Energy Storage Technologies

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*Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000

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Contents of Presentation

1. Energy Storage Technologies
2. PV Applications Requiring Storage
3. PV Battery Life Issues
4. PV Energy Storage Examples

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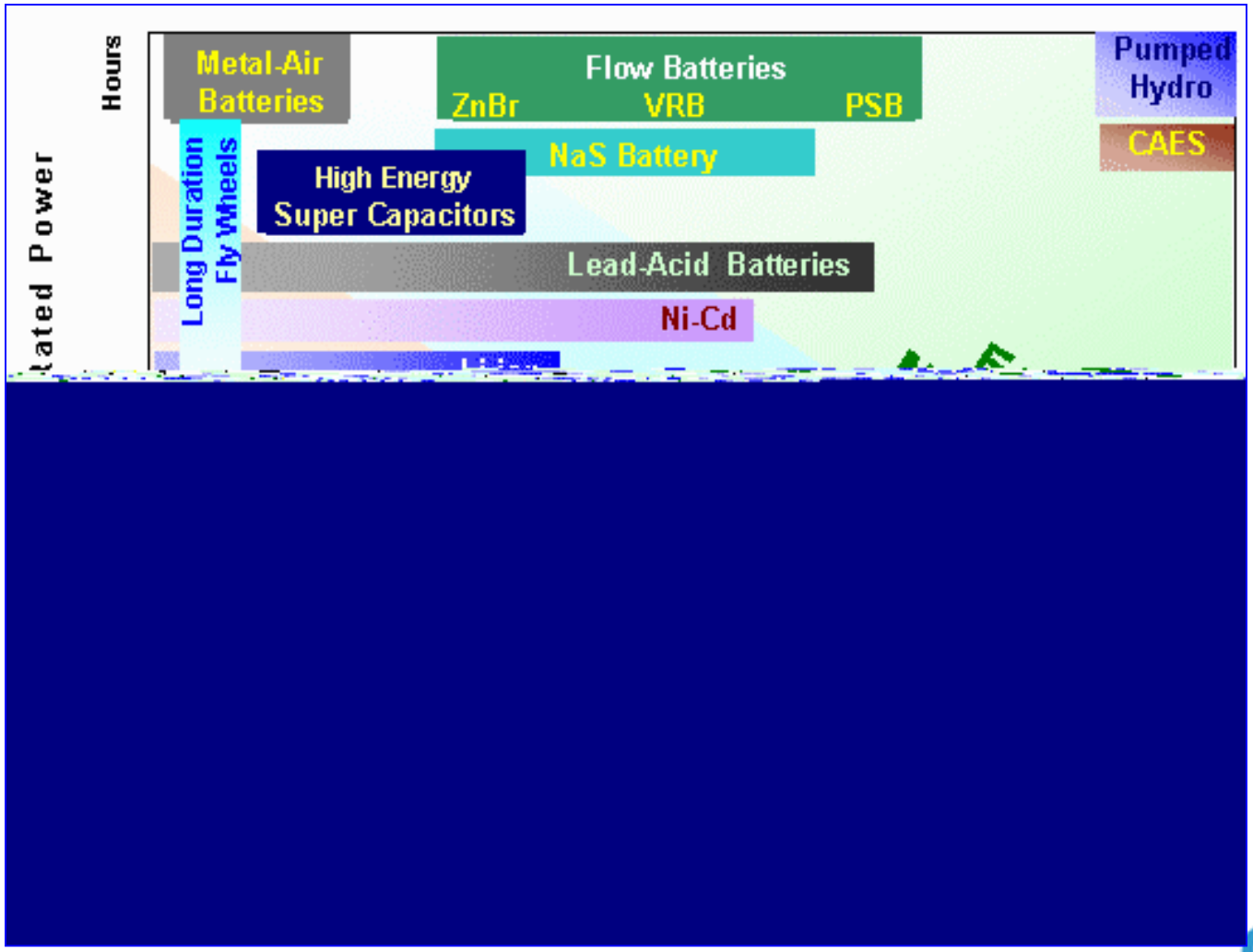
Batteries

- Li-Ion
- Ni-metal hydride
- Zn-Bromine flow
- Ni-Cad
- Lead-acid
  - Vented (Flooded)
  - Valve-regulated (VRLA)

Alternate Storage Technologies

- Hydrogen
- Flywheels
- Ultracaps
- Compressed Air
- Pumped Hydro
- SMES

Battery & Alternate Storage Technologies



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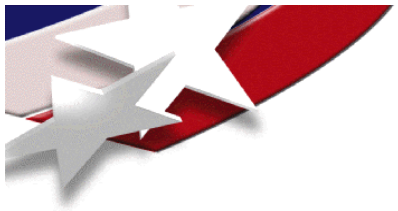

What Does ACONF Do?

- Cuts generator run time
- Reduce fuel use
- Improve battery management
- Reduces system life-cycle cost

Distributed Energy Test Lab (DETL) Microgrid

Grid

480V Microgrid

Secure SCADA Lab

Distributed Energy Resources

Loads (Various)

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Energy Storage in PV Applications

Microgrids Address Energy Surety

- Potential Microgrid Advantages
  - Diversity: fuel, resources
  - Reduce single-point vulnerabilities
  - Physical security/controls
- Military Base Assessments Underway
- Require Standalone Operation
  (ENERGY STORAGE)

Greenpoint Manufacturing & Design Center

Joint Project of PowerLight and ZBB

Sponsored by

US DOE, Sandia, NYSERTA and
Clean Air Communities

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Greenpoint PV Project

- Choose PowerLight Solar Roof Panels to Reduce Operating Costs
- Installation of 115kW on 11,500 square feet of Unused Roof Space Was Completed in 10/2002

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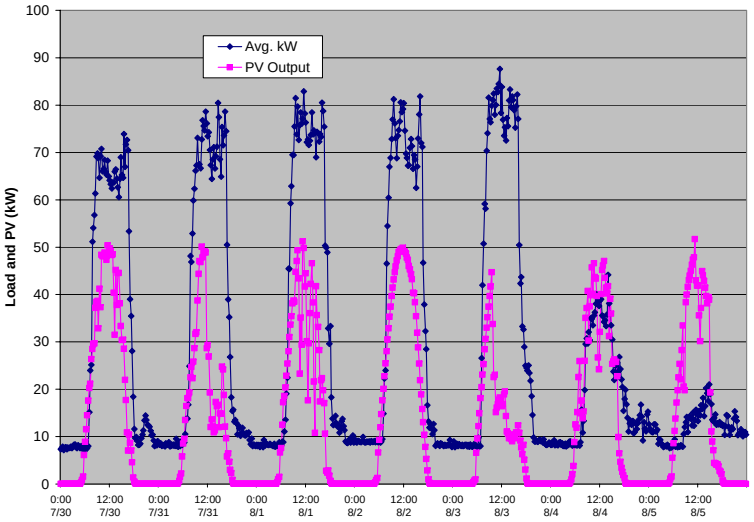
Battery Energy Storage Will Be Added in Late 2003

- Solar is Used as Generated on Weekdays
- Weekend Energy Must Be Shed as Utility Will Not Allow it to be Feed back into Grid. If Storage Available, Weekend Energy Can Be Used on Monday
- Storage Can Be Used on Weekdays to Peak Shave



Solar Generation vs. Energy Use for a Typical Week at Greenpoint Facility

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Battery Energy Storage System

- Zinc Bromine Flow Battery Manufactured by ZBB and SatCon
- Two Racks Rated at 25kW/50kWh each
- Factory Testing is Complete
- Installation Planned for Late 2003

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The RAPS Peru project

- ILZRO, CSIRO, Battery Energy, GEF, IGP, and DOE partner in the RAPS Peru Amazon project (Padre Cocha, Indiana)
- Objective
  - Electrify remote villages
  - Reduce pollutants
  - Evaluate new VRLA “extended life” battery design
  - Evaluate new hybrid RAPS operational mode

RAPS Peru SunGel VRLA Battery

- Specially designed for RAPS systems using partial-state-of-charge cycling by CSIRO (VRLA Gel)
- High cycle-life (1500+ cycles at 80% DOD)
- High purity grid alloy
- 12+ years design life
- 8 year warranty

Grasmere PV Hybrid Power System

- Grasmere is a PV hybrid power system that was funded by the Energy Conservation and Investment Program (ECIP) and the Air Force to provide power to an electronic warfare site at Grasmere, Idaho
- System design and construction was provided by Idaho Power with technical support and data acquisition provided by Sandia with support from the US DOE PV systems Program and Energy Storage Program

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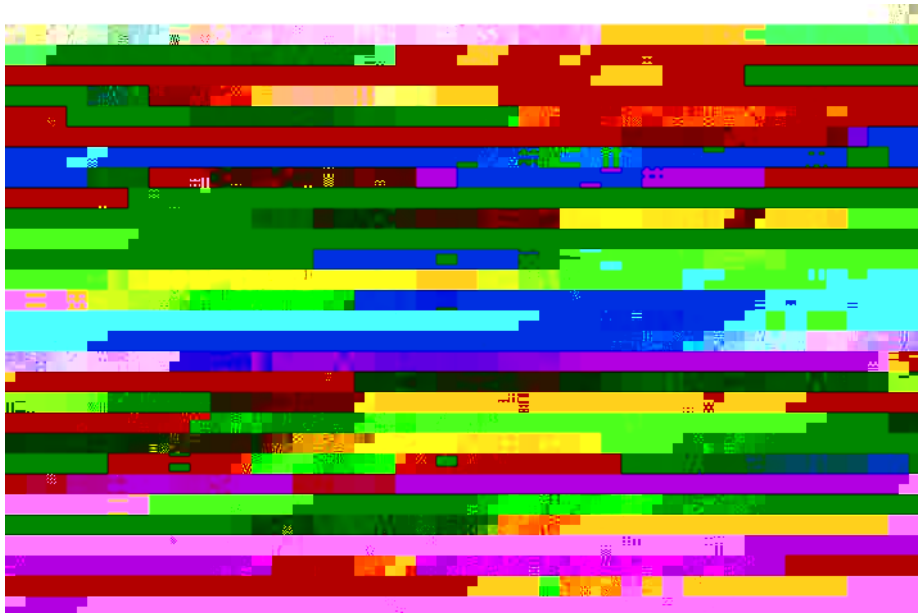
Grasmere PV Hybrid Power System

- Objectives
  - Evaluate large PV hybrid performance
  - Evaluate new vented lead-acid C&D CPV battery technology
  - Evaluate battery management strategy (extended interval taper-charge)



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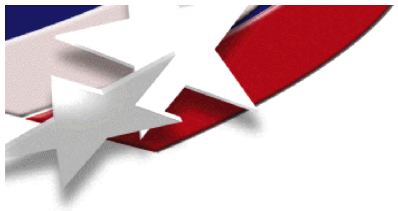
Grasmere Performance Results

- System performance has been good with minimal power outages
- The C&D CPV battery has performed well by
  - Requiring less maintenance
  - Maintaining a stable capacity
  - Providing a high cycle-life at a lower cost
- The extended interval taper-charge has been successful by
  - Improving system efficiency
  - Maintaining battery capacity
  - Lowering operating temperature



Summary
What's Needed

- **New energy storage technologies need continued R&D, and when ready, a demonstration of their performance predictions with respect to:**
  - Cycle-life
  - Reliability
  - cost
- **Lead-acid batteries most cost-effective at present, but they still need:**
  - Proper charge control
  - Optimum design
  - Proper maintenance