

Energy Storage Safety & Reliability Forum

The Arlington Microgrid - Lessons Learned



About Snohomish County PUD

- **Snohomish County & Camano Island**
- 2nd largest public electric utility in the Pacific Northwest
- **Began providing electric service in 1949**
- Serves population of over 907,000
- **367,000 customers and growing**
- ~ 80% of our power is from Bonneville Power Administration
- **3 elected commissioners**



- **Five hydro generation systems**
 - Jackson – 100 MW
 - Young’s Creek – 8 MW
 - Hancock Creek – 6 MW
 - Calligan Creek – 6 MW
 - Woods Creek – 650 kW
- **Two existing battery energy storage systems**
 - MESA 1 and MESA 2
- **Third battery energy storage system**
 - Arlington Microgrid

MESA 1

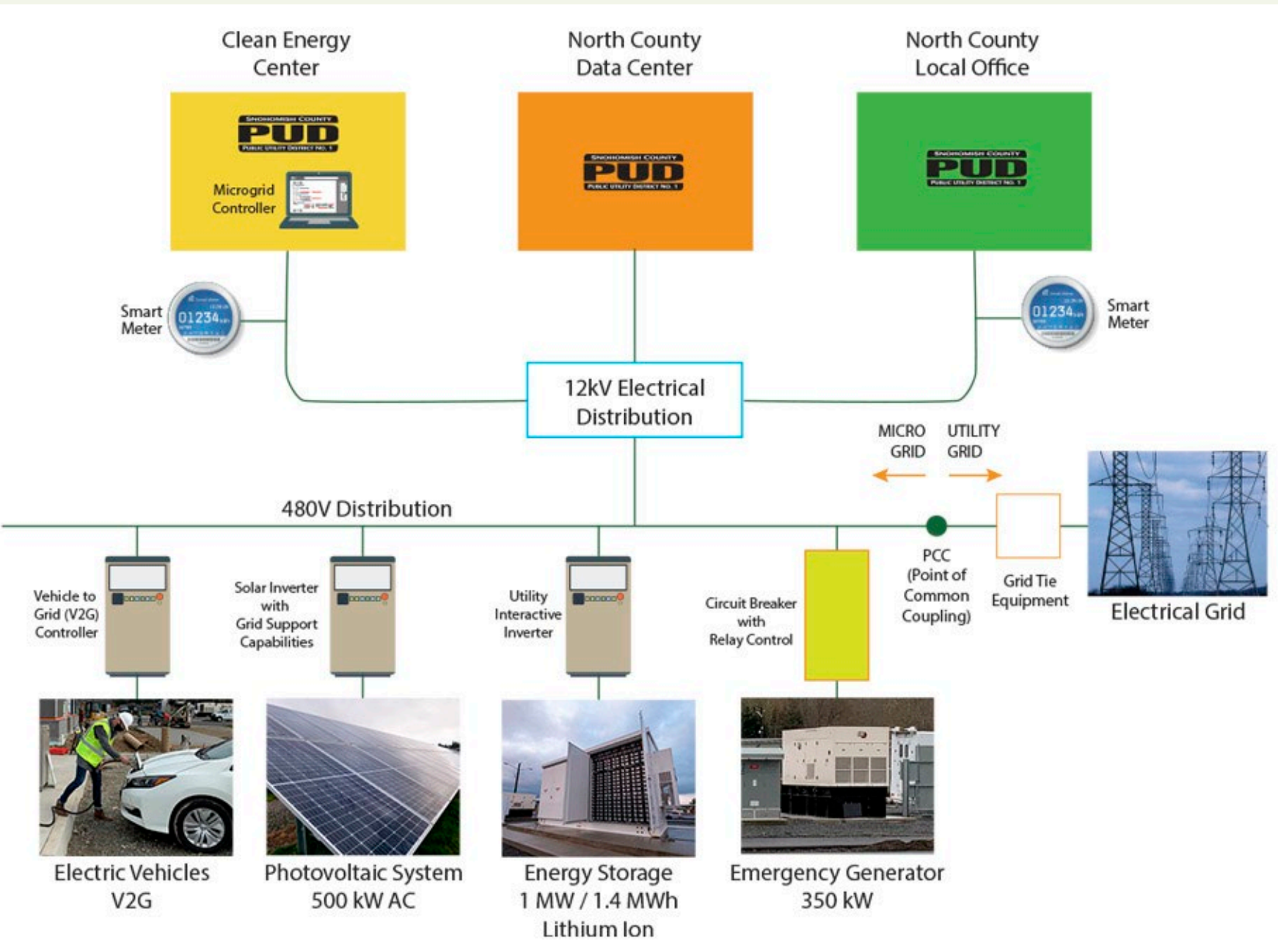


- **MESA 1A – Lithium Ion**
 - Nickel Manganese Cobalt (NMC)
 - 1MW/0.5MWh
 - Project Complete
July 2015
- **MESA 1B – Lithium Ion**
 - Nickel Manganese Cobalt (NMC)
 - 1MW/0.5MWh
 - Project Complete
February 2016

MESA 2

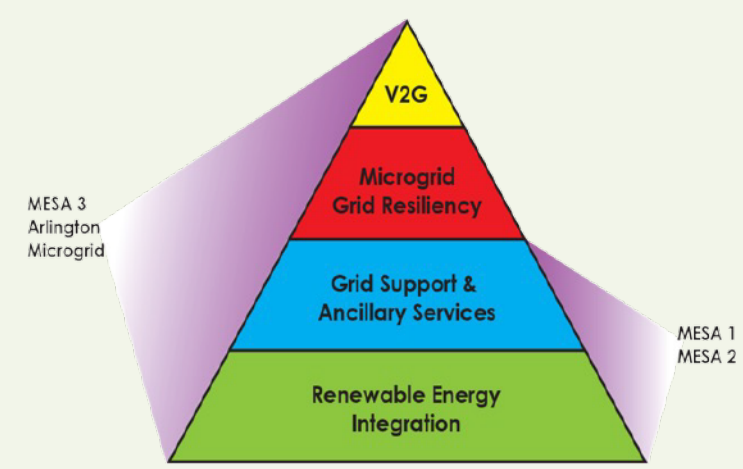


- Vanadium Redox Flow Battery
 - 2.2 MW / 8 MWh
- Constructed early 2017
 - WA State Clean Energy Funds (CEF1)
- Challenges
 - Inadequate availability
 - Mechanical (pumping) issues
- Decommissioned 2022



Arlington Microgrid

The multiple uses of energy storage





Clean Energy
Center

V2G Electric Vehicles

PowerStore
BESS

Generator

480V
Switchgear

12kV:480V
Transformer

500kW_{AC} Solar PV
1620 x 380W Panels

Goals and Use Cases

- **Grid Resiliency and Disaster Recovery**

- Provide back-up power to the Clean Energy Center, a data center and a future office building.
- Back-up office site in the event of a regional disaster.

- **Renewable Energy Integration**

- Demonstrate integration of intermittent renewable energy resources – solar smoothing.

- **Grid Support**

- Energy Arbitrage (aka “peak shaving”)

- **V2G (Vehicle-to-Grid)**

- Demonstrate how electric fleet vehicles can provide grid support.

Project Timeline

Planning and Design

- **WA Clean Energy Fund Grant: \$3.5M**
 - **2017 to 2022**
- University of Washington - Reports
 - 2017 to 2022
- Burns & McDonnell – Design
 - 2017 to 2022

Construction

- Phase 1: Site Work: Aug – Dec 2018
- Phase 2: Solar: March – June 2019 (A&R Solar)
- Phase 3: Equipment and Controls contract: 2019 – 2021 (Hitachi Energy)
- Phase 4: Facilities – Clean Energy Center & Data Center: 2019 – 2020 (Moon Construction)
- Phase 5: Microgrid Civil Construction: June – July 2020 (Trimaxx Construction)
- Phase 6: Microgrid Construction: April 2020 – Dec 2020 (Substation Crews)
- Testing and Reports: 2021 – 2022, (UW & PNNL)

Arlington Microgrid (2018)



500 kW AC Solar Array (4/30/19)



Construction paused due to COVID-19 (3/23/20)



Socially distanced construction resume (6/1/20)



Installing the Battery Energy Storage System (11/17/20)



Installing the Samsung Battery Modules (11/19/20)



PowerStore 1MW / 1.4MWh - Battery Energy Storage System

- Hitachi Energy solution includes:
 - Controller
 - Integrated Power Conversion System
 - Batteries (Samsung SDI M3)
 - Battery Management System (BMS)
 - AC/DC protection
 - Outdoor rated container
 - Climate control (HVAC)
 - Fire protection
- PowerStore Grid Forming (GFM) Power Conversion System
 - Enables seamless grid connected to islanded transition
 - Can operate in virtual generator mode (VGM)



Vehicle-to-grid (V2G)

- 2 x Level 2 chargers (Mitsubishi Electric)
 - 6kW bi-directional charger
- 2 x Electric Vehicle
 - Nissan Leaf
 - 40kWh and 62kWh
- Microgrid Control
 - When islanded
- DERMS Control
 - When grid connected



Clean Energy Center > Demonstration and Learning

- Microgrid Test Load
- Tours for:
 - K-12 Schools
 - Universities
 - Other Utilities
 - Public Agencies
 - Vendors



BESS Fire Safety > Design, Planning & Training

- **Comprehensive System Level Approach**
 - Select reputable, well-established vendors
 - Focused on quality and safety
 - Modules and Battery Mgmt System
- **Proper environmental controls**
 - Heating, cooling and humidity
- **Engage Authorities Having Jurisdiction (AHJ)**
 - Codes – WA State Fire Code, NFPA 855
- **Continuous Training**
 - First responders – Fire Department
 - SnoPUD crews



Initial - Fire Suppression System Basis of Design

- **Prior to April 19, 2019 - Arizona Public Service McKicken Battery Storage Facility Incident**
 - **2015 - Washington State Fire Code – adopted in 2016**
 - **Did not address Lithium-Ion batteries**
 - **Design included minimal fire safety equipment**
 - **Smoke detection**
 - **Clean Agent – FM 200**



Arizona Public Service (APS) McMicken Battery Storage Facility Incident

- On Friday, April 19, 2019 at approximately 5pm, a battery storage fire occurred in Surprise, AZ
- Fire and hazmat responders were dispatched to the site in communication with APS personnel
- At approximately 8pm, a secondary failure occurred; this event was referred to as an explosion
- Nine first responders were injured

Final - Fire Suppression System Basis of Design

- **Post April 19, 2019 - Arizona Public Service McKicken Battery Storage**
- **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

DNV GL - ESS Fire Safety Report Summary

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.

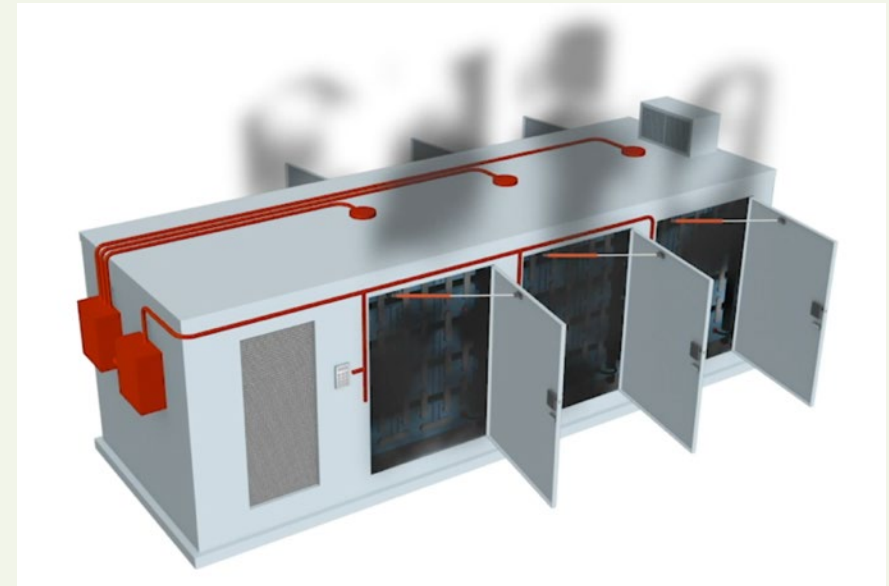
Therefore, DNV GL recommends the following:

- **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.

Additional Fire Safety Equipment added

- ***PNNL IntelliVent™ System***
 - *Meet future code requirements for deflagration gas venting*
 - *Currently - open all battery container doors 10 min after clean agent is triggered.*
 - *Doors are held closed with magnetic locks*
 - *Adding future system to immediately open doors if heat is detected on battery modules*



BESS Safety: Four-stage System

1st Stage: Early warning

Li-ion Tamer to detect off-gas before thermal runaway

Stop charging or discharging

Open AC / DC contactors

2nd Stage: Smoke Detection

VESDA (Very Early Smoke Detection Apparatus)

Novec 1230 Clean Agent Fire suppression system

Horn strobe on outside of container

Signal to Fire Department and Snohomish PUD

3rd Stage: Gas Venting

10-minutes after Novec 1230

Mechanical exhaust to remove explosive gases, with back-up manual switch.

PNNL Intellivent, automatically opens all container doors to remove explosive gases and provide visual inside container

4th Stage: Water/Deluge

Fire sprinkler water deluge System

Dry pipe to a Fire Department Connection (FDC) ~100' away from container

Water can also be sprayed directly on batteries through open doors.



Thank you !

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