USMC Hybrid Power Efforts

Joint Service Power Expo
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Justin Govar
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

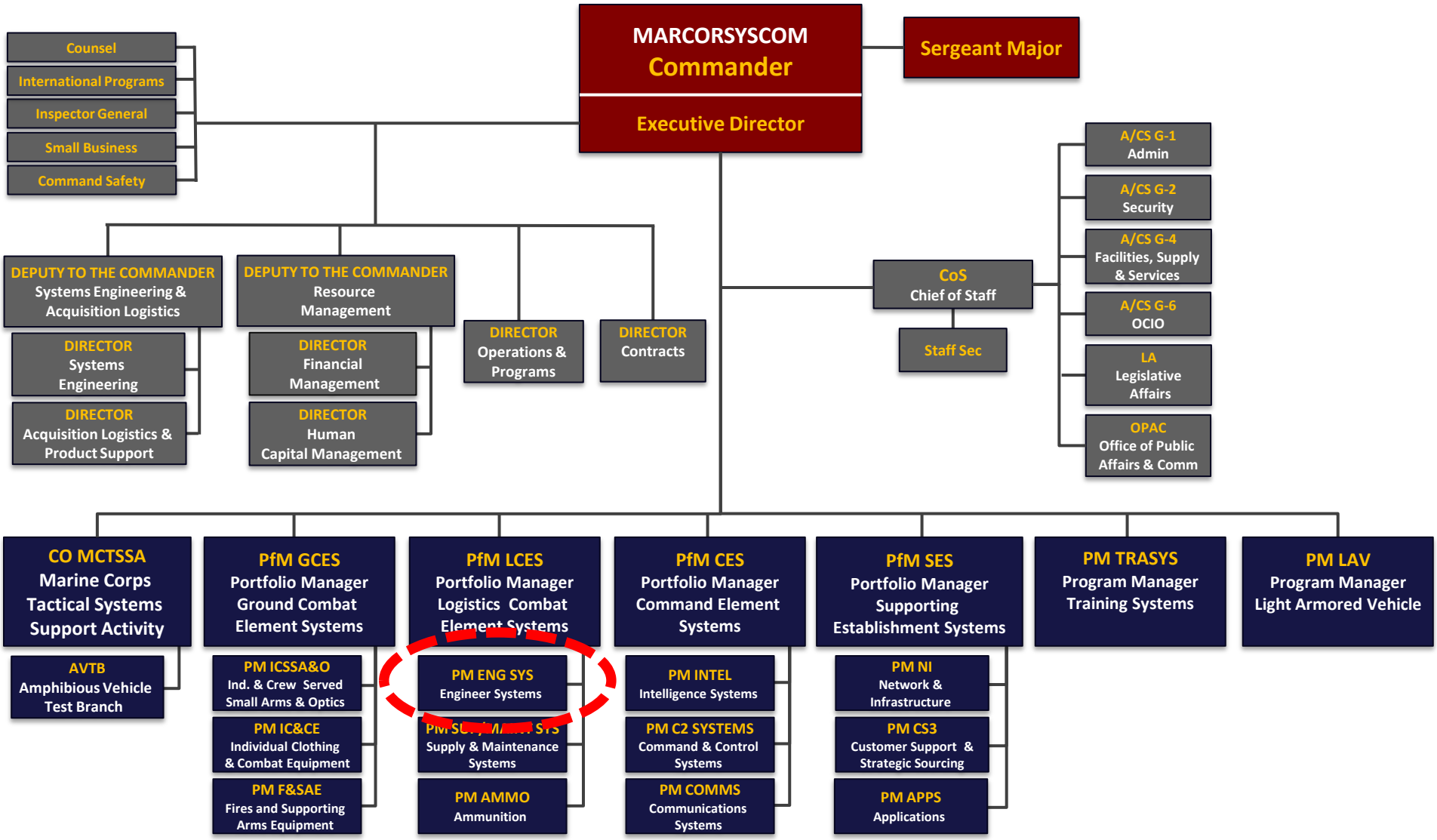
Introduction

- Organizational Overview
- Background on hybrid systems
- Key development areas
- USMC requirements in hybrid systems
- Current hybrid efforts
- Future opportunities
- Conclusion

MARINE CORPS SYSTEMS COMMAND

HOME OF THE MARINE CORPS ACQUISITION PROFESSIONALS

Organization Chart

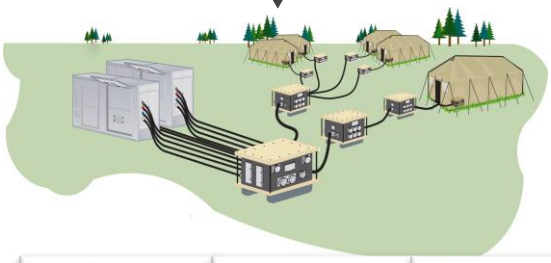


(4/10/2017) Will take effect June 2017

Current EPS Program Office

U.S. Marine Corps Expeditionary Power Systems

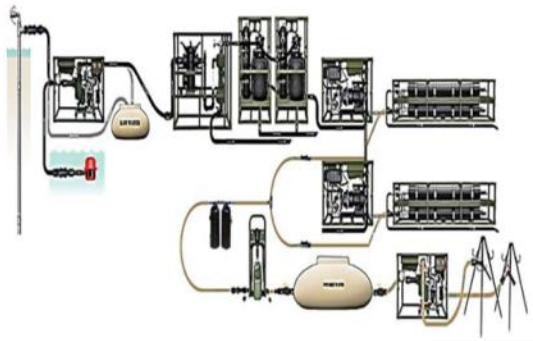
Expeditionary Energy Systems (E2S) Team



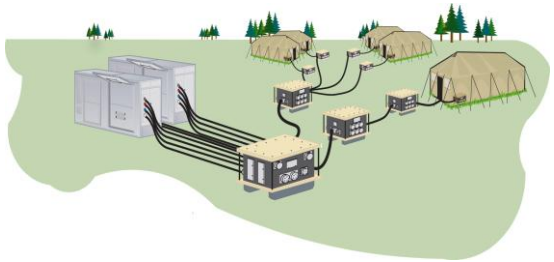
Advanced Power Team

PM ENGINEER SYSTEMS
MARINE CORPS SYSTEMS COMMAND

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

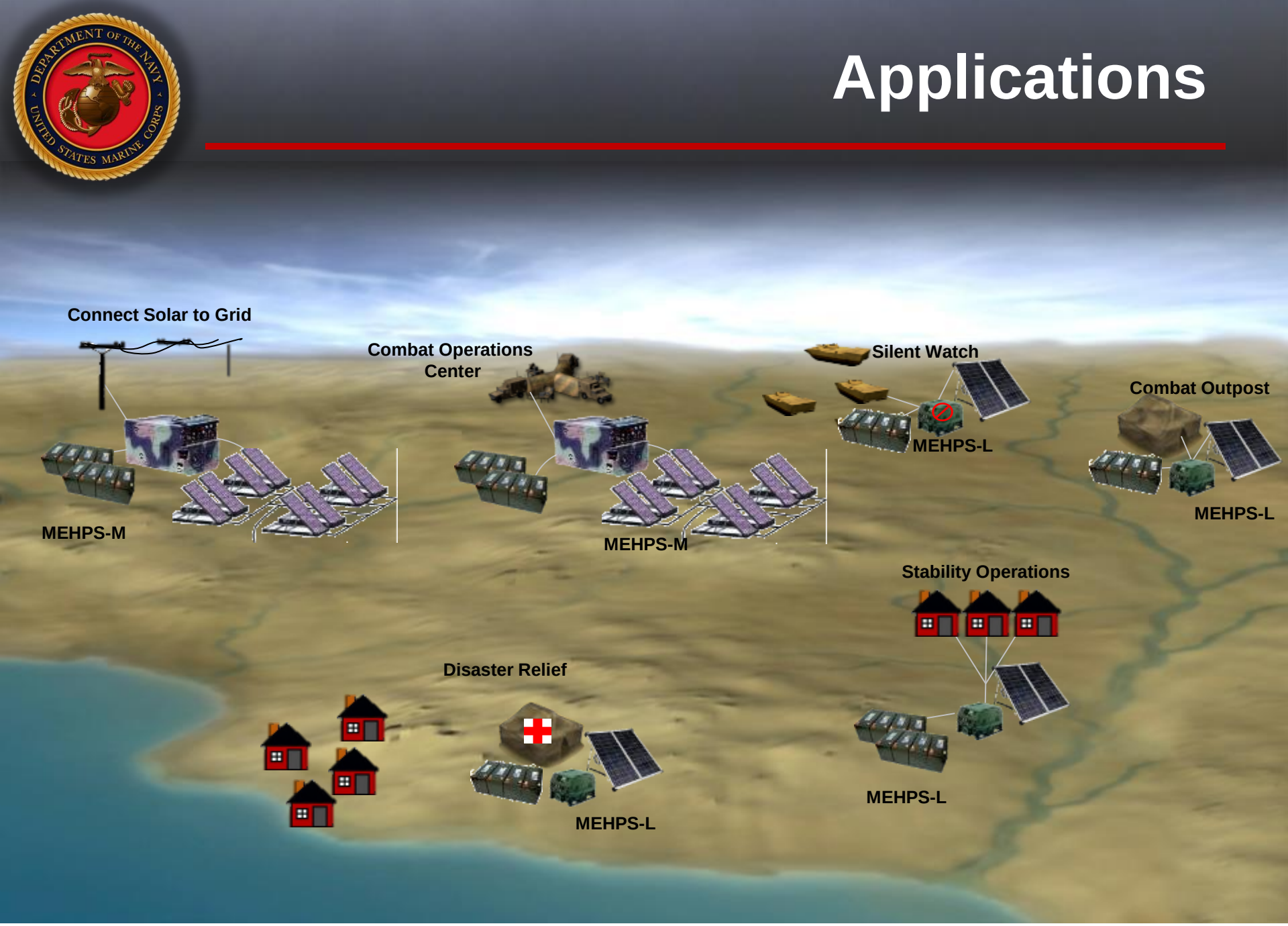
Hybridize existing generators to provide:

- **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

	10W	300W	5kW	60kW	800kW	MW
Power Range	Man Portable	Small	Medium	Large	Prime
Employment Time	Hours-Days	Days-Weeks	Weeks-Months	Months- 1 Year	Years
Employment Vignettes	➢Dismounted ➢Observation Point (OP)	➢Observation Point (OP) ➢Patrol Base (PB) ➢Vehicle Based	➢Patrol Base (PB) ➢Combat Outpost (COP) ➢Village Stability Platform (VSP) ➢Forward Operating Base (FOB) ➢Vehicle Based	➢Combat Outpost (COP) ➢Forward Operating Base (FOB) ➢Vehicle Based	➢CAMP
Unit Size	Fireteam - Squad	Squad-Platoon	Company - Regiment	Division and Above	Division and Above
Logistics Support	➢Warfighter carried/ delivered	➢Warfighter carried/ delivered ➢Sling Loaded ➢HMMWV / MATV Delivered	➢Sling Loaded ➢HMMWV / MATV Delivered ➢MTVR Delivered ➢Forklift 4K and more	➢MTVR Delivered ➢LVSR Delivered ➢Air delivery C-130/ C-17	➢Air delivery C-130/ C-17
Hybrid System Type	➢Wearable distributed power	➢Small genset/ battery/solar	➢Trailer mounted ➢Containerized ➢Vehicle Based	➢Containerized / Microgrid ➢Vehicle Based	➢Containerized ➢Microgrid
Priority	N/A	Moderate	High	Low	N/A

Applications



MEHPS

Notional

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**

System Component Technology

Generator

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

Power Inverter

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

Trailer

- Military HMMWV Trailer
- Trailer Mounting & Integration Hardware

Cables

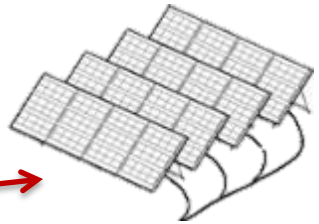
- Power and Data Cables
- Environmentally Rugged
- Quick Connect Tech.

Battery

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

Intelligent Controller

- Software Controls
- Human Interface
- Compact Electronics



Expeditionary Solar Array

- Lightweight, Compact Composite Panels
- Rugged and rapidly deployable

Development effort focuses on smaller, lighter, more efficient, easily maintainable systems.

MEHPS Requirement

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)

Program Schedule

- 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

Program Testing Plan

- 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

MEHPS S&T Roadmap

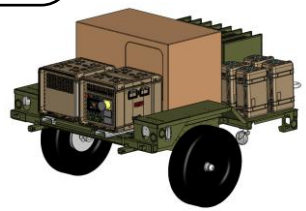
MHEES (MCSC)
10 kW Systems

Phase II SBIR
(ONR)
10kW Systems

Common
Advanced Solar
Panel –
Ruggedized
(CASPR)

AMMPS &
TQG
Generators

MEHPS-M (10-15kW System)



FY14 RIF (ONR)
Modularity between 3kW
and 10kW System

Energy Storage FNC (ONR)
3kW and 10kW Systems
Battery Focus

HESM (ASD R&E)
3kW System

MEHPS-L (3-5kW System)

FY11 RIF (ONR)
3kW System

RSEP FNC (ONR)
3kW System
Fuel Cell Focus

Lab Development
NSWC Carderock
MIT Lincoln Labs

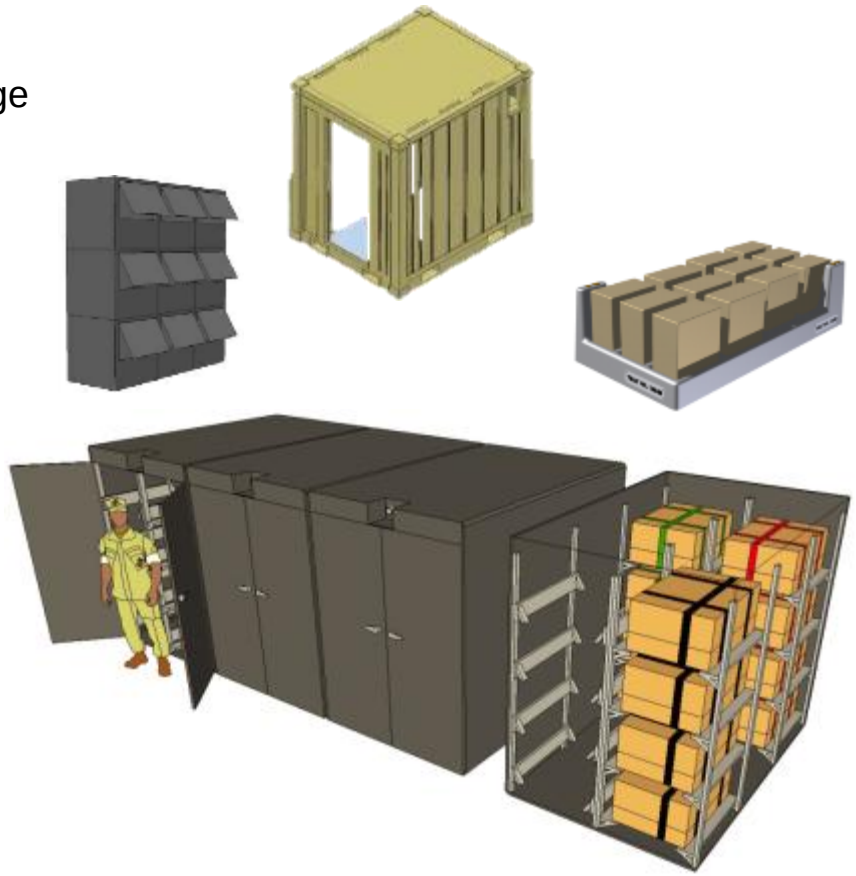
FY	14	15	16	17	18	19	20	21
	Technology Development			Engineering & Manufacturing Development			Production & Deployment	

- **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

Lithium Battery Maintenance

- 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



Title	Funding	RFP Release
Platoon Water Purification System	PMC	4QFY17
Intelligent Power Management System	RDT&E	1QFY18
Battery Storage and Maintenance Capability	PMC	3-4QFY18
Common Advanced Solar Panel – Ruggedized	PMC	4QFY18-1QFY19
MEHPS Production	PMC	2-3QFY19

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


QUESTIONS