



ONR Initiatives

Unmanned Surface Vehicles and Power & Energy

NAS TRB Marine Board
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Jeffrey Smith
Ship Systems and Engineering Div.
Technical Support
Jeffrey.d.smith4.ctr@navy.mil

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The Office of Naval Research

The S&T Provider for the Navy and Marine Corps



- 4,000+ People
- 23 Locations
- \$2.1B / year
- >1,000 Partners



Discover

→ **Develop**

→ **Deliver**

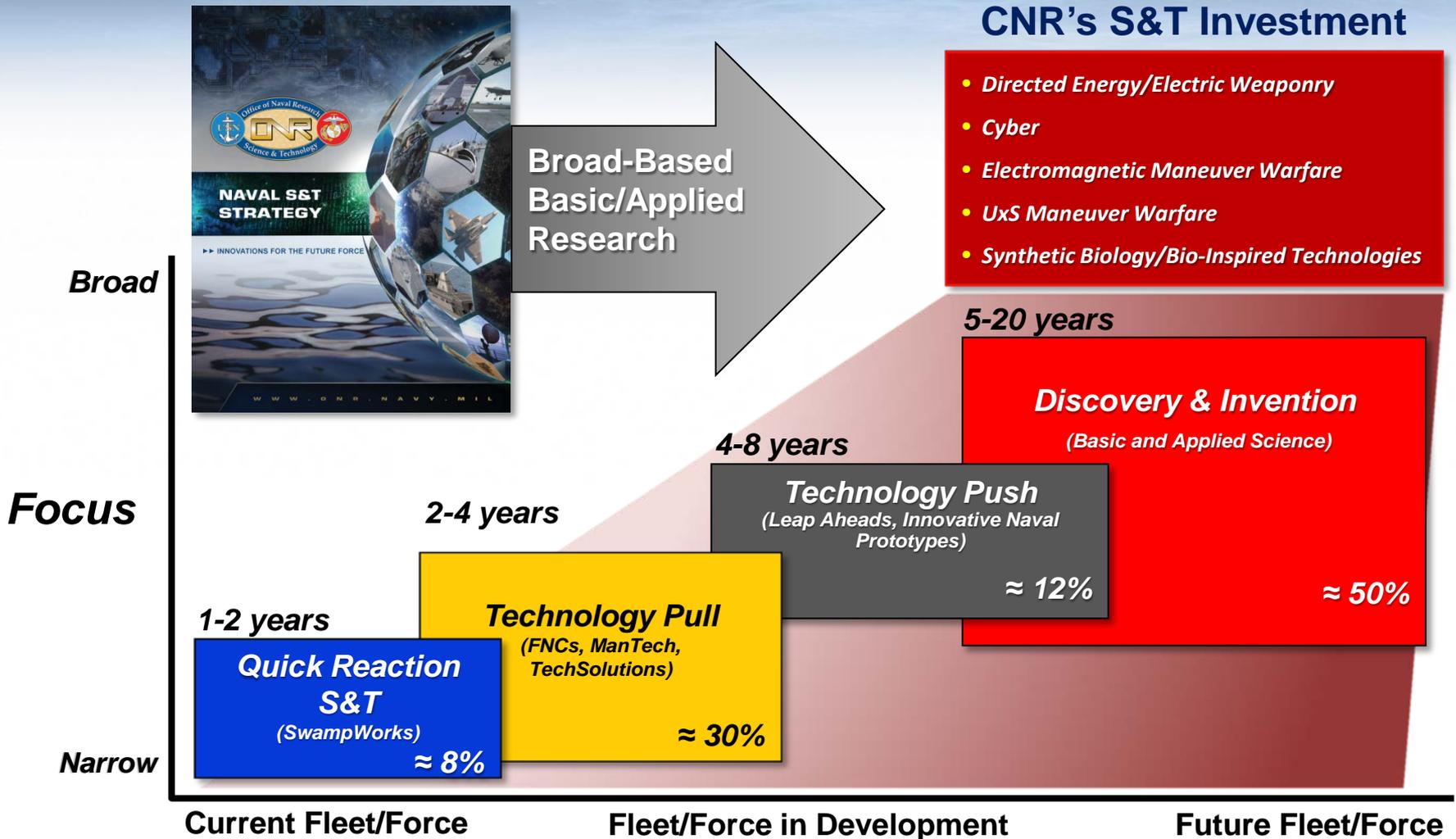


Technological Advantage





Warfighting Capabilities Enabled by S&T Investments

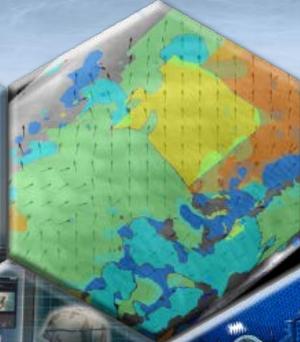


Portfolio is balanced across near, mid and long term S&T investments



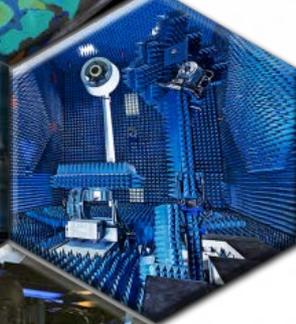
Naval S&T Strategy Focus Areas

**Autonomy &
Unmanned
Systems**



**Assure Access to
Maritime Battlespace**

**Expeditionary &
Irregular Warfare**



**EM Maneuver
Warfare**

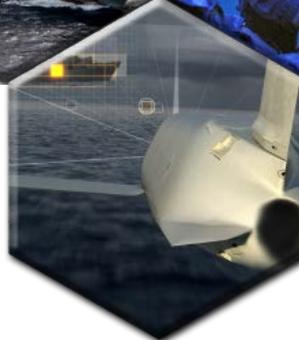
**Platform
Design &
Survivability**



Info Dominance & Cyber

**Power &
Energy**

**Power Projection &
Integrated Defense**



**Warfighter
Performance**



Autonomous Unmanned Surface Vehicles

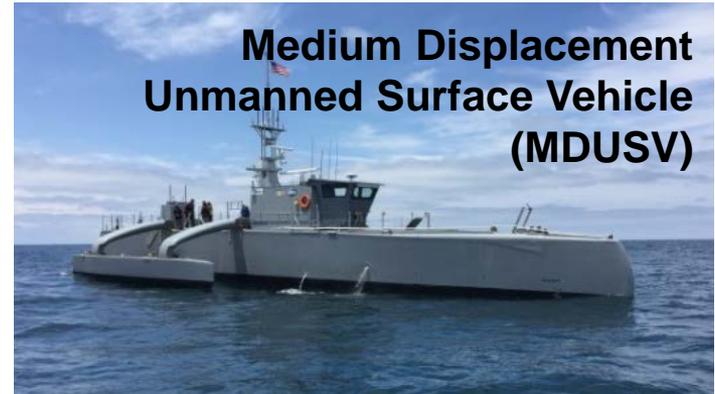
USV Swarm: S&T program to develop Unmanned Surface Vehicles capable of perceiving their environment, as well as sensing and responding effectively in a dynamic situation without human intervention.

MDUSV: S&T program to build and demonstrate an unmanned sea surface vehicle with ocean-spanning range, months of endurance, and substantial payload capacity.

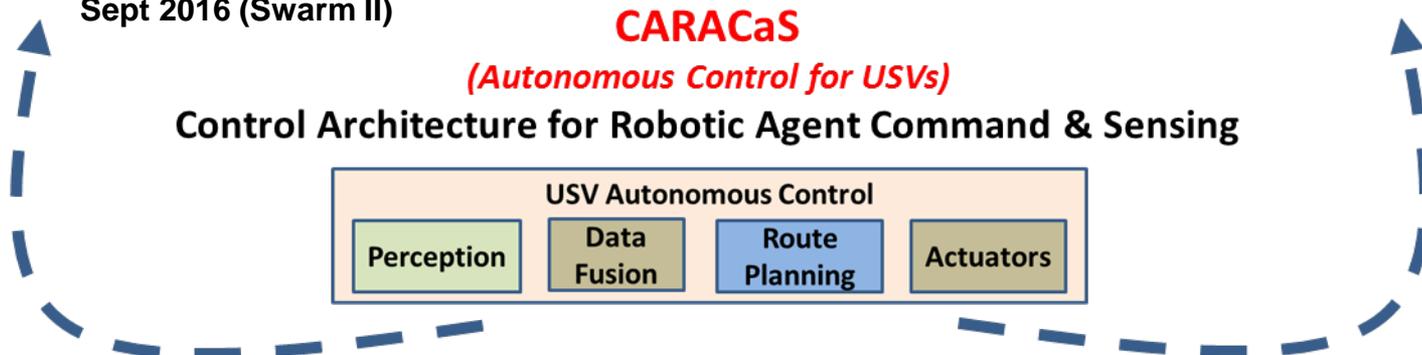


USV Swarm

Demonstrated Aug 2014 (Swarm I) & Sept 2016 (Swarm II)



Medium Displacement Unmanned Surface Vehicle (MDUSV)



USV Platforms

- USV Swarm I and II utilize 7 and 11 meter platforms →
- CARACaS cooperative autonomy can be implemented on much larger platforms:



Medium Displacement USV

A wide range of platform size and capability is possible for USV Swarm





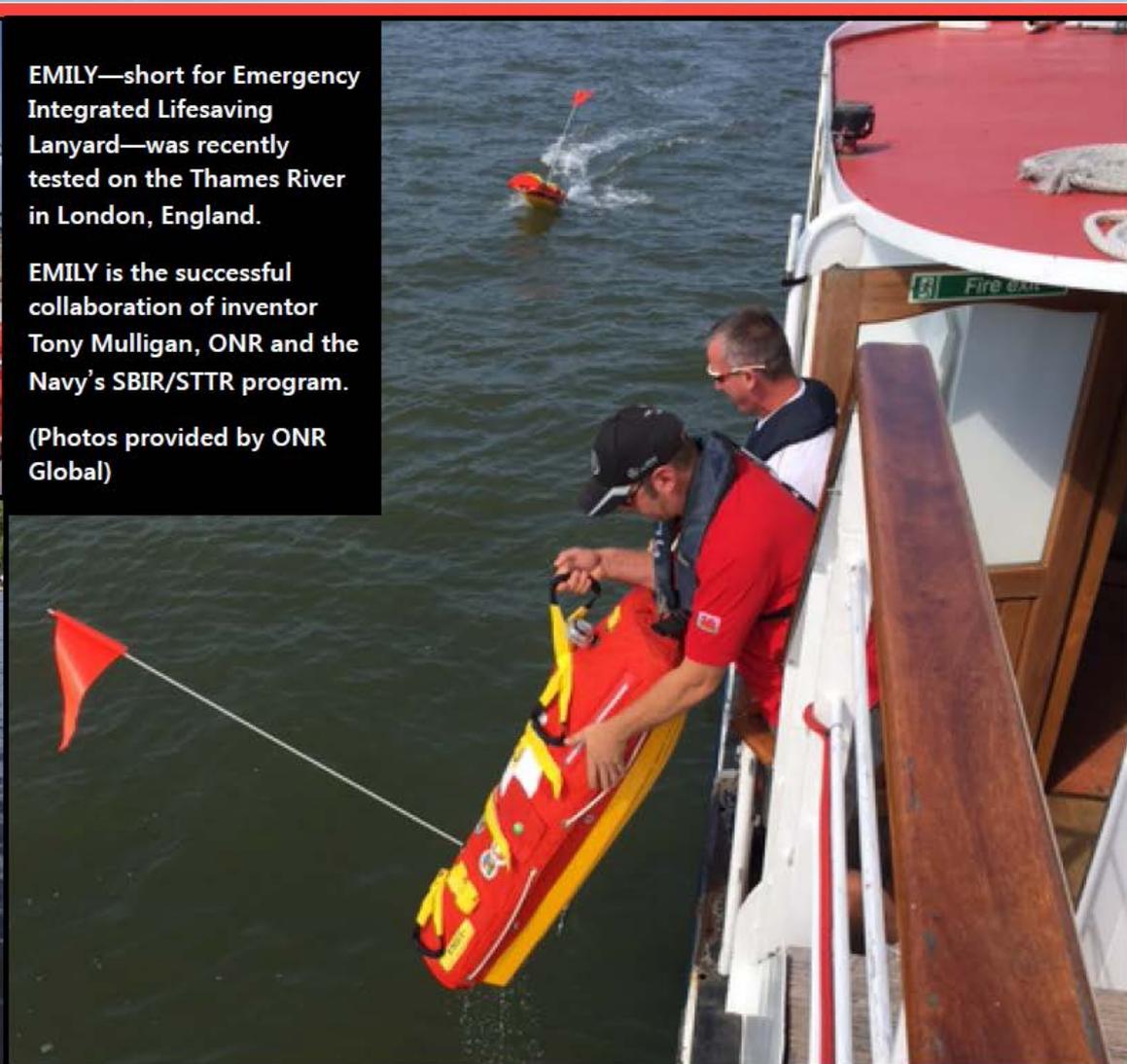
EMILY



EMILY—short for Emergency Integrated Lifesaving Lanyard—was recently tested on the Thames River in London, England.

EMILY is the successful collaboration of inventor Tony Mulligan, ONR and the Navy's SBIR/STTR program.

(Photos provided by ONR Global)





Naval S&T Strategic Plan

Power and Energy Objectives

Efficient Power and Energy Systems

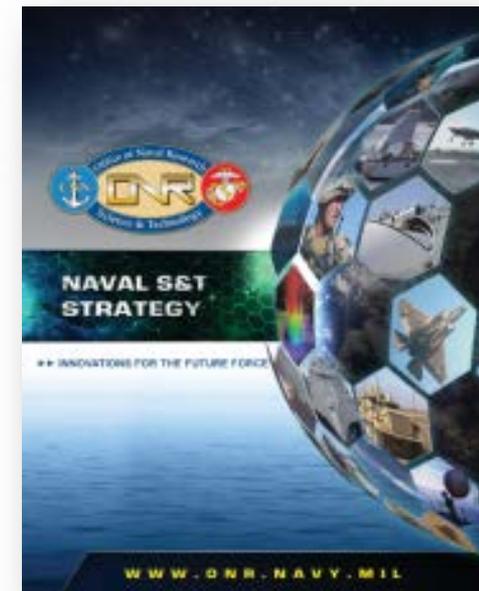
- Increased efficiency and power density on platforms and reduced weight for personal power through advanced materials, devices and architectures
- Efficient power conversion, switching, distribution, control and thermal management
- Efficient power generation equipment including engines, generators, motors and actuators
- Electrochemical, thermal, dielectric and kinetic energy storage
- Energy harvesting
- Power for distributed sensors

Energy Security

- Alternative and renewable energy sources for naval operations
- Issues associated with the logistics and compatibility of future alternative fuels
- Resilient power networks and systems for platforms and shore based Infrastructure

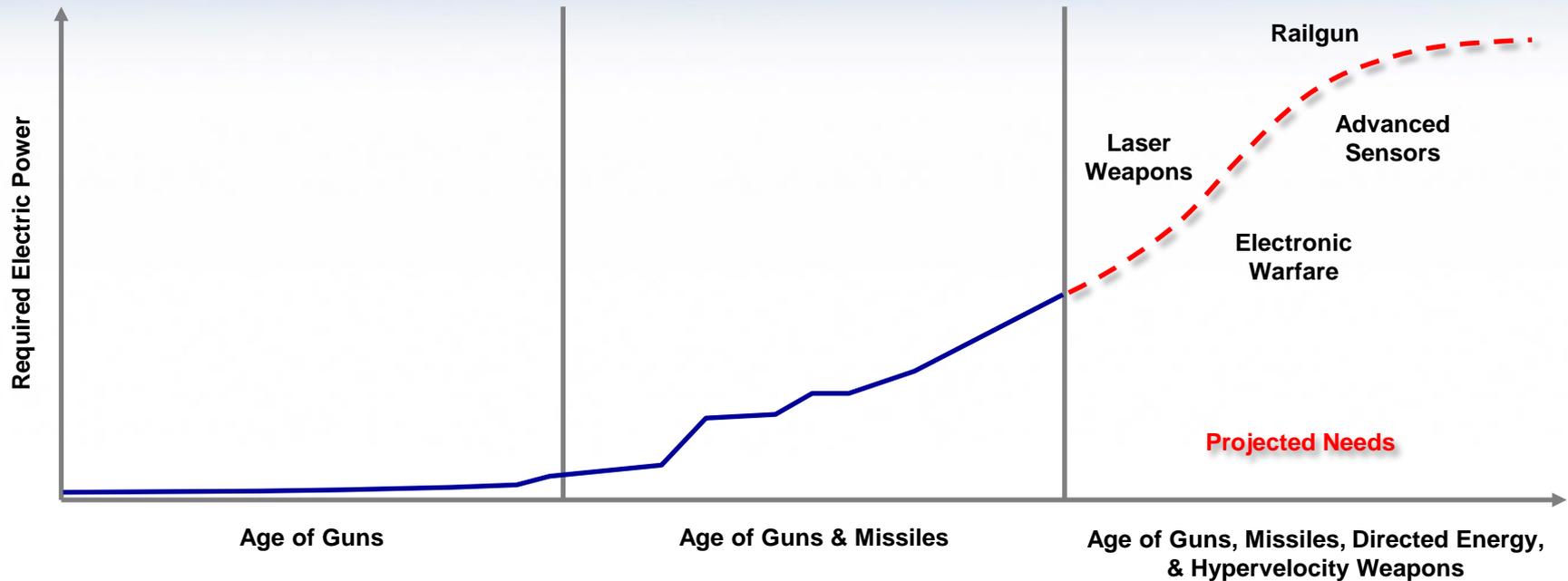
High Energy and Pulsed Power

- Energy storage, switching and control systems
- Pulsed power architectures
- Thermal management





Increasing Platform and Capability Power Demands

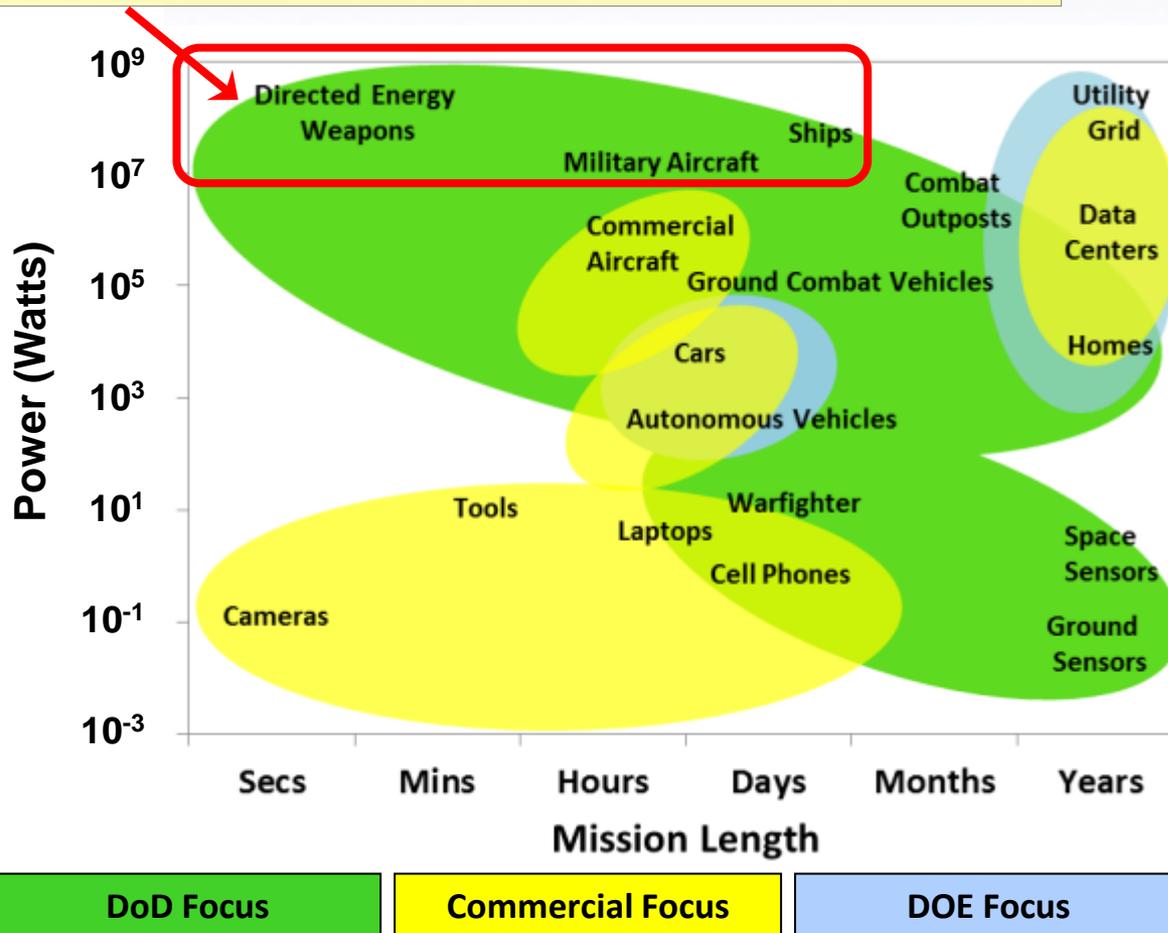


Power and Energy demands have steadily increased and are projected to increase at a higher rate in the future.



Unique DoD Energy and Power Technologies

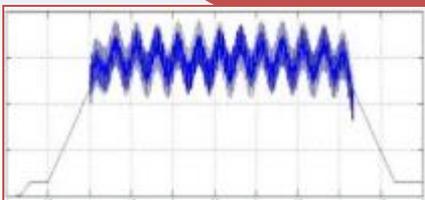
Directed energy weapons and their intended platforms are areas where the DoD must perform its own Energy & Power R&D.





Challenge of High Power Systems

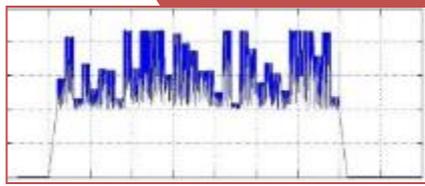
AMDR



SSL



SEWIP



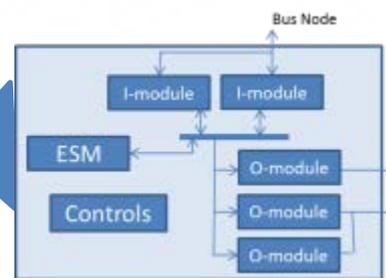
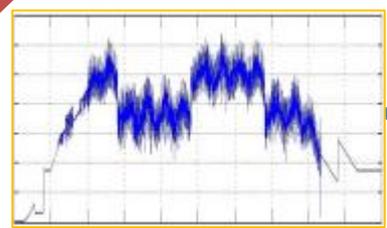
Mission Capability

Integrated Power and Energy System

Power Source

Gain an understanding of how the combined pulsating loads strain a power system through:

- Architecture Topologies
- Interface Characterization
- Modeling
- Hardware Methodology
- Testing & Validation



Goal: Support dynamic demand from steady generation (efficiency)

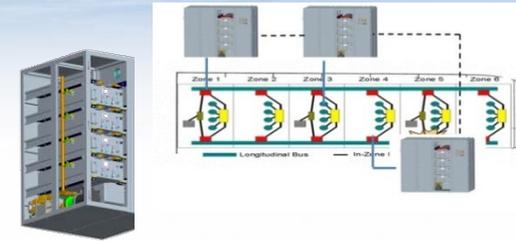
Today's Fleet and tomorrow's Fleet cannot support future high power systems without an integrated power and energy solution



Power and Energy Electric System Technologies

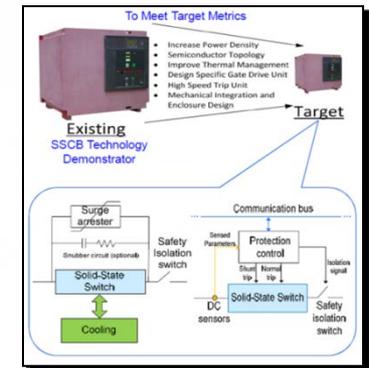
Multifunction Energy Storage for Navy-USMC Applications

Develop & demonstrate multi-function, reconfigurable energy storage modules with advanced control methodologies for fuel efficient plant configuration, power quality stabilization and surge demand capability. Integrated system demonstration FY19



High Power Solid State Circuit Protection

Develop components and methods to quickly detect and clear electrical faults, replacing slow-acting circuit breakers and protective relays. Integrated system demonstration FY 18



Efficient and Power Dense Electric Architecture and Components

Increase shipboard electrical system power density 2X while also meeting energy storage volumetric and gravimetric energy density goals.

