Northwest Energy Systems Symposium

Snohomish County PUD
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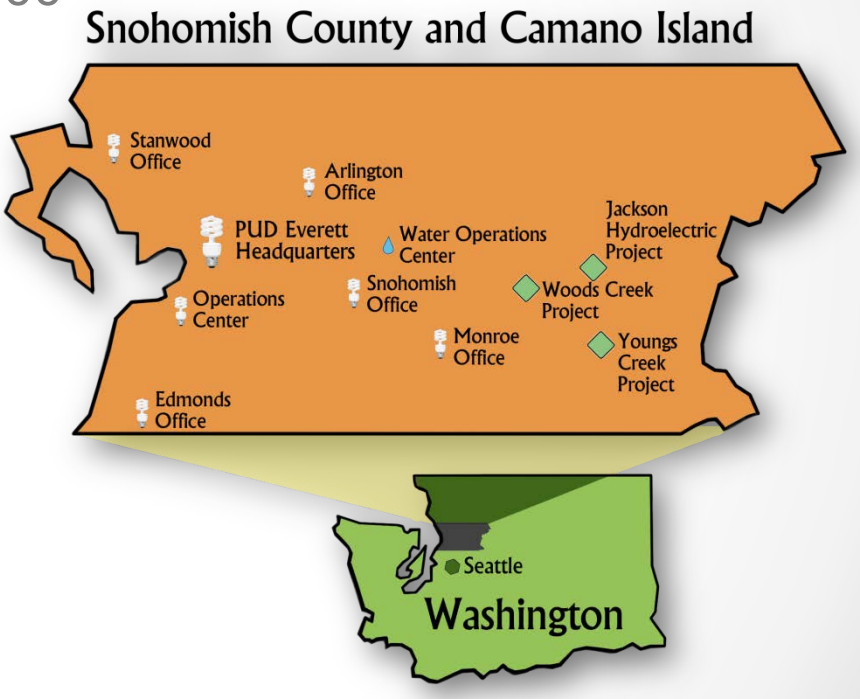
Snohomish County PUD Company Profile

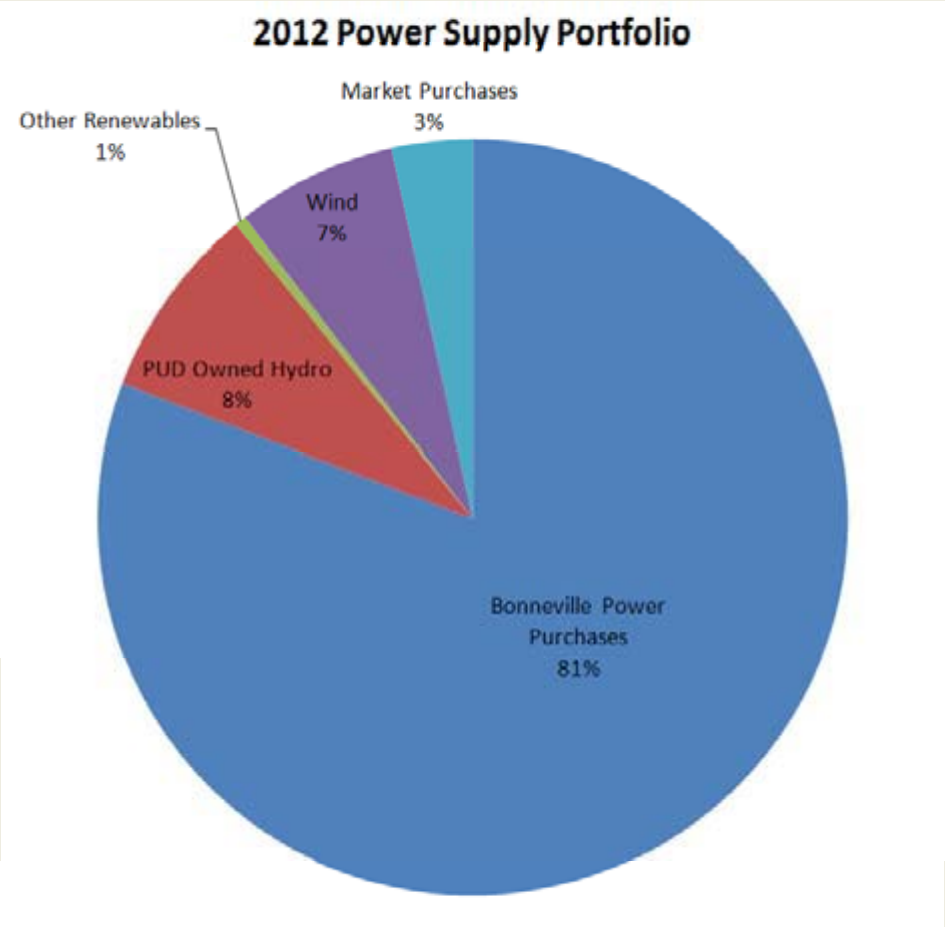
- **Total Electrical Customer:** 324,000
- **Energy Sales:** 9,194,554 MWh
- **Generating Capacity:** 120 MW
- **Residential Rates:** 9.3¢ per kWh
- **# of Substations:** 86
- **# of Circuits:** 396
- **Resource Mix:** 8% Renewables



Energy Storage

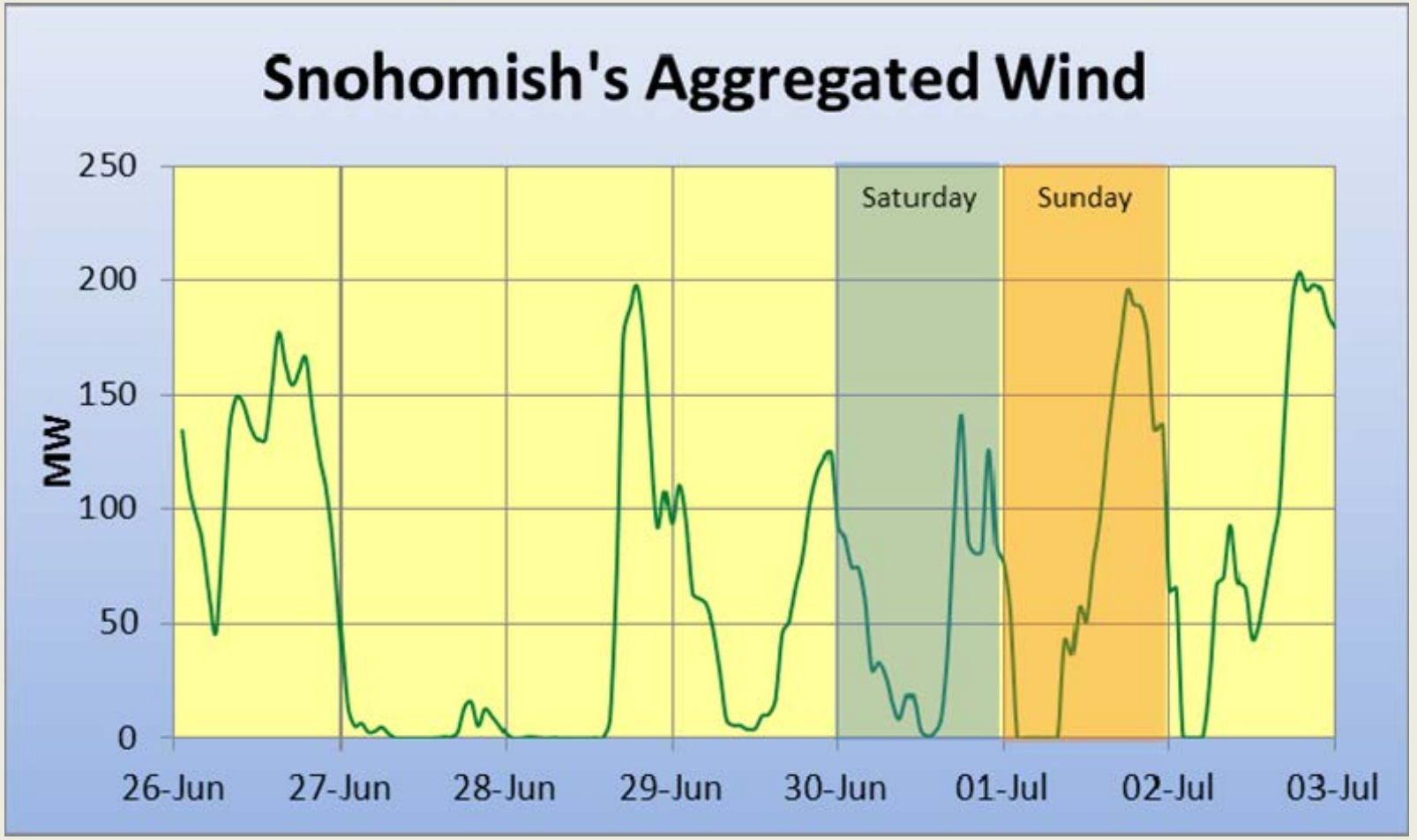
- Various Types
  - Large Batteries, Flywheels, Compressed Air, Pumped Hydro
  - Connected directly to the Electrical System
- Allows the generated power to be stored until it is needed by the end customer.

Why is Energy Storage needed?



Challenge:
Meet load growth and renewable portfolio standard requirements without the use of fossil fuels

Renewable Energy is Variable



Other Use Cases

- Integration of Distributed Generation
- Increased Reliability
- Optimize use of electric system
  - Maximize use of existing infrastructure and limit further expansion.

Modular Energy Storage Architecture (MESA)

- Current grid energy storage offerings
  - Expensive ($100k for 25 kw-hr system) →
  - Lack modularity
  - Lack interoperability
  - Lack scalability
  - Lack standardization
  - Monolithic; vendors operate beyond core expertise

For $30k you can get 24kw-hr of Li-ion storage with a Nissan Leaf wrapped around it…

- Large gap between battery manufacturers and utilities
  - Core suppliers cannot easily serve core customers

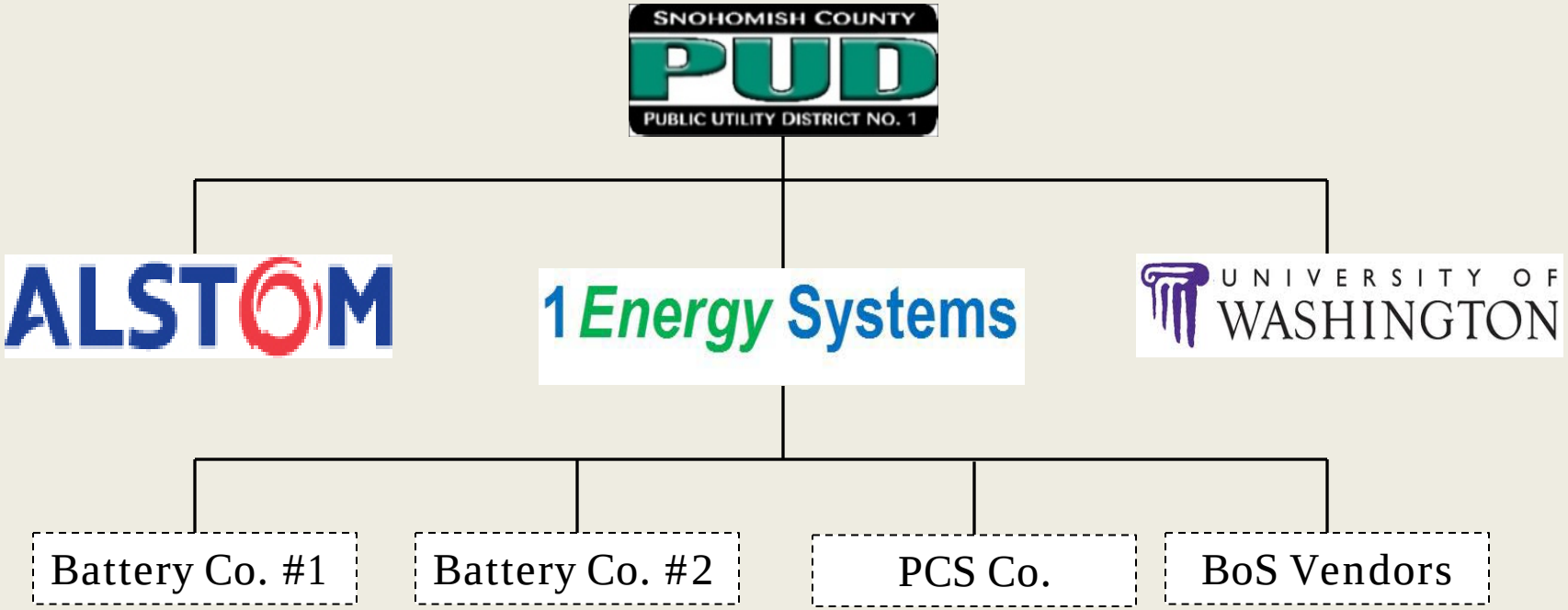
Opportunity

- Implications:
  - Utility market for significant-scale battery based storage is very small and slow growing
  - Projects to-date are either highly optimized one-off niche projects, or small learning/demonstration projects
  - Decreasing battery prices alone are unlikely to stimulate utility energy storage market growth significantly
- Opportunity: focus on architecture and standardization
  - Develop and deploy “Modular Energy Storage Architecture” (MESA)

Project Specifics

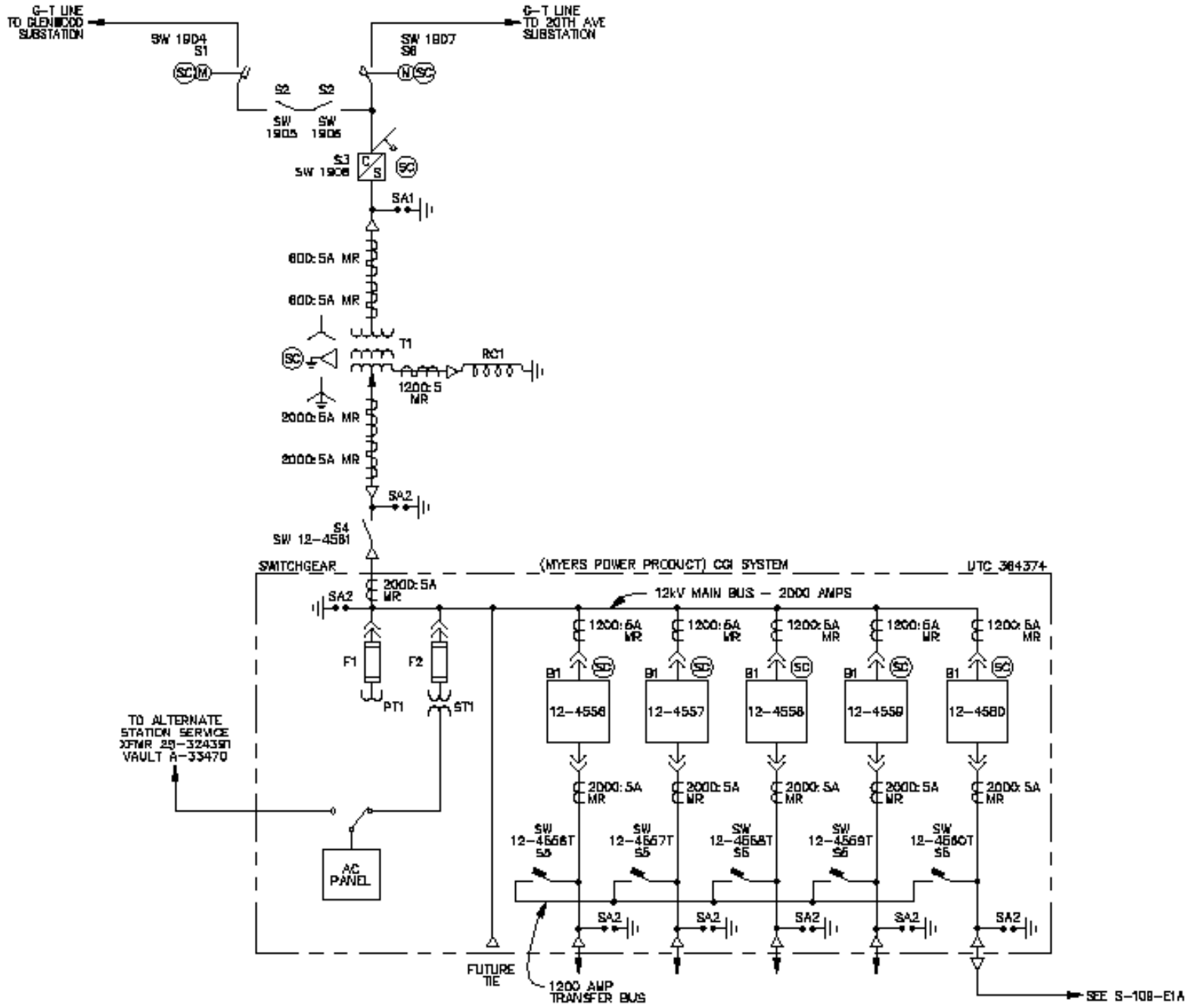
- 2MW/1MWH Lithium – Ion System
- Deploy at Hardeson Substation
- Integrate into SCADA system and Power Scheduling software

Project Organization



Project Deliverables and Schedule

- Deliverables
  - Design, deploy, and test first modular, component-based utility energy storage system
  - Demonstrate multi-vendor solution (batteries, PCS, software)
  - Integrate into District's communication and control systems.
- Schedule
  - Design: through 1Q 2014
  - Implementation: 2Q 2014 through 4Q 2014


G-T LINE
TO GLENWOOD
SUBSTATION
SW 1904
S1
G-T LINE
TO 20TH AVE
SUBSTATION
SW 1907
S8
S2
S2
SW
1905
SW
1906
S3
SW 1908
SA1
600:5A MR
600:5A MR
T1
RC1
1200:5
MR
2000:5A MR
2000:5A MR
SA2
S4
SW 12-4581
SWITCHGEAR
(MYERS POWER PRODUCT) CGI SYSTEM
UTC 364374
2000:5A
MR
SA2
12kV MAIN BUS - 2000 AMPS
1200:5A
MR
F1
F2
PT1
ST1
B1
12-4556
12-4557
12-4558
12-4559
12-4560
2000:5A
MR
SW
12-4556T
S5
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12-4557T
S5
SW
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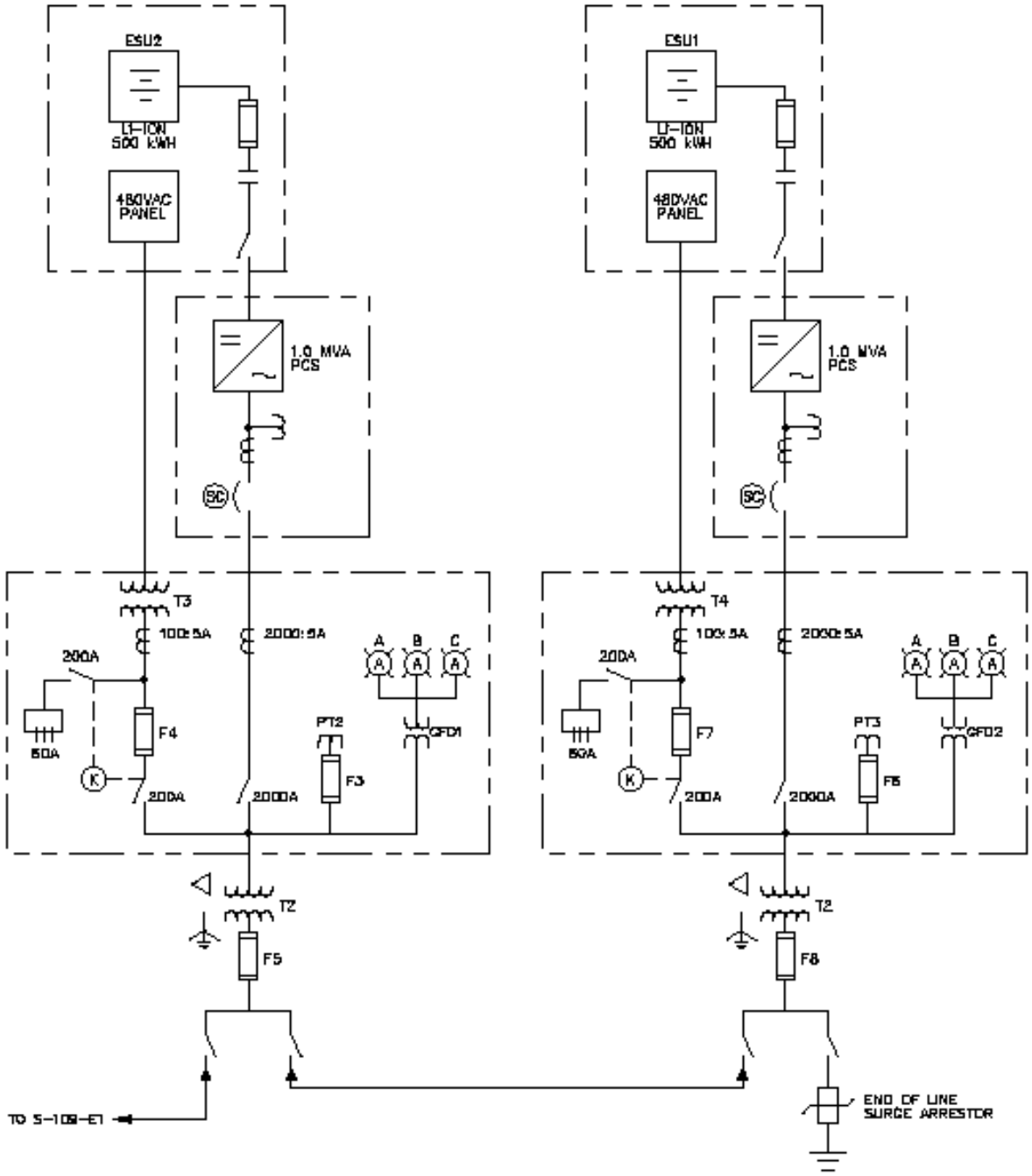
S5
SW
12-4559T
S5
SW
12-4560T
S5
SA2
TO ALTERNATE
STATION SERVICE
XFMR 25-324391
VAULT A-33470
AC
PANEL
FUTURE
TIE
1200 AMP
TRANSFER BUS
SEE S-108-E1A


ESU2
LI-ION
500 kWH
480VAC
PANEL
1.0 MVA
PCS
SC
T3
100:5A
2000:5A
200A
A
B
C
F4
50A
PT2
CFD1
F3
200A
2000A
T2
F5
ESU1
LI-ION
500 kWH
480VAC
PANEL
1.0 MVA
PCS
SC
T4
100:5A
2000:5A
200A
A
B
C
F7
50A
PT3
CFD2
F6
200A
2000A
T2
F8
TO S-109-ET
END OF LINE
SURGE ARRESTOR

System Design

- Communications
- Protection
  - Utility relaying
  - Arc Flash Detection
- Operating Modes
  - Charge Discharge, Generation/Load Following, Peak Limiting, Fixed PF, PF Limiting, Schedules, Real Power Smoothing, Dynamic Volt-Watt Mode
- Fire Suppression System
  - Hardwired SCADA alarm
  - Strobe Light

Design continued

- Permitting
- Hazardous Material Management Plan
  - Response to Emergency
  - Handling and transport of batteries
  - Spill response
- Maintenance of System
  - Batteries typically not 100% discharged
  - Cooling System
- Design requires input from various stakeholders across utility