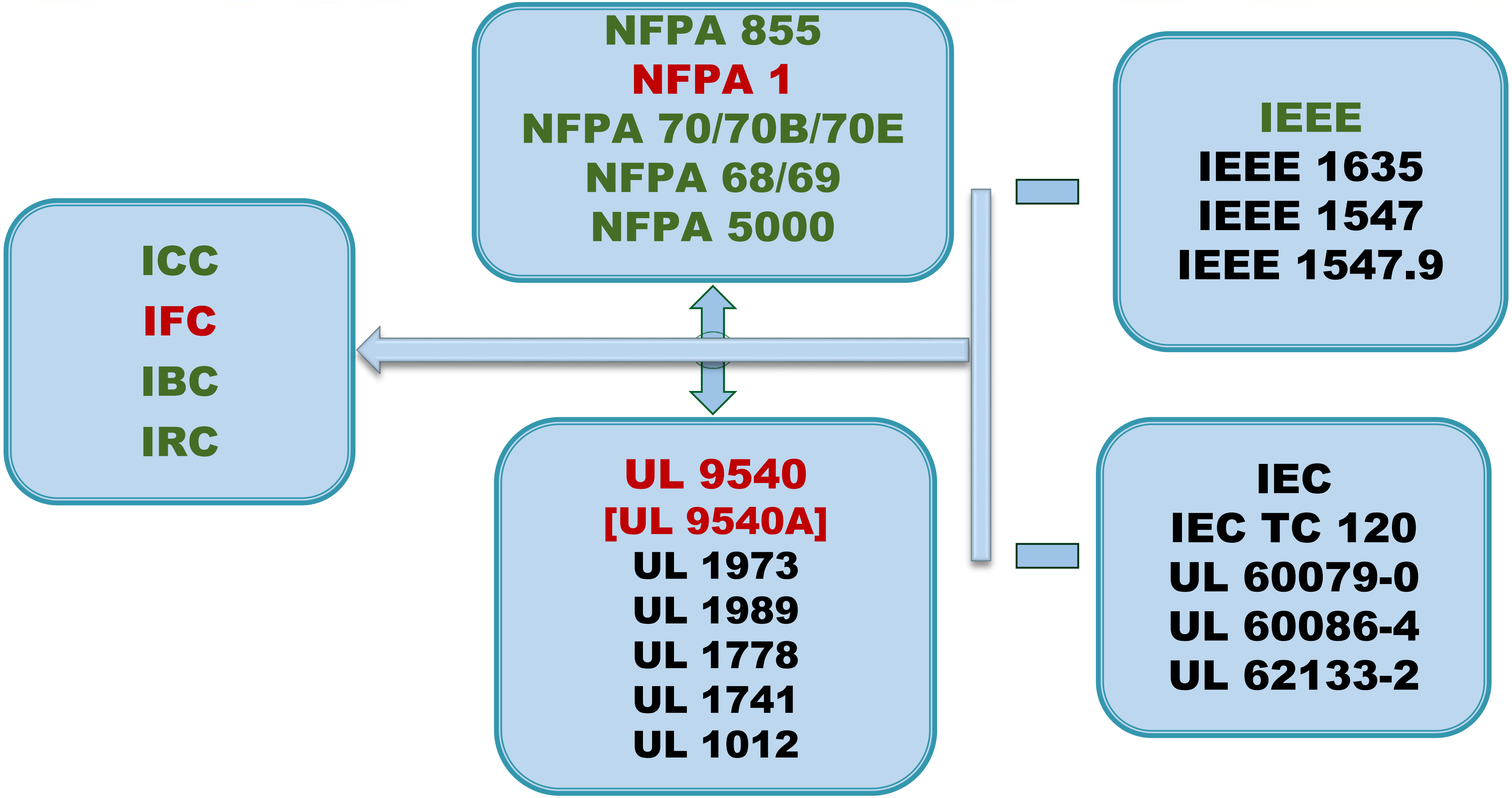
[9] Dryout/lack of maintenance can lead to thermal walkaway; no internal cell fire generated.

Note: This chart and Footnotes were put together by Curtis Ashton, Chair of the IEEE 1635 Committee and formatted by Chris Searles, Past Chair of the IEEE ESSB Committee. Be sure to check with the appropriate OEM to confirm information for accuracy.

Energy Storage Safety Codes Matrix



Energy Storage Safety Codes Matrix – One Level Down



Majority of Jurisdictions[1] Follow/Modify This Code

- **Ventilation for standby power applications**
- **Operational permits**
- **More construction documentation**
- **Decommissioning**
- **Aligns in large part with NFPA-855[2]**
- **Limits indoor array size to 50[3]/250[4] kWh**
- **Residential Battery Code (Tied closely w/ IBC)**
- **Full-scale fire testing (UL 9540A)**
- **Listing to UL9540 w/exemptions**
- **Larger outdoor separation distances**

[1] Includes District of Columbia, Puerto Rico & US Virgin Islands
[2] Not Completely; [3] IFC 2021/2024; [4] IFC 2018
Note: It is anticipated that IFC 2027 will incorporate all NFPA 855 references similar to NFPA 1 2024.

Available at 2024 International Fire Code (IFC) | ICC Digital Codes (iccsafe.org)

A Few States, Counties, Municipalities Follow This Code

- **Chapter 52 – Energy Storage Systems**
  - **Completely Aligns with NFPA-855**
  - References are to 2023 Edition of NFPA 855
- Section 52.1.1 states *"Energy Storage Systems having an aggregate quantity exceeding the threshold quantities established in Table 1.3 of NFPA 855 shall comply with Chapter 52."*
  [Carryover from 2021 Edition]
  - **Chapter 52 is composed of 8 sections .**
  - **All 8 sections refer to Chapters within NFPA 855 and state they comply with NFPA 855 requirements. This is a big change from the 2021 Edition.**
- **There are a total of 75 Chapters and six (6) Annexes, parts of which are often referenced in the IFC.**

Note: See previous Copyright Note at beginning of presentation.

Code available at [Help Ensure Safety and Compliance. Order NFPA 1, Fire Code.]

NFPA 855 – The Bellwether ESS Standard

NFPA
855

- **Key Elements of NFPA 855**
  - Thermal runaway testing to gather heat as well as combustible gas release quantities (UL 9540A) plus LSFT testing & UL 9540 listing.
  - Explosion protection by explosion control/ prevention (NFPA 69) and deflagration venting (NFPA 68).

  - Interconnection and commissioning/ decommissioning

NFPA 855 – The Bellwether ESS Standard

NFPA 855

- Key Elements of NFPA 855-2026 (continued)
  - Covers most commercially available BESS technologies including Li, Pb-Acid, Ni-Cd, Na, Ni, Flow and Zn plus mechanical Flywheel and supercapacitor.
  - Addresses stationary storage applications including ESS with standby application exemptions for Pb-acid, Ni-Cd and most aqueous electrolyte BESS.
  - Requires UL listings for all devices used in ESS applications including BESS – inverters, UPS, related equipment (to UL 9540 as system).

NFPA 855 – The Bellwether ESS Standard

NFPA 855

- ## More Key Elements of NFPA 855-2026 -

  Hazard Mitigation Analysis is a feature of NFPA 855.

  - Section 4.4.1 defines what is to be evaluated in HMA.
  - Section 4.4.2 requires a single failure mode to consider on items in 4.4.1.
  - Section 4.4.3 permits the AHJ to approve the HMA providing it demonstrates:
    - Fires will be contained within the unoccupied ESS rooms,
    - All Occupants can be evacuated safely
    - Deflagration issues addressed via an explosion control and prevention system.

Note: There are 20 references to HMA in Chapters 1, 4, 8, 11, 13 as well as Annex A,B, G.

NFPA 855 – The Bellwether ESS Standard

NFPA 855

- Other Key Elements of NFPA 855-2026
  - All electrochemical technology requirements placed in Chapter 9.
  - New Chapters for Flow Batteries (Chapter 16) and ESS on Barges and Vessels (Chapter 17).
  - Separate chapter addresses Lithium-Ion and Lithium Metal battery storage in Chapter 14.
  - Residential requirements for the most part are consolidated in Chapter 15. Lead-acid and Ni-Cd batteries not limited to 20kWh maximums. New Table15.5.2 offers Max kWh ratings for various ESS location placements.
  - Solid annex material in Annex B & Annex G (including LSFT).

NFPA 855 – The Bellwether ESS Standard

Ventilation and Gas Detection

- Table 9.7.6 lays out lengthy BESS Exhaust Ventilation requirements
  - ✓ Must activate when the level of flammable gas exceeds 25 percent of the lower flammable limit (LFL)   *Note: Annex B & G provide additional information regarding OSHA/NIOSH limits w/ reference to NFPA 704.*
  - ✓ Must provide minimum of 2-hours of fire resistance.
  - ✓ Li must provide a minimum of 2-hour of standby power w/ manual override.
- Ventilation – no change to ventilation rates but added other battery technologies to the criteria including lithium (IEEE1635/ASHRAE 21).
- Gas Detection and Explosion Control requirements
  - ✓ Section 9.7.6.7.3 - Requirement for Explosion prevention systems in accordance with NFPA 69.
  - ✓ Section 9.7.5.6.3.1– Requirement for Deflagration Venting in accordance with NFPA 68.

NFPA 855 – The Bellwether ESS Standard

Threshold Quantities[1]

Battery Capacity Threshold Covered by Codes	
Technology	Capacity Threshold (kilowatt hours)
Lead Acid (all types)	70 kWh (252 MJ)
Ni-Cd, Ni-MH, and Ni-Zn,	70 kWh (252 MJ)
Lithium-ion (all types)	20 kWh (72 MJ)
Sodium Nickel Chloride	20 (70) [2] kWh (70MJ) (252 MJ) [2]
Flow Batteries	20 kWh (72 MJ)
Other Battery Technologies (Emerging)	10 kWh (36 MJ)
Batteries in 1 and 2 family dwellings[3]	1 kWh (3.6 MJ)

SeeThreshold Levels defined in Table 1.3 of NFP 855, 2026 for other ESS Technologies including EDLC, Flywheels', Iron-air, Nickel-hydrogen, Sodium sulfur, several Zinc variants .

The actual Table 1.3 is protected by Copyright and can be viewed on line at NFPA.com/855.

[1] *Certain threshold quantities applied in NFPA 1 2018 and IFC 2018 and 2021.*

[2] *Sodium Nickel Chloride when listed to UL 9540 .*

[3] *Includes townhouses.*

Note: Quantities now specified for ESS flywheel (0.5 kWh) and electrochemical double layer capacitors (3 kWh).

NFPA 855 – A Few Key Takeaways

- **Work will begin shortly on the 2029 Edition**
  - **Initial Public Input for 2026 edition will close 06/03/2026.**
  - **First draft report is scheduled to be posted on the NFPA 855 website no later than -4/24/2027.**
  - **Public Comment period is scheduled to close 06/27/2027.**
    Note: comments can only address previous Draft 1 comments.
  - **Second Draft Report Posting Date scheduled for 03/21/2028.**
  - **NITMAM closing date is 03/29/2028.**
  - **Next release – late 4Q 2028.**

NFPA 1 – A Few Key Takeaways

- The 2021 and 2024 Editions adopted major language with direct references to NFPA 855 in Chapter 52.
- Three Technical Committees now support the Overall Coordinating Committee (new for this edition)
  - Fundamentals of the Fire Code (FCC-FUN)
  - Special Equipment, Processes and Hazardous Materials (FCC-HAZ)
  - Building Systems and Special Occupancies (FCC-OCP)

NFPA 1 2027 – A Few Key Takeaways

- **Work continues on NFPA 1.**
  - Second Draft Report Posting for NFPA 1 promised by February 26, 2026.
  - 2026 Committee meetings not yet announced.
  - Public Comments can be viewed at nfpa.org/1.
  - 6 TIAs have been balloted and can be viewed as well.
  - NITMAM closing date is March 26, 2026.
  - Next release – late 4Q 2026.

ICC IFC/IBC/IRC – A Few Key Takeaways

- **ICC Codes Development is different from NFPA**
  - Divided into Code Group A and Code Group B Actions
  - New Process in 2024 – Two Committee Public Hearings
  - FCAC and BCAC are Two of Four Action Committees
  - FCAC has 7 Working Groups –
    - WG 4 is Energy (batteries)
    - Has been active over the past year and continues into 2025.

ICC IFC/IBC/IRC – A Few Key Takeaways

- **Work is nearing completion on the 2027 Editions**
  - First One of Two Public Hearings occurred in Orlando FL the weeks of April 6 – April 19, 2024 (Group A – IFC/IBC)
  - The IRC is contained within the IBC but IFC has overlap inputs
  - Second Public Hearings Completed
    - IFC – October 23 – 31: Long Beach, CA
    - IBC – October 19 – 31: Cleveland, OH
  - Final Combined Meeting – April 19 – 28, 2026: Location TBD

SUMMARY and CONCLUSIONS

1. Energy Storage is now a Mainstream part of the evolution to electrification in many societies and remains critical for all ESS applications, especially w/ AI, cryptocurrency and data-center proliferation.

2. Safety Codes and Standards will continue and need to be a critical piece of the ESS equation.

3. Currently, electrochemical technologies (BESS) account for the largest number of new energy storage systems being installed to store energy for later use.

4. New technologies at varying stages of final dress rehearsal or initial commercial production (flow, zinc, sodium, CAES, hydrogen) are jockeying to play at the grid-scale and long-duration energy storage ranges.

SUMMARY and CONCLUSIONS

1. Education and training will be ongoing and important
   a. AHJ's,
   b. Local/Regional regulatory agencies
   c. Electric utilities and telecommunication groups
   d. Digital data center developers/implementers

2. Key stakeholders in the ESS space need to continue and share an involved role with the key SDO's.

3. A means to get all stakeholders using the current editions of ESS standards yet allowing local/regional differences where absolutely necessary.

Thank You!

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