Con Edison – NYSERDA Battery Safety Testing Project

Con Edison:

Amaury De La Cruz, Jin Jin Huang, Britt Reichborn-Kjennerud

NYSERDA:

Jason Doling

Project Motivation

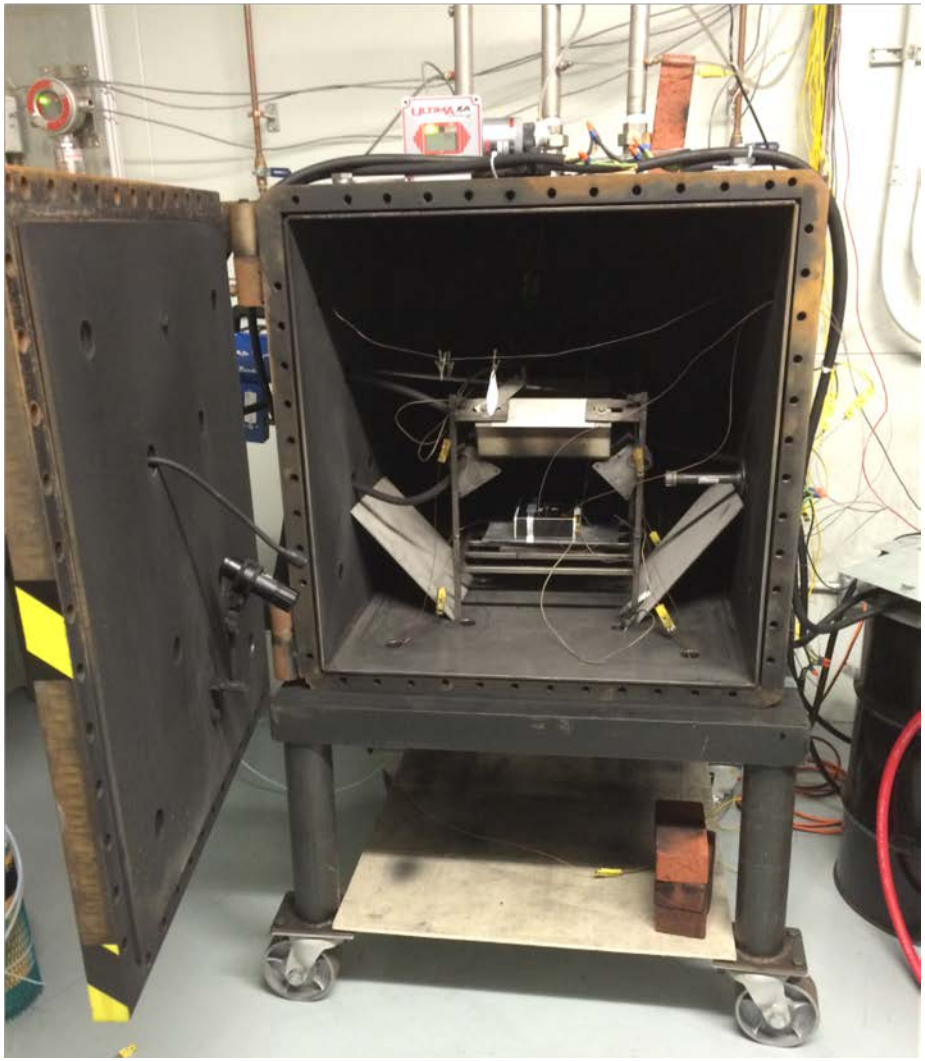
- Con Edison peak demand reduction programs require innovative customer and utility sited solutions including energy storage
- Energy storage can help meet NYS policy objectives for peak demand reduction, renewable integration, and greenhouse gas reduction
- Current NYC building and fire codes limit the use of energy storage to Uninterruptible Power Supply (UPS) applications
  - Approval process for peak demand applications adds significantly to project development schedule and cost
- Battery safety hazard assessment and first responders' guidelines are needed
  - Safety information gaps existed in the testing literature and standards are evolving
  - Prescriptive measures in permitting required for efficient project planning
- Project activities developed in collaboration with FDNY and NYC DOB
- Testing and modeling performed by DNV GL in collaboration with Rescue Methods firefighters

Project Activities

- Literature review
- Small scale cell testing
  - Heat release rate
  - Gases, Liquids and Solids released
  - Explosivity
- Suppression effectiveness testing
- Module burn and suppression tests
- Computer modeling to predict larger system behavior
- Final Report February 2017 – “Considerations for ESS Fire Safety”
  - https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Energy-Storage/20170118-ConEd-NYSERDA-Battery-Testing-Report.pdf

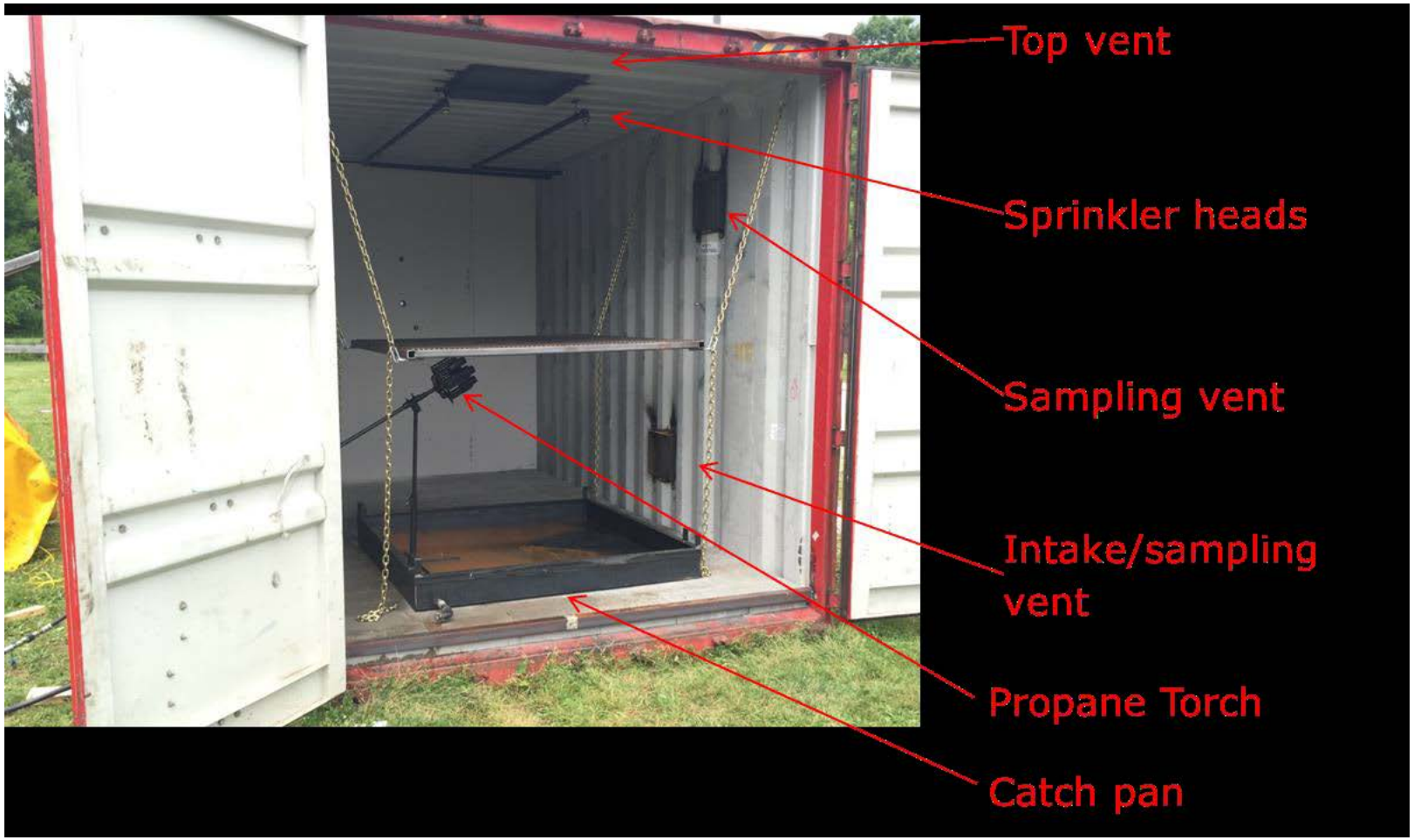
Chemistries and Suppressants Tested

- Batteries Tested:
  - Lithium Ion:
    - 4 Nickel Cobalt Manganese (LG Chem, Samsung SDI, Electrovaya, Kokam)
    - 2 Iron Phosphate (BYD and XO Genesis)
    - 1 Titanate (Toshiba)
    - 1 BM-LMP (C4V)
  - Lead Acid (EnerSys)
  - Vanadium Redox Flow (UniEnergy Technology)
- Suppressants Tested:
  - Water, Pyrocool, F-500, FireIce, Stat-X aerosol agent



Cell burn chamber at DNV BEST Test Lab

Module Testing Setup



(Photo Credit: Rescue Methods / DNV GL)

High Level Takeaways

- Existing building codes and engineering controls can be adequate in many cases to handle battery safety issues.
- Legacy codes could provide insightful interim requirements for battery systems used in energy management, provided that technical and practical engineering considerations are made.
- All of the battery chemistries tested demonstrated flammability and toxicity safety hazards.

Extinguishing Conclusions

- Gas-based agents:
  - Can reduce flammability in an enclosed environment and put out single battery fires.
  - Should not be considered an adequate cooling measure.
- Water demonstrated the highest cooling efficacy of all extinguishing agents tested.
  - Can cause collateral damage to remainder of system, therefore recommended as secondary system to a dry system.
  - The report provides recommended water flow rates per kg of battery mass; calculations are very conservative and can likely be reduced with further testing.
  - Systems with adequate internal cascading protections will minimize the water volumes required for extinguishing.

Ventilation Conclusions

- The gases emitted are also found in typical plastics fires in up to 20-50 times greater time-averaged quantities.
  - The toxic emissions from fires in this study can generally be managed by today's engineering controls
- Forced ventilation is recommended for first responders, even after the fire has been extinguished.
- For nearly all chemistries, toxicity considerations dominate the ventilation need rather than flammability.

Do tested technologies automatically become eligible for approval by an AHJ?

- No. Testing was designed to provide clarity and data surrounding key questions and uncertainty in the event of a battery fire, whether through an internal fault or introduced from within a building.
- Results are intended to help AHJs develop clearer permitting requirements and be able to review applications with a better understanding of risks and mitigation approaches.
- Authority to approve applications rests solely with the AHJ.

Next Steps

- Possible additional testing on the horizon:
  - Constrain suppression needs
  - Address emerging battery chemistries
  - Larger scale burn testing to develop more robust models
- Recently awarded NYSERDA RFP 3407 provides assistance to AHJs with developing storage siting requirements and permitting guides
  - Includes guidance on assimilating the learnings from the “Considerations for ESS Fire Safety” report

For More Information

- Full report available at: https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Energy-Storage/20170118-ConEd-NYSERDA-Battery-Testing-Report.pdf
- Executive summary available at: https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Energy-Storage/20170118-ConEd-NYSERDA-Battery-Testing-Report-ExecSummary.pdf
- Contacts for further information:
  - Con Edison: Britt Reichborn-Kjennerud, R&D Senior Specialist, reichbornb@coned.com
  - NYSERDA: Jason Doling, Energy Storage Program Manager, jason.doling@nyserda.ny.gov
  - DNV GL: Davion Hill, Energy Storage Lead davion.m.hill@dnvgl.com, Nicholas Warner Nicholas.Warner@dnvgl.com