ENERGY MANAGEMENT SYSTEM (EMS)
Shelter Solutions - The product
Solar Powered, Efficient, Relocatable
Shelter Solutions - The system

- Energy efficient, lightweight, rigid
- Manual Deployment option
- Roof-integrated PV
- Integrated battery storage
- Mains power available to users
- Integral backup generator control
EMS - The focus

• COTS components where possible
  • Choice of OE options
  • Spares and servicing availability

• High level of independence

• Blue Planet solution
  • Package the system
  • Develop integrated smart features
Energy Management System

- **Scope**
  - Bridges the gap between
    - Small, field deployable kits
    - Larger Microgrids
  - 5 – 40 kW range
  - Serving range of demands
Energy Management System

- Integrate into existing facilities
- Larger scale energy availability
- 72 hr platoon mission 32 kWh requirement

10 kW PV 14-44 kWh / day
30 kWh battery
14 kW power output
Energy Management System

- Broader scope of use
  - HVAC / ECU power hungry
- Water
  - Pumping / Purification / AWG
- Waste – Incineration capability
- Appliances
  - Refrigerator, microwave
System Objectives

● GENERATE energy locally (PV)
● STORAGE of excess for later use
● HARVEST any other available energy
  ● Grid; Generator; PV; wind; water
● DISTRIBUTION of power to users
  ● Fixed location and expeditionary
System Objectives

GENERATION (PV)
Generation – PV array

Flat mounted - performance
Generation – PV array

Issues manually tracking solar activity
Generation – PV array

Elevation of PV Panels

- Minimizes...
  - footprint; shading; visibility
Generation – PV array

Maximizing solar yield

- Accounting for seasonality
Generation – sizing the system

When PV is significant (~30kW/day)

• Optimizing the system...
  • What are the loads?
  • Variation in solar energy?
  • What size battery is needed?
  • Generator? If so, what size?
Maximizing solar yield

- Configuration based on PV yield...
  - Minimum ? Over-specified
  - Maximum ? Under-specified
  - Average ? “Best Bet”
Maximizing solar yield

Averaging has its problems...
Reconfigure based on seasons

Maximizing solar yield - solution

• Blue Planet EMS control unit
  • Optimises system to utilise maximum available solar energy
  • Allows dynamic reconfiguration based on location
System Objectives

STORAGE of energy (BULK)
• Battery sets: ~10kw modules
  • Normally Li-Ion (LiFePO4)
  • Capacity / Low Losses / High charge & discharge rates
• Lead Acid compatible
• Availability / Cold operating
Storage – secondary option

- **BoB** add-on
- **Break out Batteries**
  - Smaller modules - expeditionary
  - Used as capacity when parked
  - Fully charged when needed
- Highly flexible I/O options
Storage – secondary option

BoB modules: 3 variants

- Battery (DC)
  - 400 Wh
  - Output: 3 – 80V
  - Input: 6 – 80V
  - 3.9 × 3.2 × 12 in: Weight < 8lb
Storage – secondary option

BoB modules: 3 variants

- **AC Module**
  - 1.2 kW
  - 50 / 60 Hz
  - Output: 120 / 240 V
  - Input: 90 – 240 V

Storage – secondary option
Storage – secondary option

BoB modules : 3 variants

- CDM
  - Configurator
  - Touchscreen
- DC / AC compatible
- Module parameter programmer
System Objectives

- HARVESTING
  - Main System
    - Grid / Generator if available
    - Generator used at peak loading
  - Sub System (BoB)
    - Ad hoc AC / DC
System Objectives

• DISTRIBUTION of power
  • Dual Voltage Dual Frequency
    • AC mains at :-
      • “US” supply (120 V / 60 Hz)
      • “EU” supply (230 V / 50 Hz)
    • Each split into 2 legs
      • Essential and non-essential
DVDF

- Dual Voltage Dual Frequency
  - Universal device connection
- EU leg works with PV (native)
  - Ideally EU powers HVAC
  - Minimizes impact on US supply and battery state
Dual supply phases

- Battery preservation
  - Below a defined level of charge: non-essential loads disconnected
- User decides what’s essential
- Swap standard plugs to reconfigure
Energy Management System

- Central Control Unit (CCU)
  - Connectivity station
  - System configuration & setup
  - Rapid reconfiguration
  - System performance & status
  - System monitoring (remotely)
Energy Management System

- Central Control Unit (CCU)
  - Battery optimisation & calibration
  - Generator “exercise”
  - Generator call criteria
  - Generator activity mapping
Energy Management System

Schematic

Array 2
Array 1
EU
BPSS CCU
US
BULK
Scavenged Power
Energy Management System

- Coverage
  - Typical DVDF system 14kW power
    - 10 kW PV / 30kW battery
  - 3-4 shelters
    - First cut load levelling
  - Utilizes PV from low-power shelters
Energy Management System

- Modularity
  - System can be paralleled
  - 3-40 kW single phase capacity
  - 3-phase capability

Final specification dependent on SOW
Performance Test

- 1 week; 24 / 7 operation
- HVAC / recirculating air / lighting
- Additional loads introduced
Test Environment

Worst case – constant demand, all heating
Location: MD, March
Ambient temperatures 7 – 62°F: HVAC set-point 68°F

Source: Accuweather.com
Performance Analysis
Battery synchronisation
Performance Analysis
Load & charging profile
Performance Analysis

7-day summary

3 day window PV only
(no generator required)
Performance Summary

- 75% generator runtime reduction
- Generator optimal loading (60% FL)
- Independent of generator for 3 days
  - only modest solar activity

...as part of efficient shelter system
The takeaways..

- Broad scale energy availability
  - Occupants and expeditionary
- Wide variety of inputs & outputs
- Ease of deployment
  - No constraints on setup
- SMART system
  - Class-leading fuel savings
Contact

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