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”
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

- Top vent
- Sprinkler heads
- Sampling vent
- Intake/sampling vent
- Propane Torch
- Catch pan

(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


• 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