
ESS INC
Energy Storage Systems
ENERGY STORAGE FOR MICROGRIDS
Microgrid 2017 Conference
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Iron Flow Battery Microgrid Projects

- Stone Edge Farm Microgrid Project - Sonoma, CA
- IFB for bulk shifting of PV to nighttime use

- US Army Corps System for FOB load following
- Automatically starts generator to re-charge, saving fuel

- IFB 50kW/400kWh system installed at wind test facility in west Texas
- Wind and solar shifting, DNV-GL testing multiple use cases

- IFB 50kW/400kWh system installed at Univ. of Calf. San Diego
- Testing is microgrid environment for multiple use cases

Flow Battery Inherent Advantages for Microgrids

Low cost, abundant electrolyte materials

- + Can ship dry, just add water
- + Non-toxic, non-flammable

8-hours nameplate capacity, 25 year life

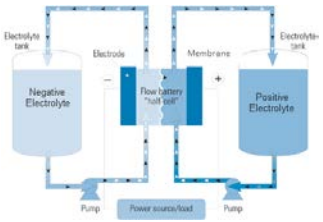
- + No capacity loss with cycles, or time
- + Flexibility for multiple uses

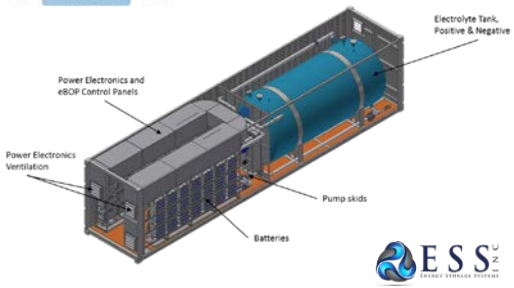
DC/DC round trip efficiency ~75%

Fast response times for grid stability

- + Full power in <1 second

Lowest LCOS when frequently cycled





Military Forward Operating Base Microgrid

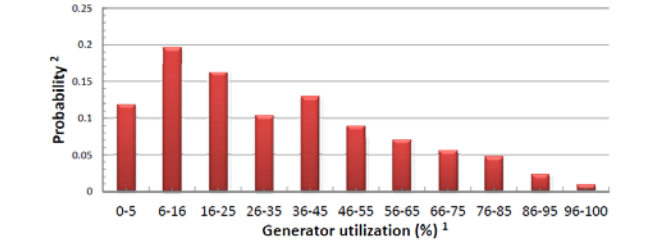
- Reduce Fuel Requirements

Multi-Service Objective

+ Fuel logistics is a linchpin to forward deployments
+ Costs in both $$ and lives

Issue with Power Generation

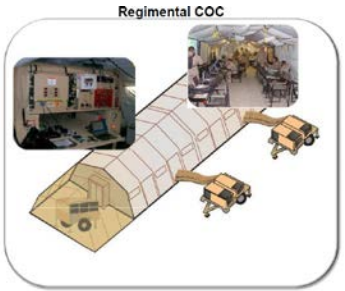
+ Revolves around generator efficiency over variable loads



Expeditionary variability =
Generators operate at sub-optimal loads the majority of the time

Forward Operating Base Microgrid

- Reduce Fuel Requirements

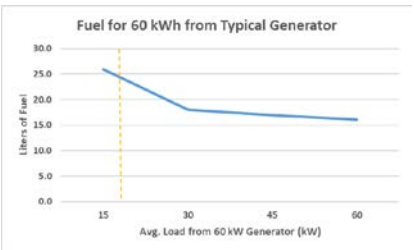


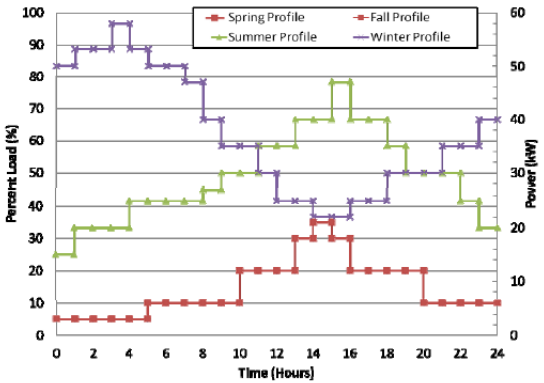
Regimental Combat Operations Center (COC)

- Power Generation: 60 kW “Tactical Quiet Generator”

- Seasonal Load Variations
  - + Average 19.1 kW
  - + Peak in winter at 60 kW

- Issue Revolves Around Generator Efficiency vs. Load





USACE FOB Microgrid Demonstration Project

- Introduce Long-duration Energy Storage

US Army - Fort Leonard Wood, Missouri

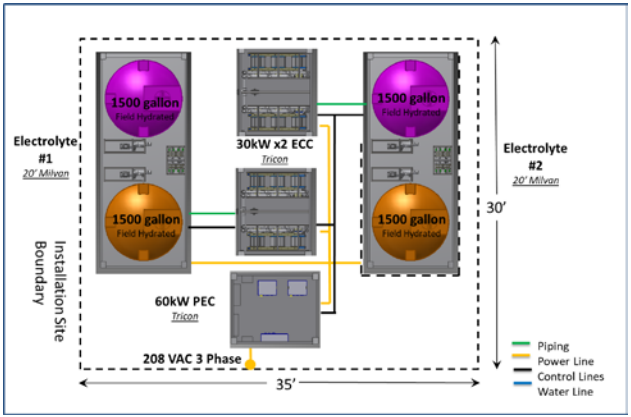
- US Army Corps of Engineers operates a FOB test area
- Standard 60 kW TQG with barracks loads

ESS Inc. Supplied "Custom" Iron Flow Battery System

- Two (2) 30 kW "DC" Iron Flow Battery systems with 112 kWh of energy storage capacity each
- Power Conversion System – 60 kW (208V AC)
- Software to control generator

Operational Task for IFB Energy Storage

- Form grid and follow FOB load
- Control generator to recharge IFB systems

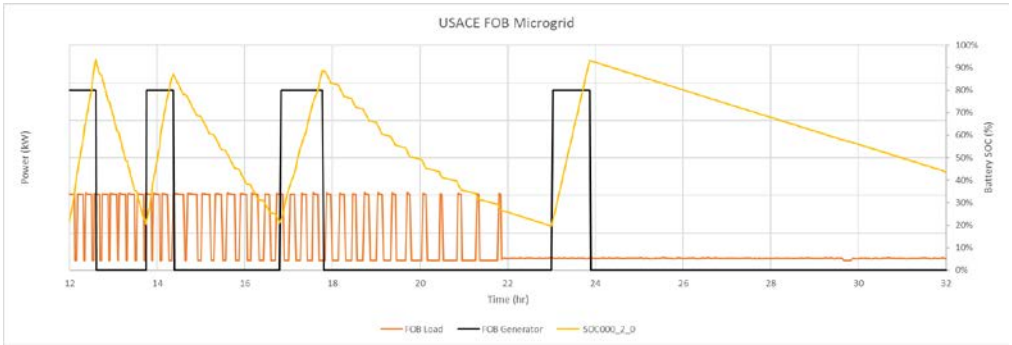


USACE FOB Microgrid Demonstration

- Introduce Long-duration Energy Storage

Iron Flow Battery at FOB Test Site – Ft. Leonard Wood

- US Army Corps of Engineers operates FOB test area
- Barracks load
  - ~2kW of lighting and plug loads
  - 8kW electric heater cycled as needed
- IFB SOC to cycle between 20% and 95% State of Charge (SOC)

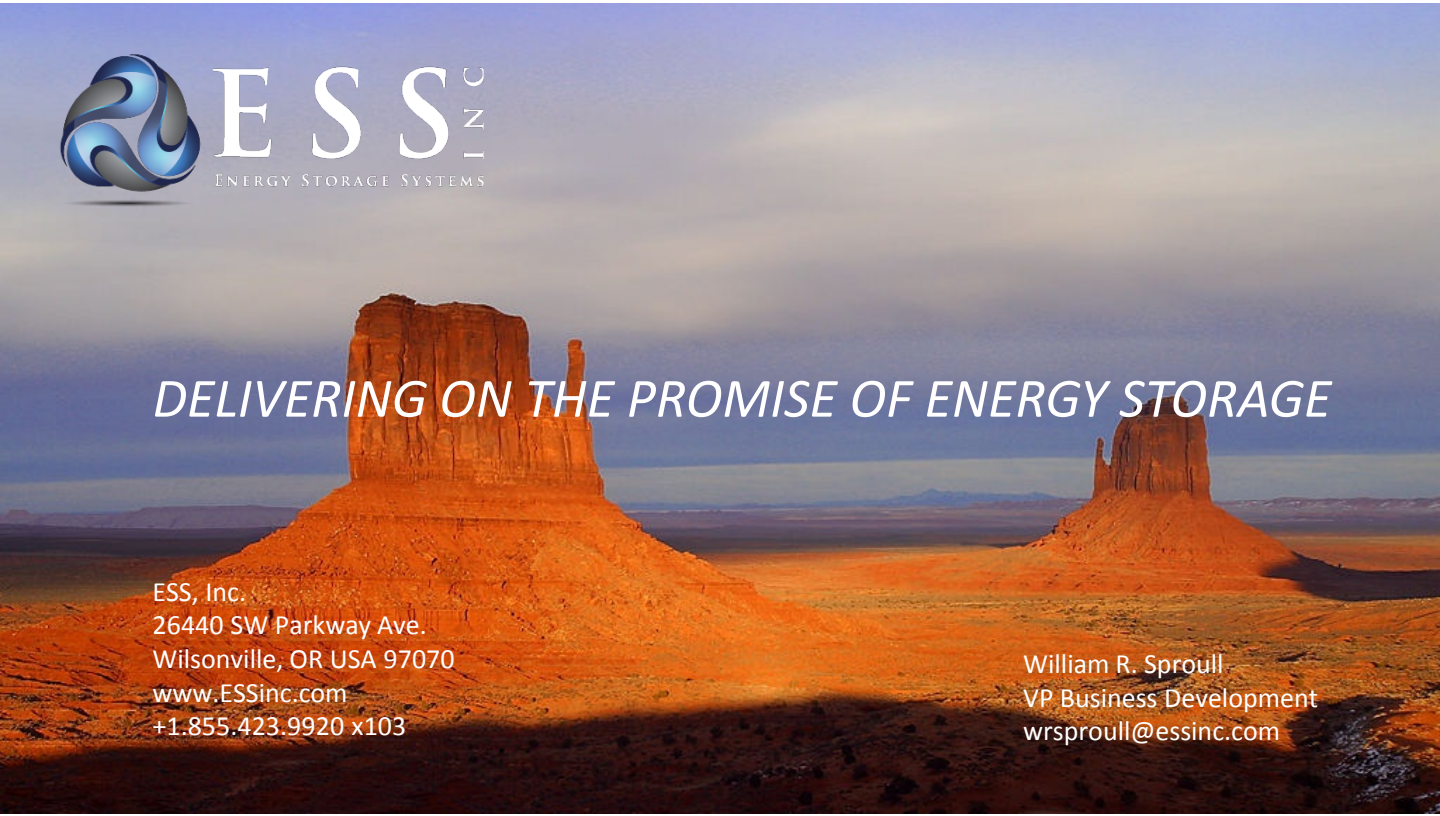


Forward Operating Base Microgrids

- Reduce Fuel Requirements

Attributes of Energy Storage for the Military FOB Microgrid Applications

+ Reduce use of generators, only operate at peak efficiency
    + Expecting 20-30% fuel savings
+ Combine with PV or wind and dramatically reduce generator use
+ With Iron Flow Battery, ship dry and add water at FOB
    + Saves 60% of shipping weight
    + Portable for redeployment
+ Non-toxic, non-flammable for safety with troops
+ Operates without air conditioning in hot environments
+ Silent watch capability



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