LITHIUM-ION BATTERY PROTECTION

PRESENTED AT THE 54TH ANNUAL CAFAA CONFERENCE

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LITHIUM-ION BATTERY PROTECTION

Today's Presenter

Wayne Aho

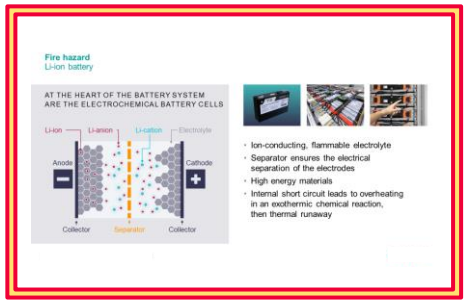
Sr. Product Manager
Detection and Peripherals

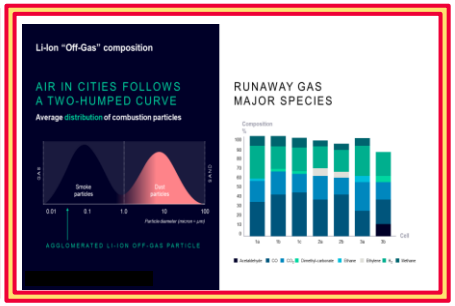
Seasoned **Fire Protection Industry professional** with **extensive product management** and **product growth experience**. Focused on creating new **smoke/fire detection technologies** and **associated products**. Wayne represents Siemens on many **national-level Fire Industry** and **technical forums.**

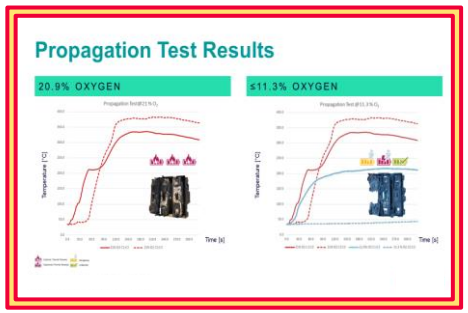
AGENDA

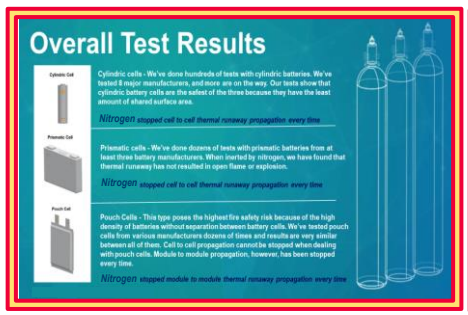
- Welcome
- Review Li-ion fire protection solution
  - Technology development Journey
- Li-ion battery manufacturing applications
  - Process overview
  - Areas of concern / risk
  - Application of solution
- Q&A

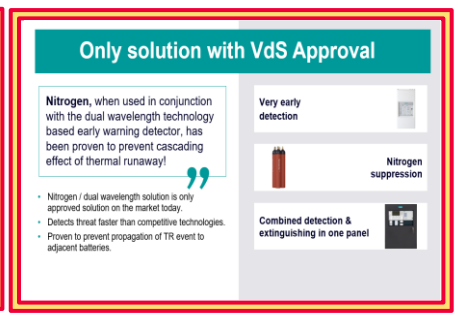
LI-ION BATTERY PROTECTION JOURNEY



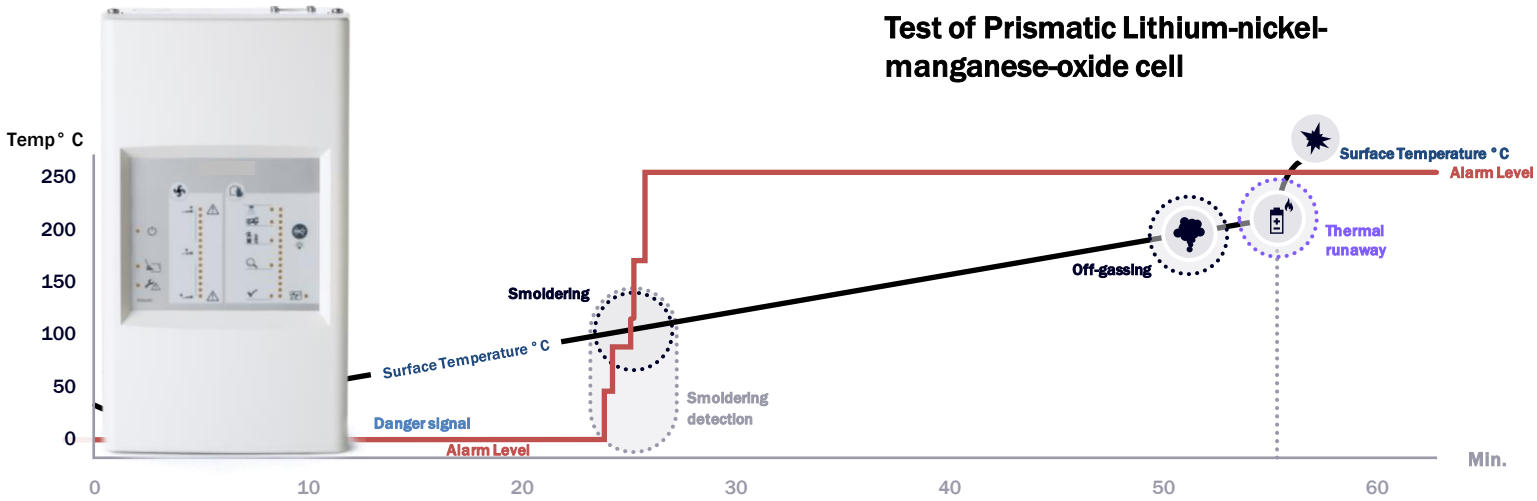








DETECTION TESTS



Forcing thermal runaway by heating

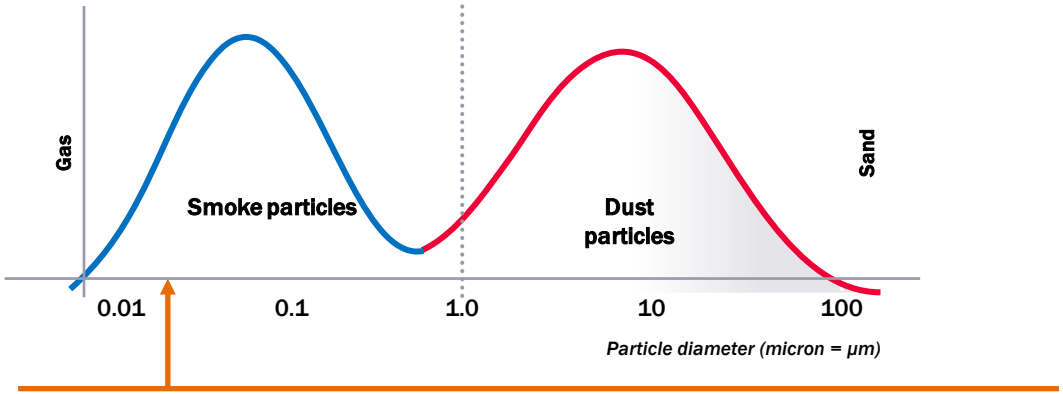
Dual wavelength detector detects smoldering **@T = 145 °C**
28 minutes before off-gas venting and
32 minutes before thermal runaway

Fire alarm due to earliest smoldering detection.
Ideal precondition for triggering of e-stop and
Explosion prevention and fire suppression

LITHIUM-ION "OFF-GAS" COMPOSITION

Air in environment follows a two-humped curve

Average distribution of **combustion particles**

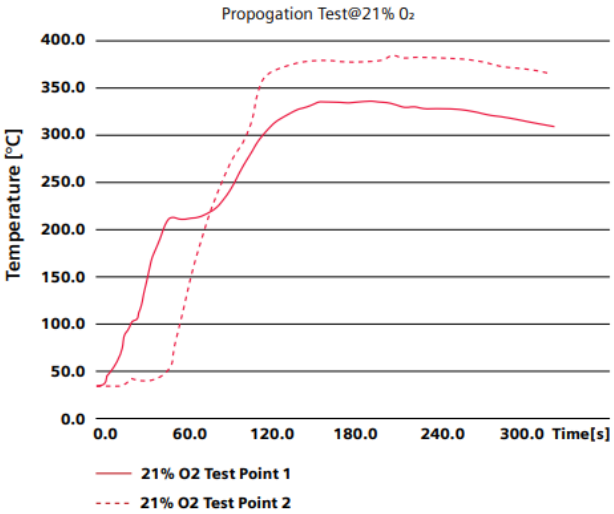


Agglomerated li-ion off-gas particle

Propagation Test Results

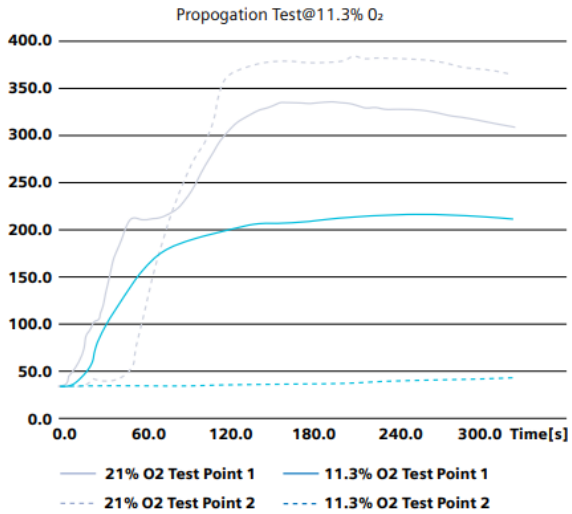
20.9% Oxygen

Graph A - Normal Oxygen Environment

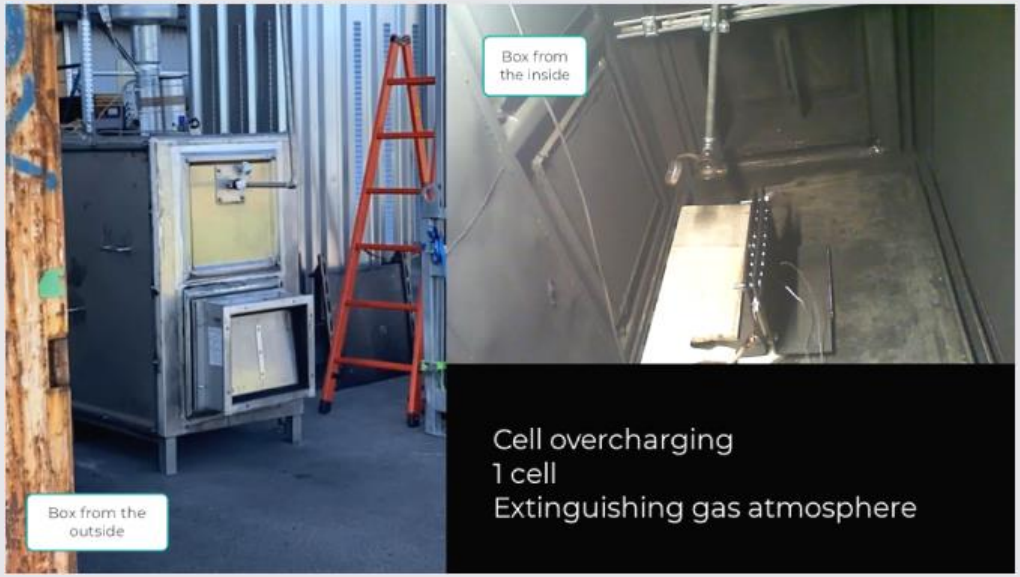


≤11.3% Oxygen

Graph B - High Nitrogen Environment



VIDEO OF TORCH EFFECT



OVERALL TEST RESULTS

Cylindric cells | We've done hundreds of tests with cylindric batteries. We've tested 8 major manufacturers, and more are on the way. Our tests show that cylindric battery cells are the safest of the three because they have the least amount of shared surface area.

Solution stopped cell to cell thermal runaway propagation every time

Prismatic cells | We've done dozens of tests with prismatic batteries from at least three battery manufacturers. When inserted by nitrogen, we have found that thermal runaway has not resulted in open flame or explosion.

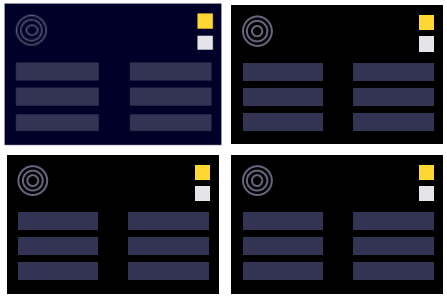
Solution stopped cell to cell thermal runaway propagation every time

Pouch Cells | This type poses the highest fire safety risk because of the high density of batteries without separation between battery cells. We've tested pouch cells from various manufacturers dozens of times and results are very similar between all of them. Cell to cell propagation cannot be stopped when dealing with pouch cells. Module to module propagation, however, has been stopped every time.

Solution stopped module to module thermal runaway propagation every time

Standard

Normal li-ion Fire Risk



High Density

Very High Li-ion Fire Risk

KEY TAKEAWAYS

Lithium-ion battery usage across all markets – including “energy storage systems” expected to maintain increasing growth rate.

Lithium-ion batteries present fire hazards that can be mitigated by early detection of runaway condition and propagation prevention.

Dual wavelength detection technology provides earliest possible detection – IRed / Blue particle detection in the industry.

Nitrogen, when used in conjunction with early warning detector, has proven to prevent the cascading effect of thermal runaway.

A solution enabling Lithium-ion battery thermal runaway events to be managed.

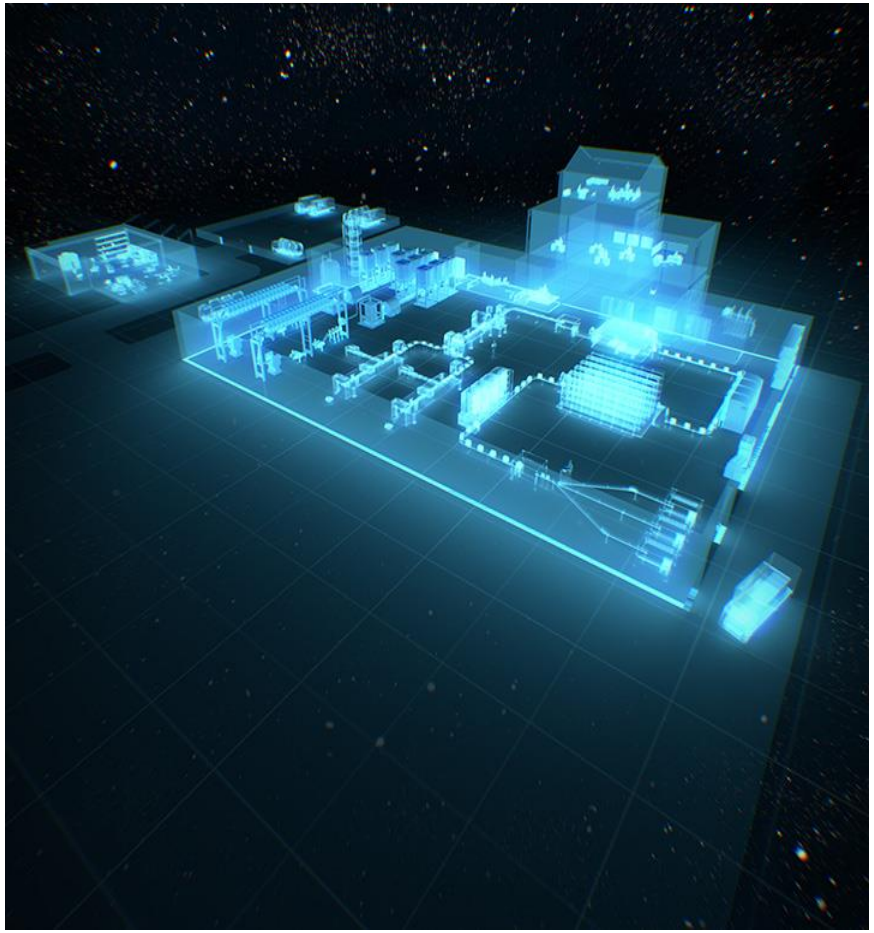
LITHIUM-ION BATTERY STORAGE CONTAINER SOLUTION

TRADITIONAL BATTERY STORAGE ROOM

BATTERY MANUFACTURING

Marked increase in Li-ion battery manufacturing facilities

A new set of fire risks

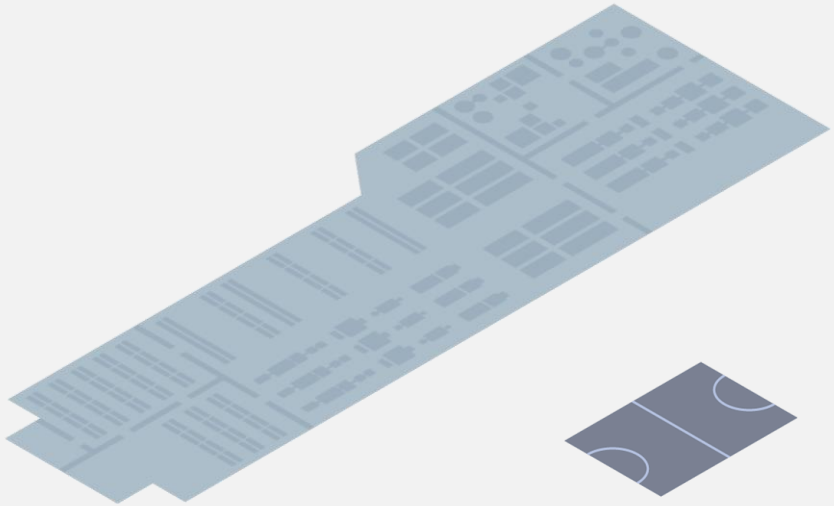


HUGE DIMENSIONS

8 GWh
Production capacity

~20,000,000
Annual target-output
of good battery cells

< 200,000
annual eCar output



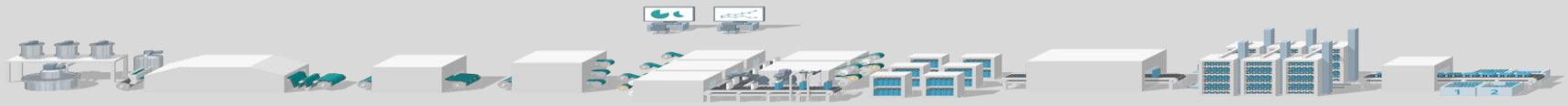
~12 soccer fields

→ 1 GWh = 108,000 ft² = 2.5 acres
Size of a general battery cell production plant

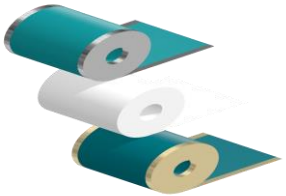
LITHIUM-ION BATTERY CELL PRODUCTION PROCESS

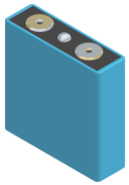
Electrode production

Battery cell production



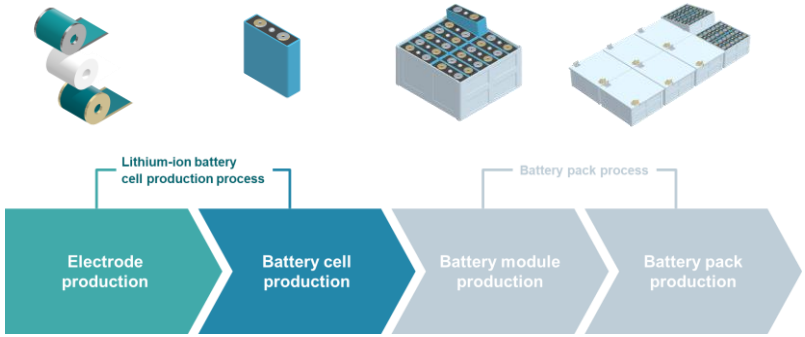
1. Mixing
2. Coating
3. Calendering
4. Slitting
5. Cell assembly
6. Drying
7. Electrolyte filling
8. Formation and aging
9. Testing and grading

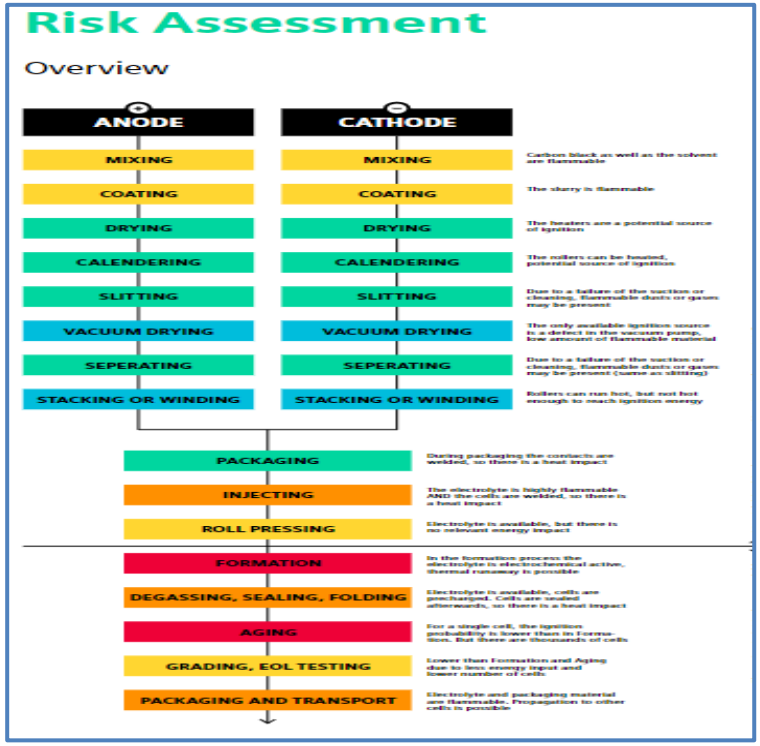




LITHIUM-ION BATTERY MANUFACTURING

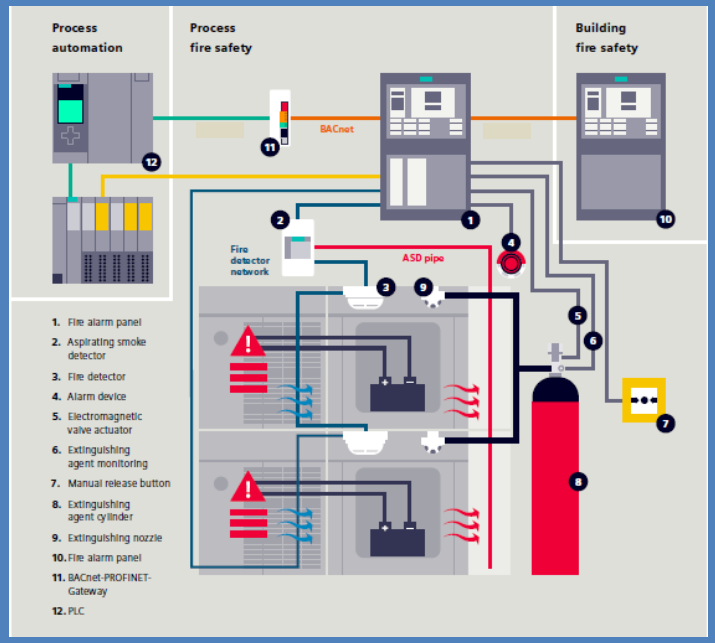
- Each process step offers potential risk of fire
- Electrode production process has lower risk
- 2nd half of process offers increased risks
- 7 of last 8 process steps are medium+ risk



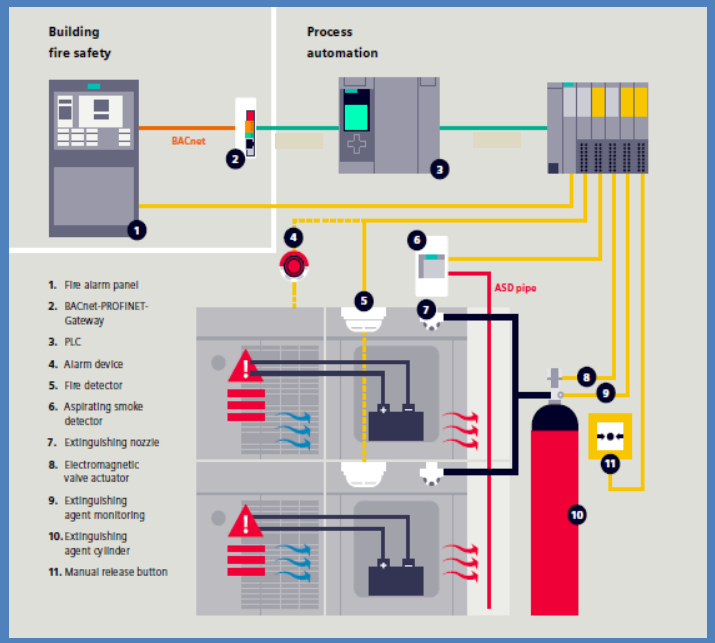


PROTECTION CAPABILITY OPTIONS

Entire facility

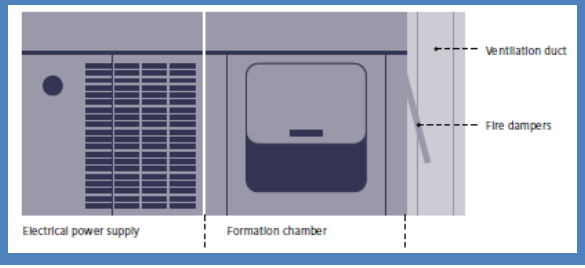


Building / Process

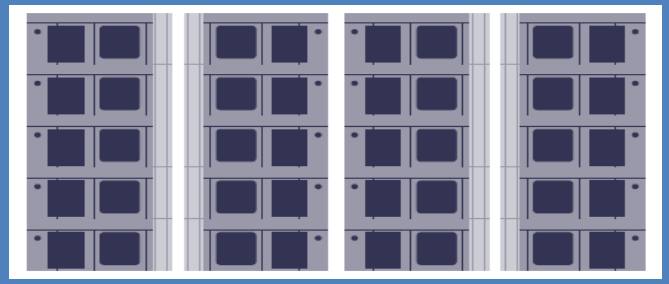


ELEVATED RISK AREAS - FORMATION

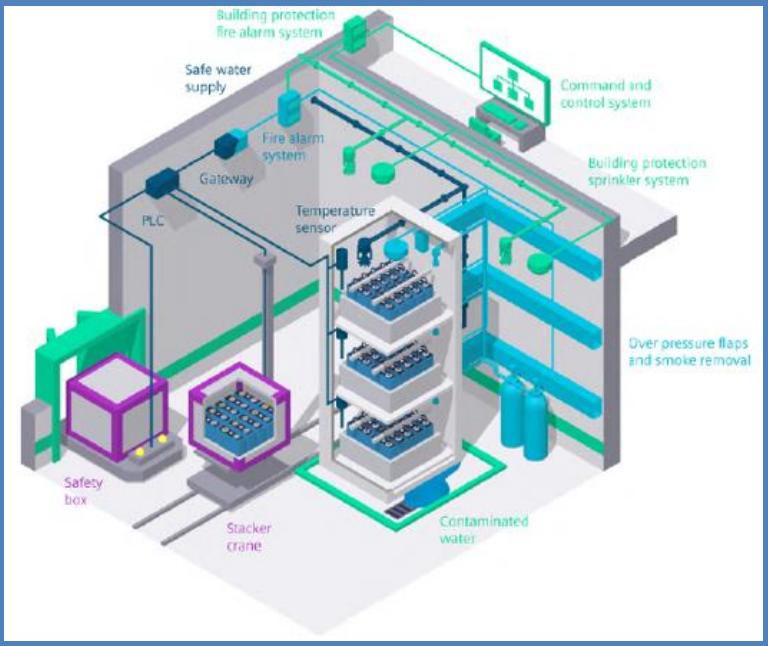
Formation Chamber



Formation Tower

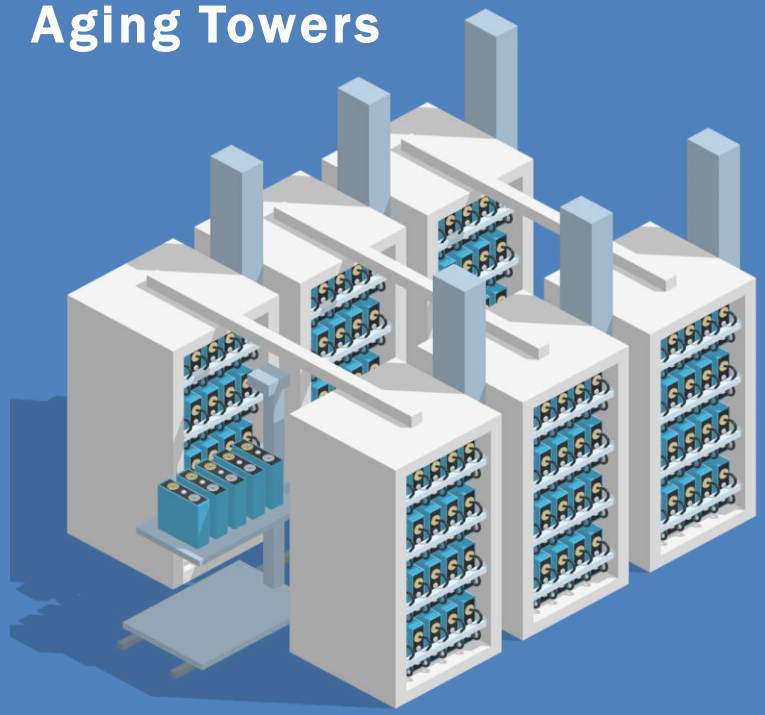


Formation Tower protection

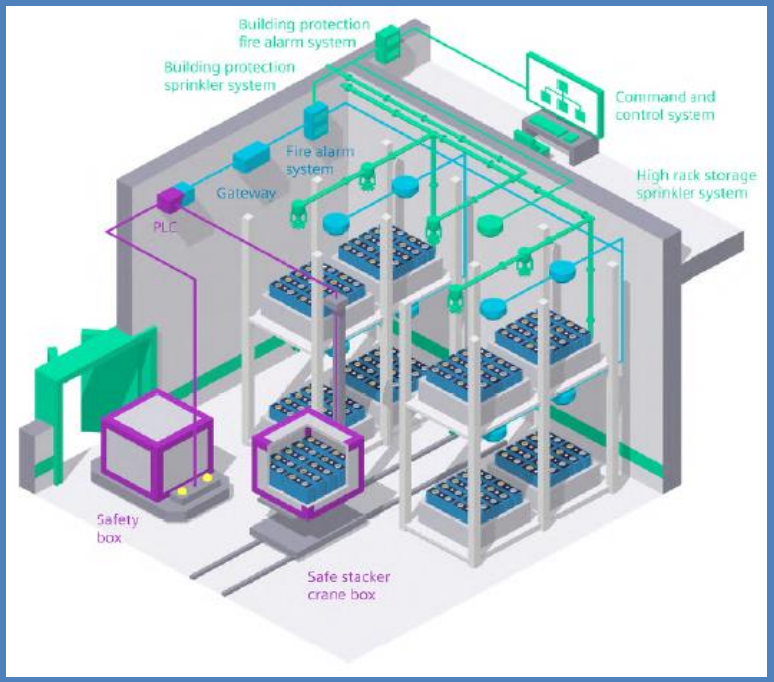


ELEVATED RISK AREAS - AGING

Aging Towers

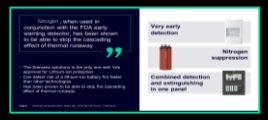


Aging Tower protection



SUMMARY
BROAD APPLICATION SOLUTION

- **Li-ion battery protection solution**



  - Very early warning detection
  - Nitrogen agent
  - Prevents thermal runaway propagation
  - Limits loss / damage

- **Li-ion battery manufacturing solution**

  - Mitigates risk profile
  - Very early warning detection.
  - Nitrogen agent
  - Contains damage.

Li-ion battery fire protection leadership

- Muti-year engagement with Li-ion battery stakeholders.
- Development of proven solutions through research.
- Allows Li-ion battery risk to be managed

QUESTIONS

CONTACT

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Thank You