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# Energy Storage Demonstration and Analysis

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# Projects

**Mission:** Advance energy storage systems in cost effectiveness, performance, safety and reliability

- Feasibility Study
  - Cordova, Alaska
- Factory Acceptance Testing, Commissioning and Analysis
  - Puget Sound Energy
- Application and Optimization
  - Base Camp Integration Laboratory

# Cordova Hydroelectric/Energy Storage Feasibility Study



- Players
  - Cordova Electric Cooperative (CEC)
  - DOE/OE and Sandia National Labs (SNL)
  - Alaska Center for Energy and Power (ACEP)
- Issue
  - Expansion of fishing industry has exceeded the supply capability of the 8.5MW hydroelectric plants which supplemental power demand is met with diesel generation.
  - Supplemental power by diesel generation is only needed for minutes
  - Hydro units are run with a 500kW reserve which energy storage can free up and defer diesel generation
- ACEP with SNL and has developed an energy balance model to determine feasibility of an energy storage system installed on the Cordova system





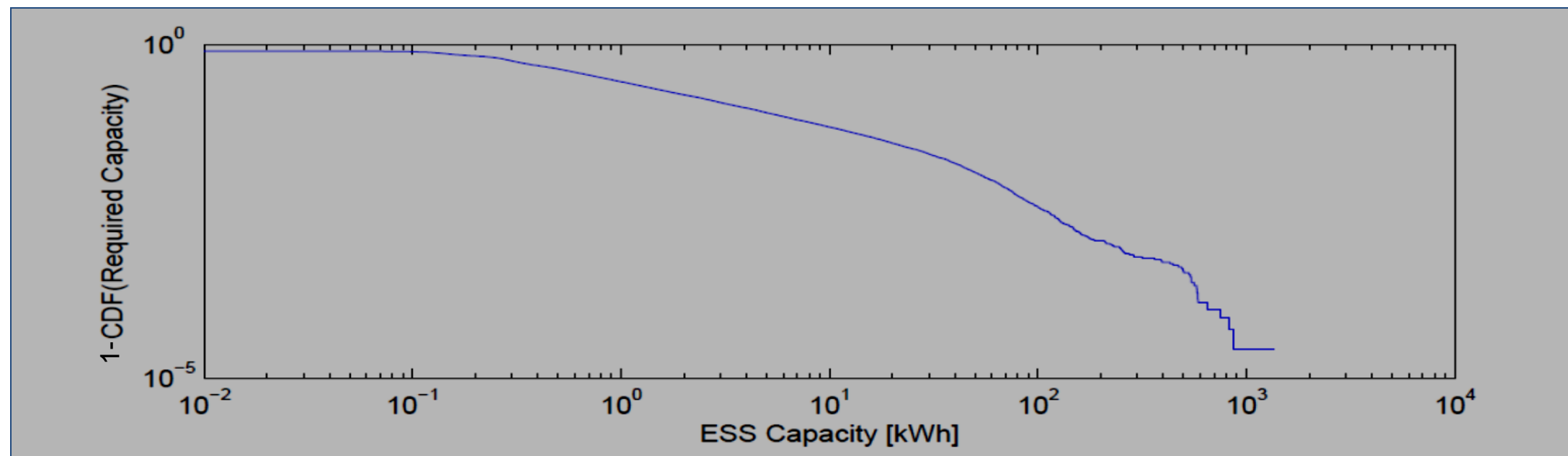
# Cordova Electrical System Overview

- Member-owned COOP serving 2,000 Customers with summer load peak of 8.4 MW
- Generation Assets
  - Pump Creek: 2 hydro units, 3 MW each
  - Humpback Creek: 2 hydro units, 1.25 MW each
  - Orca Power Plant: 5 diesel units, Total of 9.8 MW
- Distribution system is underground
- SCADA system records over 200 channels of systems data at 1 second intervals with over 10 years worth of data

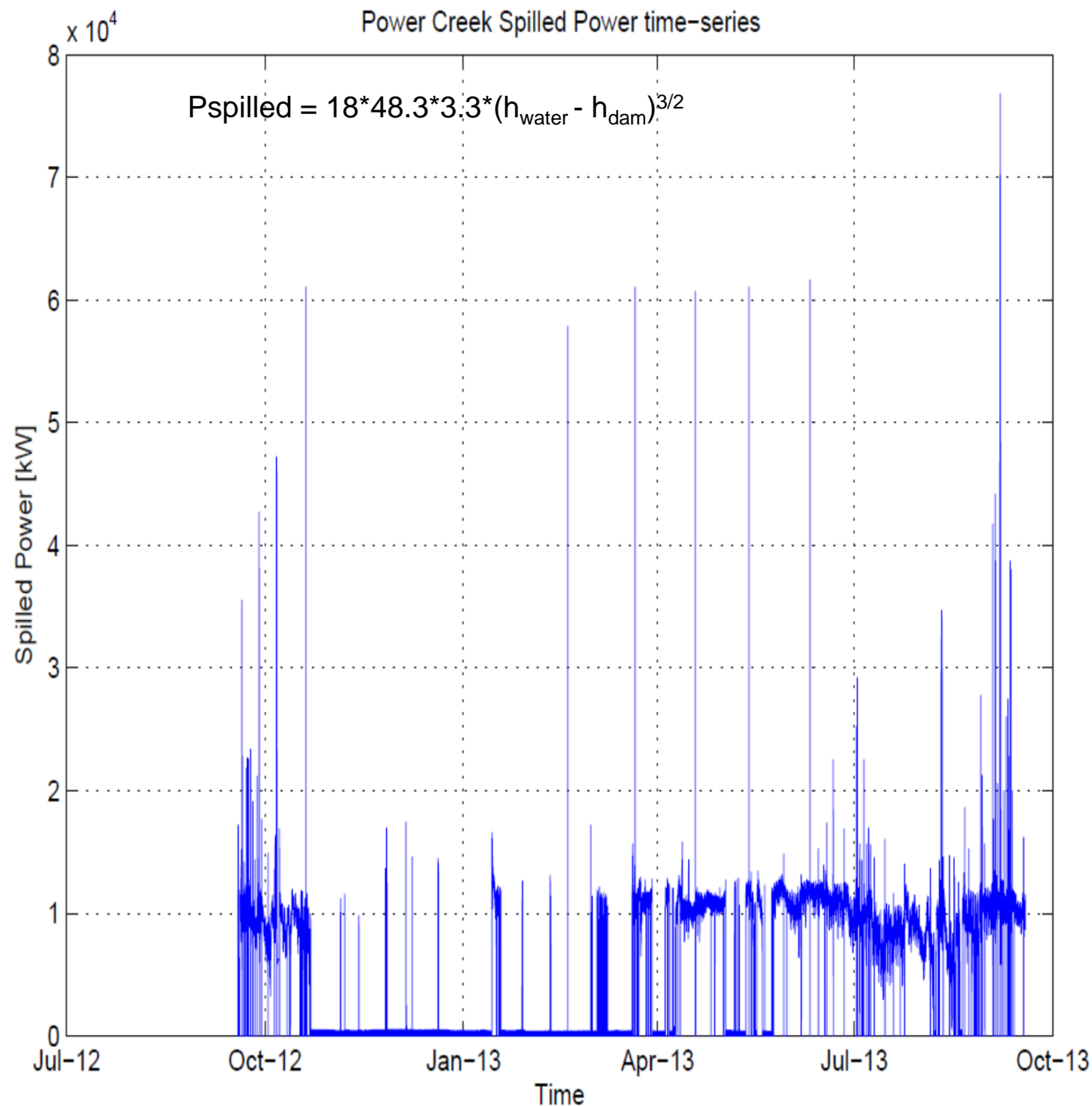


# Results of Energy Balance Model

- Total hours per year within 500kW of spinning reserve while running on hydro power was 215.9167 hours
- Total displaceable diesel hours is 185.4589 hours
- Assuming electricity cost of \$0.45/kWh, economic value of energy storage systems is ~\$54,640/year
- Power class energy storage system will not have significant economic benefit for Cordova used for diesel displacement



# Summary/Conclusions



- Recovering water spilled during times when load demand is below the hydropower capacity has a beneficial impact
- Initial economic benefit of \$750,000/year off-setting thermal loads. (~14x better return)





# Future Tasks

- New Energy Balance Model for Capturing Water Spilled Through
  - Distributed thermal storage units
  - Electrochemical energy storage
- Develop Dynamic Model for Energy Storage Based Off Energy Balance Model
  - Size Specifications
  - Control of single or multiple devices
- Use developed process and model for replication which will be through a partnership with DOE Indian Affairs





# Puget Sound Energy Flow Battery Energy Storage System

## ■ Players

- Puget Sound Energy (PSE)
- Bonneville Power Administration (BPA)
- Primus Power
- DOE/OE and Sandia National Labs (SNL)
- Pacific Northwest National Laboratory (PNNL)

## ■ Project Objectives

- Installing and analyzing an innovative 0.5 MW / 1.0 MWh Zinc Bromide flow battery system from Primus Power
- Develop best practices for commissioning an energy storage system
- Assessing and demonstrating the benefits of energy storage on the distribution grid



# Current Status and Future Effort

- Currently
  - Developing Factory Acceptance Test (FAT) document with PSE as the lead
  - Incorporating Sandia's lesson learned document for commissioning
- Future
  - Develop Commissioning Tests, which Include
    - Field or Operation Acceptance Test
    - Functional Acceptance Test
  - Performance Evaluation
    - Team will monitor installed energy storage system for a period of time to evaluate performance for peak shaving, renewable integration and uninterruptible power supply based on PNNL performance metrics document
    - Change Application of energy storage system based off performance evaluation



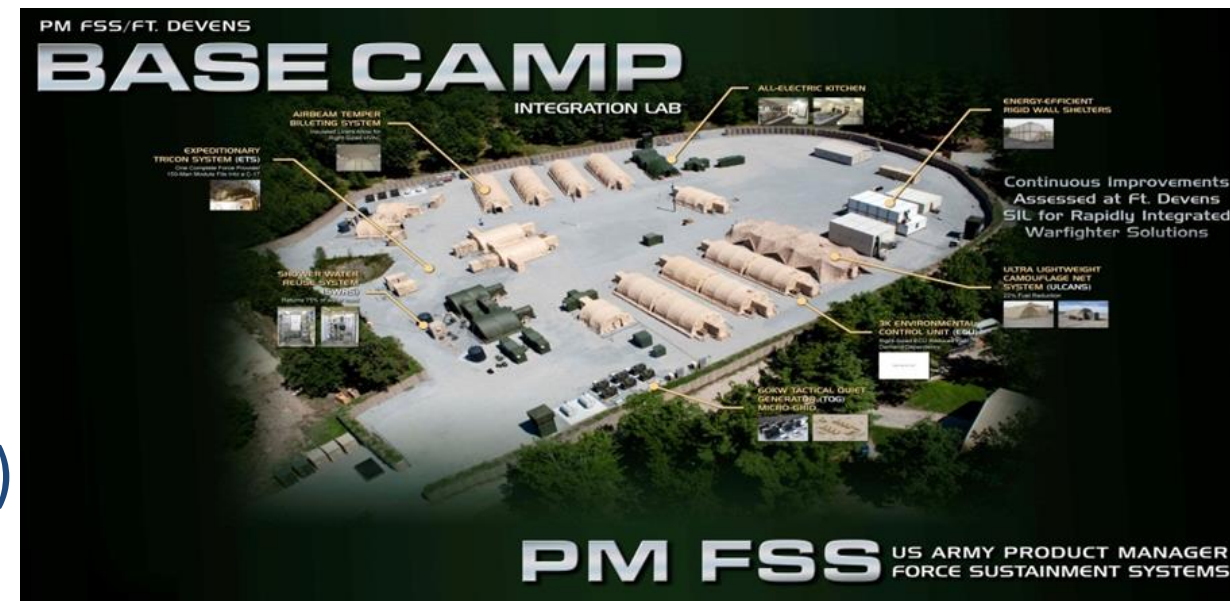
# Energy Storage Incorporated Into a Forward Operating Base

## ■ Players

- Army Program Manager Force Sustainment Systems (PM FSS)
- GS Battery
- Raytheon/Ktech
- MilSpray
- Princeton Power Systems
- DOE/OE and Sandia National Labs (SNL)

## ■ Project Objectives

- Analyze energy storage's capability to increase the reliability of the electrical power microgrid at a FOB while decreasing the fossil fuel consumption of the system



**Raytheon** Ktech

**GS YUASA**



**PRINCETON**  
POWER SYSTEMS

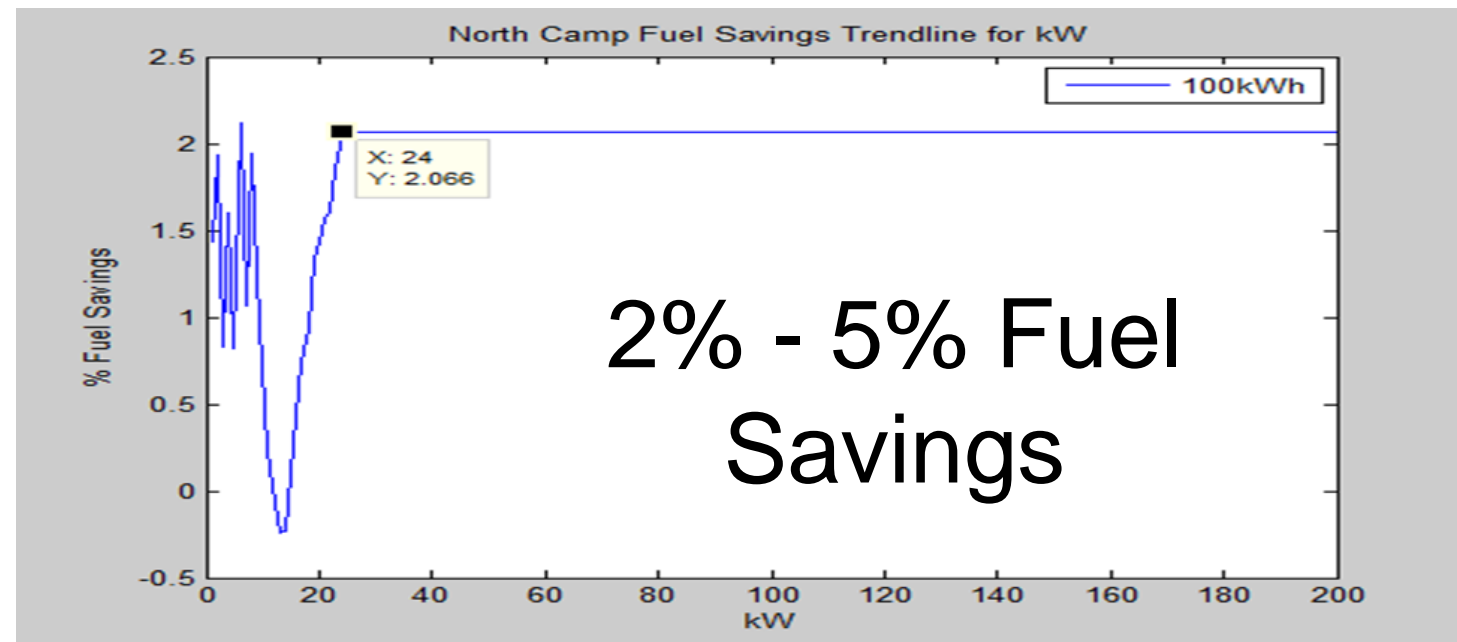
**MILSPRAY**  
Military Technologies



# Accomplishments at Energy Storage

## Test Pad (ESTP)

- RFI Issued based on Army Regulations and Sandia Applications
  - Milspray, Lead Acid
  - Princeton Power, Li-Ion
  - Raytheon/Ktech, Zinc Bromide
  - GS Battery, Lead Acid
- Completed Operation Analysis at Sandia ESTP
  - Published SAND reports of testing results
- Developed predictive fuel savings model



**Raytheon** Ktech

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**PRINCETON**  
POWER SYSTEMS

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# Accomplishments at BCIL

- Completed First Round of Functional Analysis at Base Camp Integration Laboratory (BCIL)
  - Princeton Power and GS Battery energy storage system completed
  - Princeton Power sent to MIT Lincoln Labs (MIT/LL) for further evaluation



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# Current Status and Future Efforts



GS Battery Rendering of RESCU unit with PV

- Currently
  - GS Battery HES RESCU unit is being engineered to be hardened to increase capability to grid forming
- Future
  - Analyze GS Battery HES RESCU unit at BCIL with new grid forming capability
  - Pair energy storage system with renewable energy and evaluate
  - Scale up existing energy storage systems for larger base camps



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Questions?

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