Lithium Ion Battery Energy Storage Safety Lessons from Snohomish County PUD

March 4, 2020
AGENDA

• Who is Snohomish PUD?
• PUD’s Battery Energy Storage Systems
• Fire suppression - Retrofits - MESA 1
• Fire suppression - New Construction - Arlington Microgrid
• Lessons learned so far…..
• Questions
About Snohomish County PUD

- Snohomish County & Camano Island
- Second largest PUD in the state.
- Began operation in 1949
- Serves population of about 817,000
- 353,000 customers and growing
- ~85% of our power is from BPA
- 3-Elected commissioners

- **Five generation systems**
  - Jackson Hydroelectric Project – 100 MW
  - Young’s Creek Hydro Project – 8 MW
  - Woods Creek Hydro Project – 650 kW
  - Hancock Creek and Calligan Creek – 6 MW each

- **Two existing battery storage systems** – MESA 1 and MESA 2

- **Third battery energy storage system**
  - The Arlington Microgrid
PUD’s Energy Storage Portfolio

Bonneville Power Association

Snohomish PUD

Transmission

PUD System

Distribution

MESA 1A
MESA 1B
MESA 2
Arlington Microgrid MESA 3
MESA N

Lithium Ion
2MW / 1 MWh

Vanadium Flow Battery
2.2 MW / 8 MWh

Lithium Ion
1MW / 1.3MWh w/ 500kW Solar

w/ 500kW Solar
- MESA 1A – Lithium Ion
  - Mitsubishi - GS Yuasa batteries
  - Parker Hannifin Power Conversion
  - 1MW/0.5MWh
  - Project Complete – July 2015
- MESA 1B – Lithium Ion
  - LG Chem batteries
  - Parker Hannifin Power Conversion
  - 1MW/0.5MWh
  - Project Complete – February 2016
MESA 1 – Existing Fire Suppression Systems and Plan

• Four Smoke and Fire Detectors – hardwired to remote annunciator
• FM200 triggered if two detectors are activated
• Audible alarm and flashing light
• RTDs to provide battery temp to SCADA even when auxiliary power is lost.
• Arc-flash detection relaying
• Closed loop HVAC system to keep container at 72°F and constant humidity
• Reviewed by PUD’s insurance company and Fire Department
• Hazardous Material Management Plan – detail how to store, transport, monitor and respond to emergencies
• Training with PUD crews and local Fire Department
MESA 1 – Retrofit Fire Suppression Systems Equipment and Plan

- Two Stage System
- Stage 1: Existing FM200 system
- Stage 2: Deflagration prevention exhaust and deluge
  - Deluge system – Dry sprinkler system with Fire Department connection (FDC)
  - Automatic and/or Manual Venting control for prevention of deflagration gas build-up
  - Thermal Camera installed
  - HMI displayed on laptop so systems can be viewed remotely by PUD crews and Fire Department prior to deluge activation
- Revised - Insurance company and Fire Department review
- Revised - Hazardous Material Management Plan
- Revised - Training with PUD crews and local Fire Department
Arlington Microgrid BESS – 1MW / 1.3MWh
ABB and Samsung SDI
Mitsubishi & Nissan 2020

ABB 2020

A&R Solar 2019
Fire Suppression System Basis of Design

• DNV GL Final Report for Consolidated Edison, New York, NY
  Considerations for ESS Fire Safety -
  Report No. OAPUS301WIKO (PP151894), Rev 3, January 18, 2017

• New York Fire Department
  608-01 outdoor stationary battery systems 4-23-19 publication draft.doc
  Notice of Public Hearing and Opportunity to Comment on Proposed Rule –
  Section 608-01 to Title 3 - Rules of the City of New York - Outdoor Stationary Battery Systems
Because cooling is an inevitable need, a fixed suppression gas agent may reduce or mitigate flammability in an environment until ventilation and/or cooling strategies are implemented.

While the use of water demonstrates excellent cooling capability, it also potentially shorts out undamaged cells or neighboring modules. The use of water is a fully committed extinguishing tactic that is highly likely to result in a total loss of the asset. Because it was noted that the aerosol test demonstrated extinguishment of the fire upon execution, aerosols can potentially serve as an initial attack for the fire followed by water as a backstop.

Therefore, DNV GL recommends the following:

- **Stage 1:** If a system can limit cell cascading, a gas based suppression system may be considered for the first stage of fire fighting to extinguish a single cell fire and prevent flashover in a contained environment.
- **Stage 2:** If temperatures continue to rise or if an increasing level of smoke and gas is detected, forced ventilation and water extinguishing should be considered to cool the system and prevent further propagation of fire.

Stage 1 provides an opportunity for avoiding collateral damage and total asset loss. Stage 2 provides a backstop for a situation when more than one battery cell is on fire. Both stages may also include some form of alarm or notification external to the battery system that notifies first responders of elevated risk.
Microgrid - BESS Details

Two Stage System based on DNV GL and NYFD reports and recommendations

• First Stage:
  • Li-Ion Tamer - thermal run-away off-gas detection
  • Smoke and heat detector with horn strobe on the outside of container
  • Clean Agent Fire suppression system – Novec 1230

• Second Stage:
  • Heat / Gas Detection / Timer to activate mechanical exhaust for removal of explosive gases (TBD)
  • Water – fire sprinkler deluge type system – dry pipe system connected to an FDC – Fire Department connection approximately 100’ away from containers. Based on battery energy management (BEMS) fire data screen.
Battery Energy Management System (BEMS) Display

- **The BEMS display** shall be located in the Clean Energy Technology Center building fire control room.

- **At a minimum the screen shall display the following:**
  - Smoke and Heat detection system status
  - Stage 1 clean agent system status
  - Battery module and container temperatures
  - Gas Detection System status
  - Grid connection system status
  - Battery Stage of Charge (SOC)

- A username and password **shall not be** required.
Lessons Learned so far ........

- Retrofits are difficult and expensive
- Deflagration Exhaust
  - Think about location and type? Separate fan or HVAC Economizer mode?
  - Automatic (timer or via gas detection) – or - Manual?
- Deluge Water System
  - Dry or Wet type?
  - Automatic or with Fire Department connection?
  - FDC should be located 100’ - 200’ away from container and within 50’ +/- of a hydrant
  - Do you need containment?
  - Will the doors hold water and how do you drain the container?
- Coordination and training with local agencies and fire department
- Training with internal PUD crews
- Insurance company notification
Thank you!

Questions?

Scott Gibson, P.E
hsgibson@snopud.com