USMC Hybrid Power Efforts

Joint Service Power Expo
Virginia Beach, VA
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APdM-E Expeditionary Power Systems
Marine Corps Systems Command

“Our purpose is clear: equip and sustain our Marine forces with the most capable and cost-effective full-spectrum ground weapon and information technology systems for current and future expeditionary and crisis-response operations.”

—Brig. Gen. Joseph Shrader
Commander, Marine Corps Systems Command
Introduction

- Organizational Overview
- Background on hybrid systems
- Key development areas
- USMC requirements in hybrid systems
- Current hybrid efforts
- Future opportunities
- Conclusion
(4/10/2017) Will take effect June 2017
Current EPS Program Office

Expeditionary Energy Systems (E2S) Team

Advanced Power Team
Future Program Office

Fuel and Water Team

Power Team
During Operation Enduring Freedom, fuel and water accounted for seventy percent of the logistics required to sustain Marine Corps expeditionary forces ashore.

Solution

Hybridize existing generators to provide:

- Increased Energy Efficiency (33-60% fuel reduction over fielded generators)
- Extend time between required generator maintenance
  - Generator run time will be reduced approximately 40%
- Reduced fuel consumption, resupply and total mission weight for the MAGTF, extending the Commander’s reach by ~ 73%
### MEHPS AOA

<table>
<thead>
<tr>
<th>Power Range</th>
<th>Man Portable</th>
<th>10W</th>
<th>300W</th>
<th>5kW</th>
<th>Medium</th>
<th>60kW</th>
<th>Large</th>
<th>800kW</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment Time</td>
<td>Hours-Days</td>
<td>Days-Weeks</td>
<td>Weeks-Months</td>
<td>Months-1 Year</td>
<td>Years</td>
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<tr>
<td>Employment Vignettes</td>
<td>Dismounted, Observation Point (OP), Patrol Base (PB), Vehicle Based</td>
<td>Patrol Base (PB), Combat Outpost (COP), Village Stability Platform (VSP), Forward Operating Base (FOB), Vehicle Based</td>
<td>Combat Outpost (COP), Forward Operating Base (FOB), Vehicle Based</td>
<td>CAMP</td>
<td></td>
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</tr>
<tr>
<td>Unit Size</td>
<td>Fireteam - Squad</td>
<td>Squad - Platoon</td>
<td>Company - Regiment</td>
<td>Division and Above</td>
<td>Division and Above</td>
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<tr>
<td>Logistics Support</td>
<td>Warfighter carried/delivered, Sling Loaded, HMMWV / MATV Delivered</td>
<td>Sling Loaded, HMMWV / MATV Delivered, MTVR Delivered</td>
<td>MTVR Delivered, LVSR Delivered, Air delivery C-130/ C-17</td>
<td>Air delivery C-130/ C-17</td>
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<tr>
<td>Hybrid System Type</td>
<td>Wearable distributed power, Small genset/battery/solar, Trailer mounted, Containerized/Microgrid, Vehicle Based</td>
<td>Containerized/Microgrid, Vehicle Based</td>
<td>Containerized/Microgrid, Vehicle Based</td>
<td>Containerized/Microgrid</td>
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<td>Priority</td>
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<td>Moderate</td>
<td>High</td>
<td>Low</td>
<td>N/A</td>
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</tr>
</tbody>
</table>
Applications

- Silent Watch
- Combat Outpost
- Stability Operations
- Disaster Relief
- Connect Solar to Grid

MEHPS-M
MEHPS-L
MEHPS-M
MEHPS-L
MEHPS-L
USMC System to be used to augment existing generators in order to reduce fuel consumption in expeditionary environments

Technical Description
MEHPS is a hybrid power system that will consist of:
- Controller/Power Inverter
- Generator
- Battery
- Solar Array

The program will produce Light systems operating in the 5kw range and Medium systems operating in the 10kw range

Current Status
• Currently in Engineering & Manufacturing Development (E&MD) Phase, getting ready to start Developmental Testing

Key System Parameters
• 4 hour silent watch
• 4/6 man lift components
• Reduction of fuel between 30-66%
• High reliability

Program Timeline
• Current Program Phase: E&MD
• Developmental Testing begins 3Q FY17
• Limited User Evaluation 1Q FY18
Expeditionary Solar Array
- Lightweight, Compact Composite Panels
- Rugged and rapidly deployable

Power Inverter
- High Efficiency Inverter
- Fully Ruggedized
- 3-Phase Power
- 2-Way DC/DC Converter

Intelligent Controller
- Software Controls
- Human Interface
- Compact Electronics

Battery
- High Energy Density
- Modular & Expandable
- Broad Operating Temperature Range

Generator
- Militarized generator
- Flexible Fuel
- Universal Generator Control Technology (Remote start/stop)

Cables
- Power and Data Cables
- Environmentally Rugged
- Quick Connect Tech.

Trailer
- Military HMMWV Trailer
- Trailer Mounting & Integration Hardware

Development effort focuses on smaller, lighter, more efficient, easily maintainable systems.
**Light Hybrid**
- 2/4 man lift components
- Uses 5kW AMMPS (T); and 3kW TQG (O)
- Movable by multiple vehicles
- 3 Hours silent watch; 8 hours (O)
- 3 (T); 2.1 (O) gal/day fuel
- Reliability of 500 hour EFF

**Medium Hybrid**
- 4/6 man lift components
- 10kW (T); 15kW (O)
- Uses 10kW AMMPS (T); 15kW AMMPS (O)
- MCC-LTT Mountable
- 3 hours silent watch (T); 8 hours (O)
- 7.2 (T); 5.8 (O) gal/day fuel
- Reliability of 750 EFF (T); 1250 EFF (O)
• Received MS B – 2QFY16
• MS C/LRIP – 3QFY19
• Full Rate Production Decision – 2QFY20
• Fielding Decision – 3QFY20
• Initial Operational Capability – 4QFY21
Current EMD Vendors

- **Control**
  - Basic control logic used

- **Energy Storage**
  - Looking at high voltage and low voltage systems

- **Solar Size**
  - Both are utilizing USMC standard solar panels

- **Inverters**
  - Internally developed (no commercial options)

- **Packaging**
  - Mounting methods, ruggedization approach
• EMD
  – Planned for 3Q FY17
  – Electrical & Environmental Performance

• FUE
  – Planned for 1Q FY18
  – Human factors, operational sufficiency

• PVT
  – Planned for 3Q FY19 – 2Q FY20
  – Full Requirements Verification
Lessons Learned

- **Efficiency**
  - Efficiency gains will only be found in certain parts of the power curve
  - Solar has a bigger impact to this number than expected

- **Weight and Volume**
  - These become huge limiters to your other requirements

- **Reliability**
  - Intelligent control will be needed to increase reliability
  - Component reliability does not equal system reliability

- **Interoperability**
  - Failures often caused by interoperability issues.

- **Technical Maturity**
  - Individual components are high (systems are low)
  - Inverter systems are lower than other components
• A Program Agreement is being completed with India Ministry of Defense for MEHPS
• Phase I – Technology information exchange program wraps up 4Q FY17
Recent Marine Corps study found that vessels caring Marine Corps assets are inadequate to meet future large format lithium battery storage needs. In addition garrison battery storage and maintenance capabilities are lacking.

**Problem**
- Growth in lithium batteries
- Lack of proper ground and ship based storage
- Million in damaged batteries
- Lack of maintenance capabilities

**Critical Parameters**
- Safety
- Electrical Interface (Interoperability)
- Mobility
- Modularity
- Autonomous maintenance
- Environmental Control
- User Feedback

**Planned RFI release in 3QFY17**
<table>
<thead>
<tr>
<th>Title</th>
<th>Funding</th>
<th>RFP Release</th>
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<tbody>
<tr>
<td>Platoon Water Purification System</td>
<td>PMC</td>
<td>4QFY17</td>
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<tr>
<td>Intelligent Power Management System</td>
<td>RDT&amp;E</td>
<td>1QFY18</td>
</tr>
<tr>
<td>Battery Storage and Maintenance Capability</td>
<td>PMC</td>
<td>3-4QFY18</td>
</tr>
<tr>
<td>Common Advanced Solar Panel – Ruggedized</td>
<td>PMC</td>
<td>4QFY18-1QFY19</td>
</tr>
<tr>
<td>MEHPS Production</td>
<td>PMC</td>
<td>2-3QFY19</td>
</tr>
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Further Information

Email questions to:
PM_EPS@usmc.mil

Find more programmatic information:
http://www.marcorsyscom.marines.mil/ProgramOffices/EPSHome.aspx
www.onr.navy.mil
http://www.hqmc.marines.mil/e2o/E2OHome.aspx

Current / Future Solicitations:
www.fedbizopps.gov

Any questions about on-going solicitations:
Must contact the listed Contracting Officer in the solicitation
QUESTIONS