# Designing Safe Energy Storage Projects

**Noah Ryder, PhD, PE**
Chief Operating Officer
Fire & Risk Alliance



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# Speaker Intro: Noah Ryder, PhD, PE

- For over 25 years Noah has focused on understanding fire and explosion's interaction with both built and natural environments.
- He presently serves as Chief Operating Officer at Fire & Risk Alliance, LLC. and he oversees the Risk, Modeling, Applied Research, Performance Based Design, and Forensics groups.
- He is a licensed professional fire protection engineer in numerous states and focuses on how safety can be improved through the use of engineering analysis and product improvement.
- Noah teaches FPE courses in the FPE department at University of Maryland and the University of Waterloo.
- Additionally, Dr. Ryder has been awarded numerous patents, serves on the SFPE Foundation Board, serves as a principal member of NFPA 855 and other NFPA technical committees, and frequently publishes and presents his work.


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# Agenda

1 Energy Storage Fire Safety

2 UL 9540A testing

3 Community Risk Assesment

4 Hazard Mitigation Analysis

5 ”Bespoke” Large-scale testing

6 Education



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# Energy Storage Fire Safety

Wholistic approach to product design and safety — de-risking the total cost of ownership throughout the project lifecycle

*Goal is to minimize the probability and impact of an event*

- Permitting package
  - Test Reports
  - Community Risk Assessment
  - Hazard Mitigation Analysis
  - Code Compliance Reports/Designs
- Large scale fire and explosion testing
- Prioritizing education of customers, first responders, and communities by providing Q&A sessions, technical analysis, and Emergency Response training



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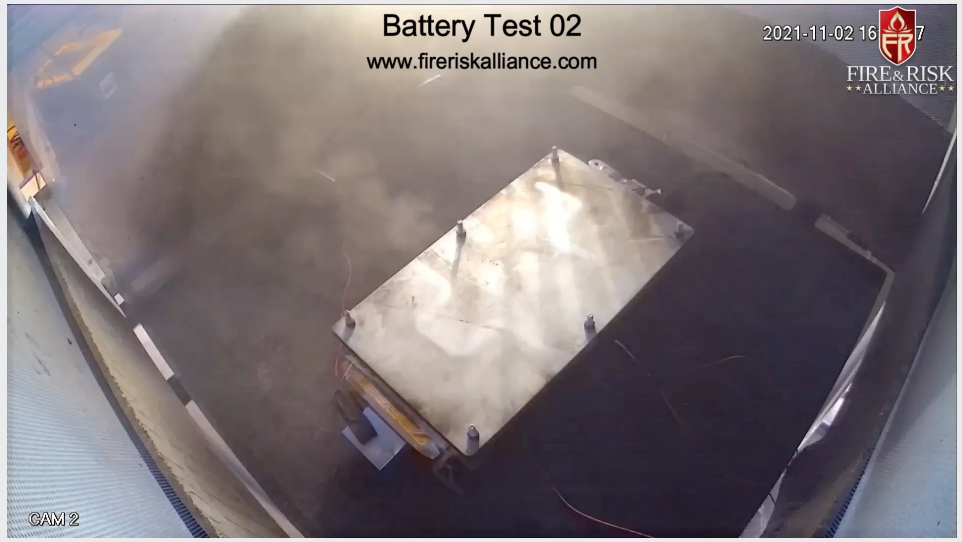
# UL 9540A Testing

## What to look for in testing?

- Cell level test results
  - Gas Composition
  - Flame Speeds
  - Gas Volume

- Module level test results
  - Heat Release Rate
  - Gas Composition & Volume
  - Flaming or flying debris
  - Number of cells involved

- Unit level test results
  - Visible flaming or flying debris observed
  - Propagation beyond initiating unit





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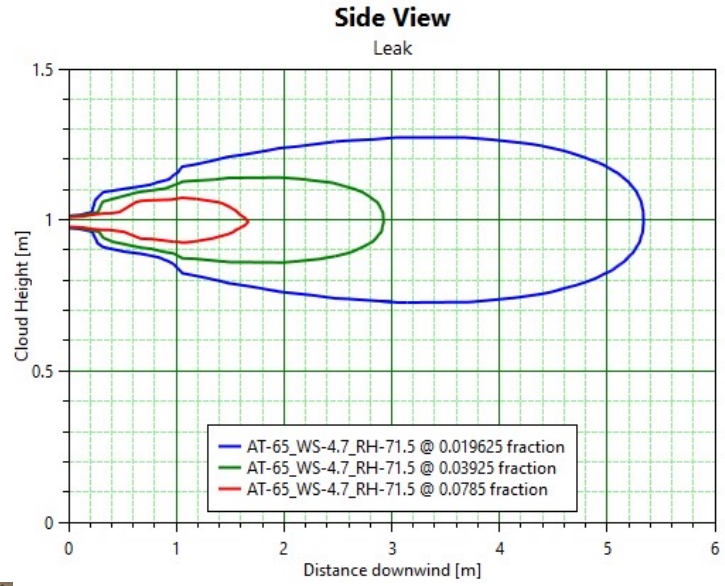
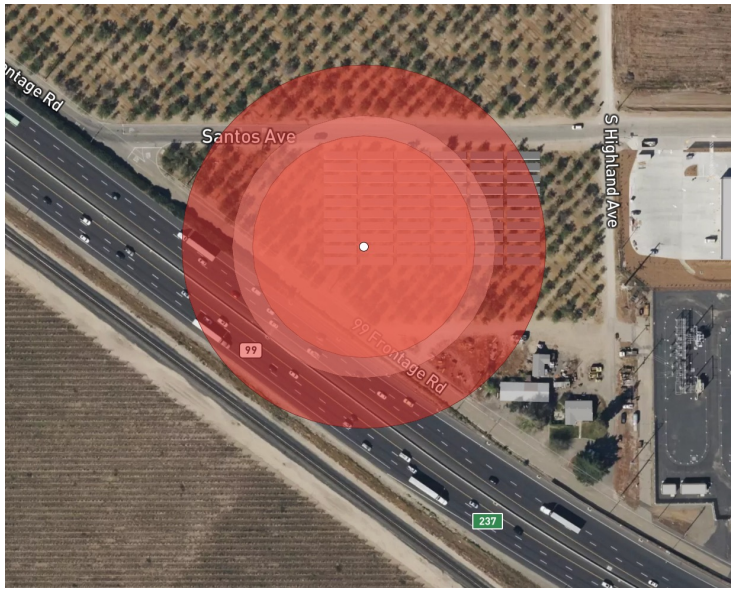
# Community/Fire Risk Assessment

Community Risk Assessment (CRA, sometimes called a Fire Safety Assessment) may be used to support specific project sites.

The CRA evaluates the potential toxic gas, flammable gas, heat, and overpressure extents and any impacts to the site, the fire service, or the public

- Smoke and toxic gas modelling
- Heat flux analysis
- Other site-specific risks

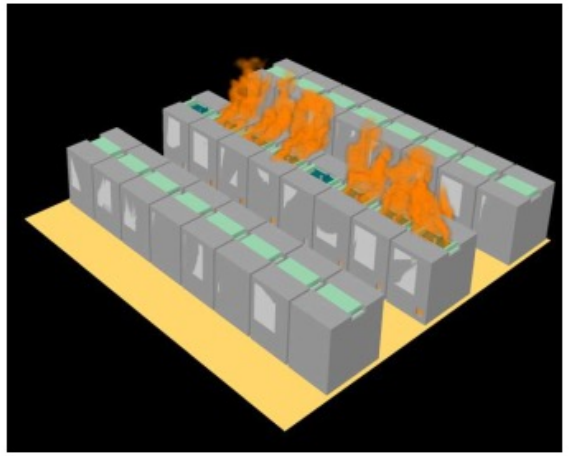



Figure 88. Simultaneous Flaming Event Inside 6 Containers (3 Each on Either Side of the Initiating Container) in the Middle Row and Flame Tilt Due to the Presence of Wind (Scenario 11) (Wind Speed 50mph)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# Hazard Mitigation Analysis

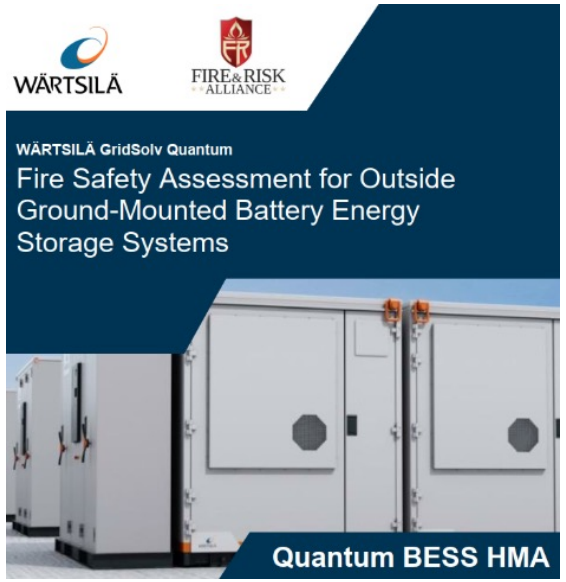
## Hazard Mitigation Analysis

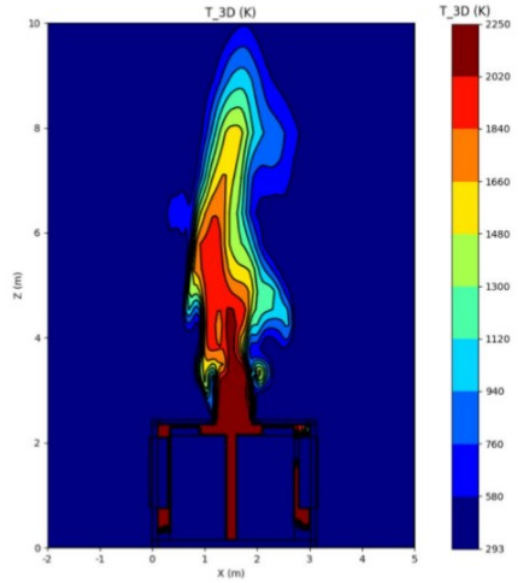
Hazard Mitigation Analysis are required per code for any systems of 600 kWh

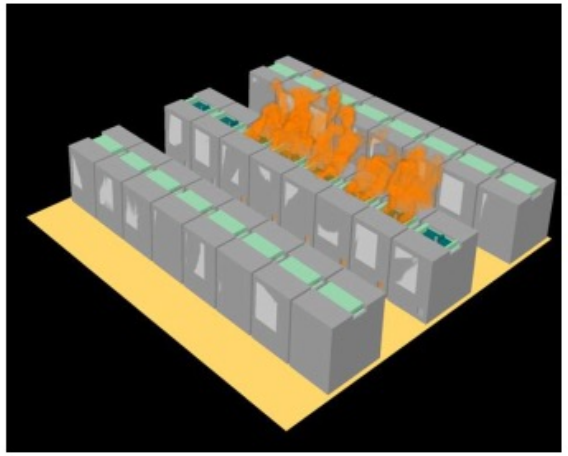
It summarizes all reports and analyses, to show the product meets the Hazard Mitigation Analysis criteria laid out in IFC 2024, NFPA 855, or other standards.

Annexes included:

- Heat Flux Analysis
- Deflagration Analysis
  - FLACS (NFPA 68)
  - Ventilation (NFPA 69)
- FMEA
- ERP



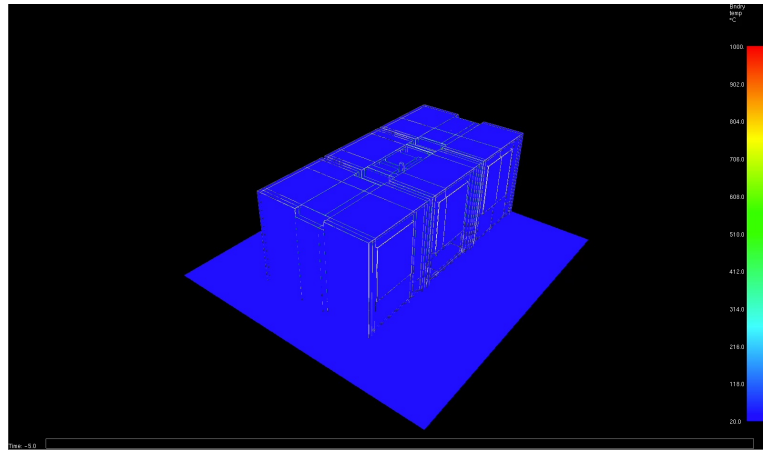


Figure 87. Simultaneous Flaming Event Inside 5 Containers in the Middle Row and Flame Tilt Due to the Presence of Wind (Scenario 11) (Wind Speed 50mph)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# Large-Scale “Bespoke” Tests


Controlled Wärtsilä burn tests


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# Large-scale NFPA 69 testing

- Extensive modelling to show that under a wide range of release conditions, systems **meet the requirements** of **NFPA 855** & **NFPA 69**.
  - This included release in different locations, magnitudes, durations, and sensor locations.
- This modelling was backed up by **two series of real-world tests**.
  - Examined a variety of gas sensors and about a dozen fans to evaluate performance.
- The testing involved using both syn gas and a custom blend designed to replicate thermal runaway gases.

We were able to ID which actual components worked the best and confirmed that the **fans chosen meet code requirements.** This allows us to provide a complete, robust package to the AHJs.

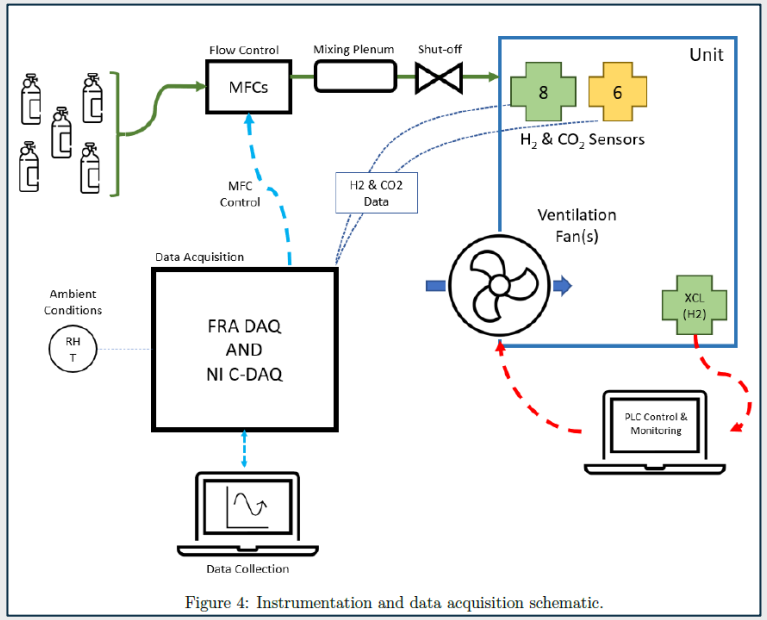
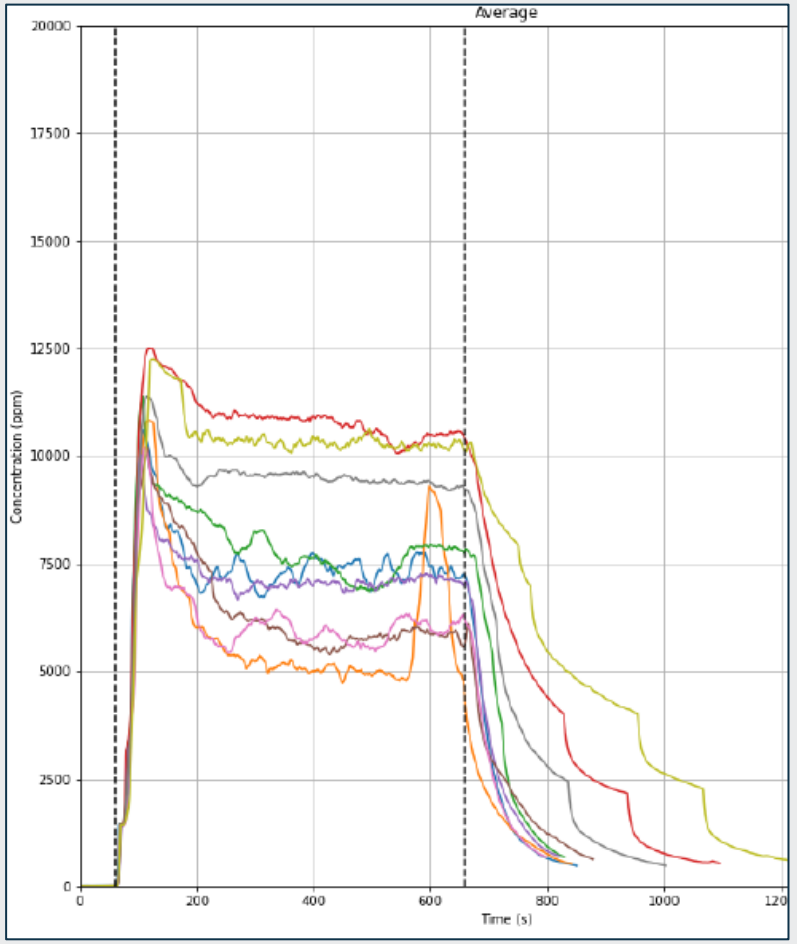


Figure 4: Instrumentation and data acquisition schematic.





(a) Average hydrogen concentrations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# Education

Addressing the gaps between

- Manufacturers and code compliance
- Real risk vs. perceived risk

Fill the gaps by providing

- First responder training
- 24/7 support
- Community engagement
- Etc.


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# Fire and Risk Alliance- 24/7 Hotline overview

### Subject Matter Expertise

Experience matters when dealing with an emergency. Our experienced Subject Matter Experts know the hazards of battery energy storage systems and how to mitigate them. Let them share that expertise with you, so you don't have to learn the hard way.

### Emergency Response

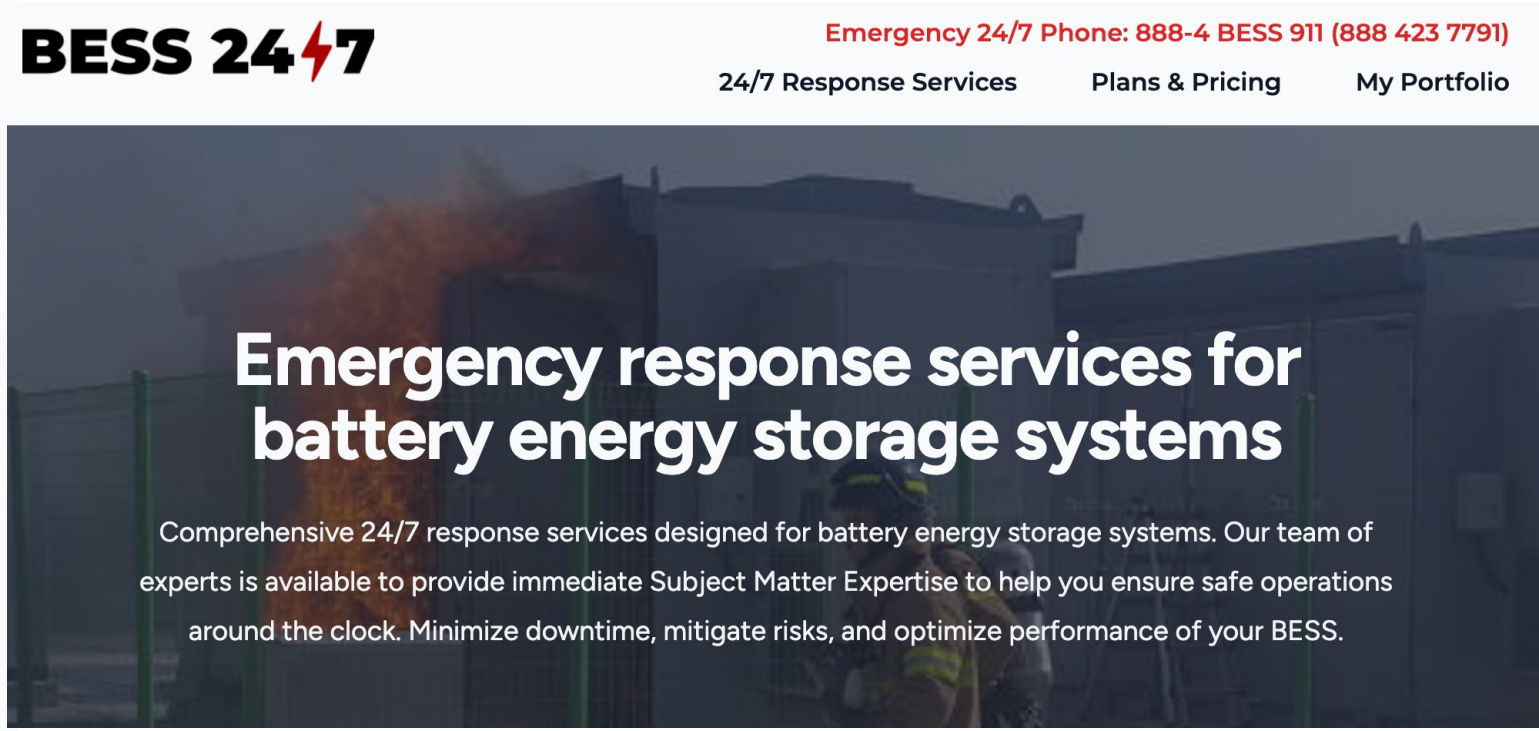
In an emergency, having experts on site can help minimize damage and mitigate risks. Our team of experts will help ensure a safe, effective response to your emergency.

### Emergency Response Plans

Developing a thorough Emergency Response Plan (ERP) is the first step to being prepared for an emergency. Our team of experts can help you develop a comprehensive ERP that will have you covered in any emergency.

### Fire Department Training

To be effective when dealing with a BESS emergency, your fire department must be properly trained on the hazards and mitigation strategies specific to your site. Our expert instructors can train fire department personnel on everything they need to know to be prepared for an emergency at your site.





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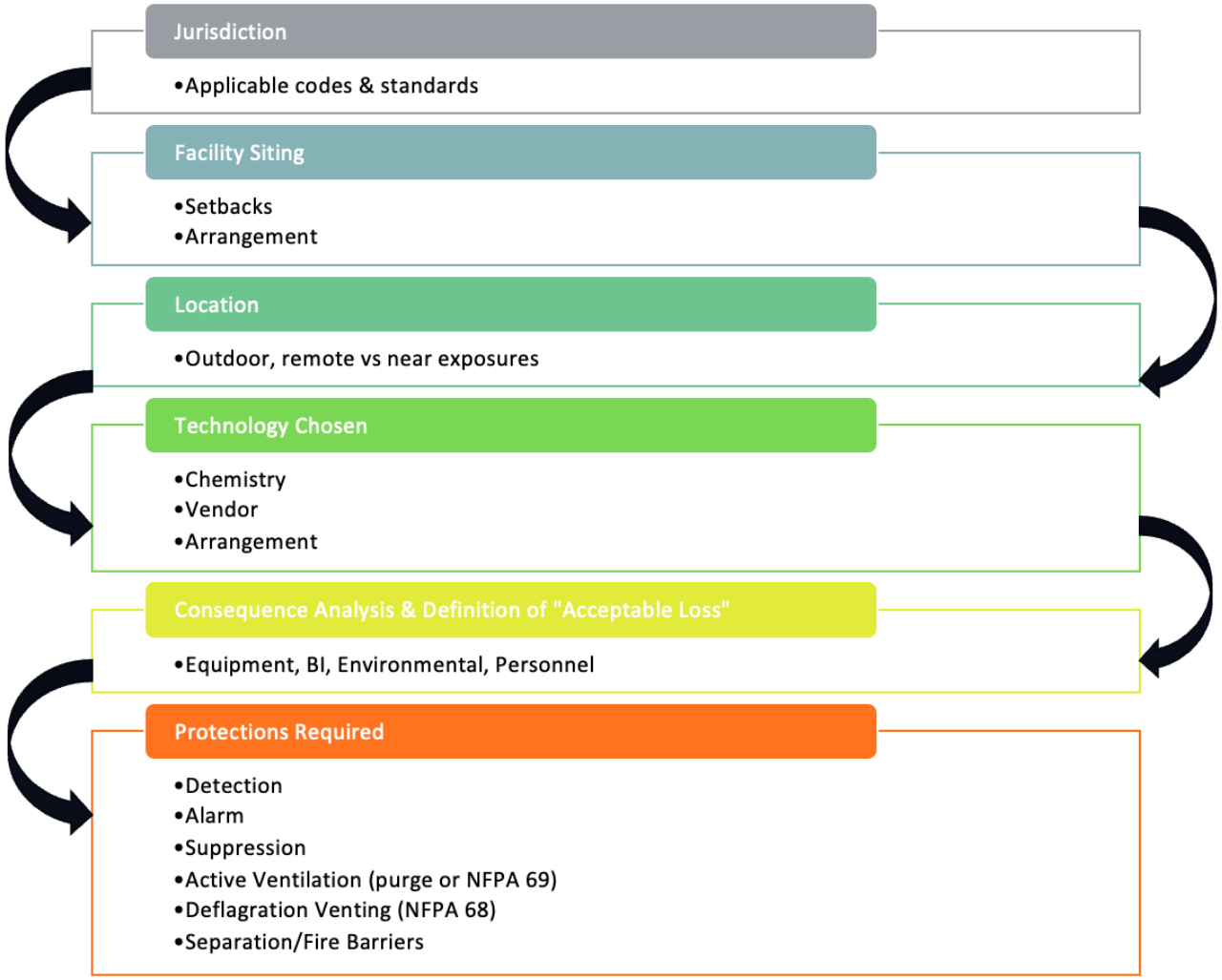
# Summary

- Goal is to minimize the probability of something occurring, but to plan as if it will
- Build robust product level systems to mitigate the consequences
- Analyze potential impacts
- Plan site accordingly
- Educate and train





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# Q&A


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