



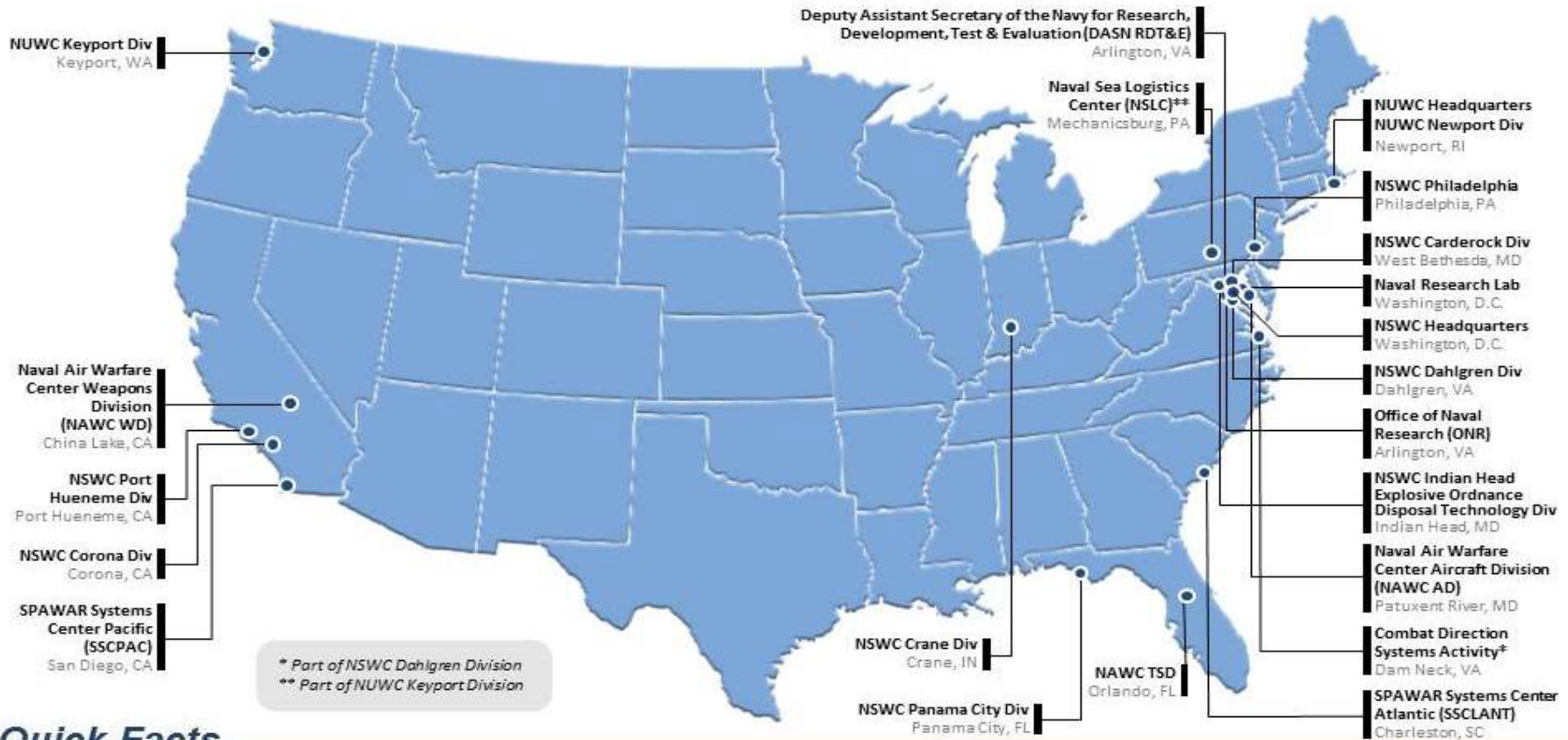
HARNESSING THE POWER OF TECHNOLOGY
for the
WARFIGHTER

**Safe, Common, Affordable Power &
Energy Storage (SCAPES) Overview**
Presented By: Keith DeVries/Alex Askari/Eric Shields
3 May 2017

*CAPT JT Elder, USN
Commanding Officer
NSWC Crane*

*Dr. Brett Seidle SES
Technical Director
NSWC Crane*

Naval Research & Development Establishment

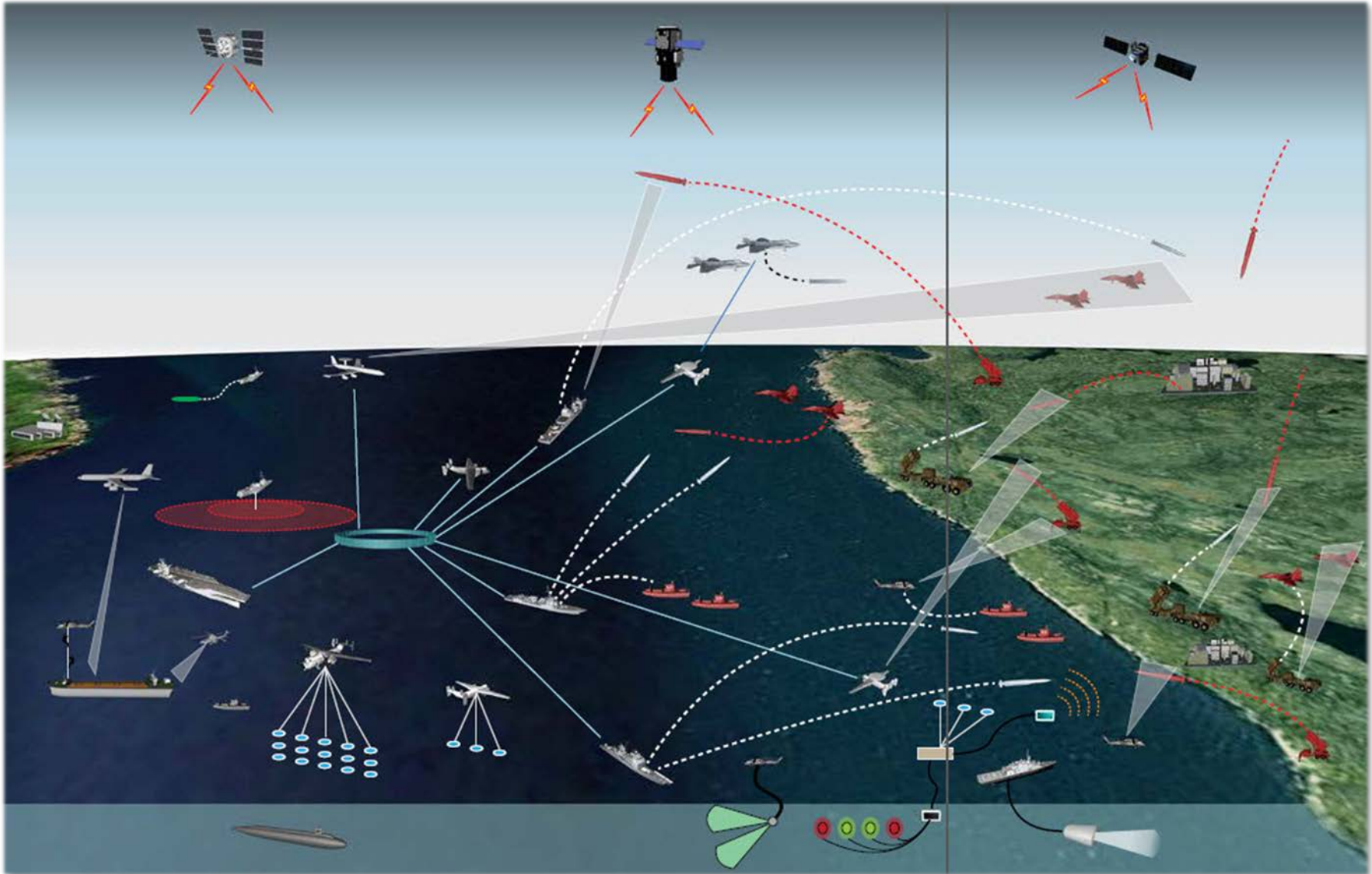


Quick Facts

- Diverse and highly educated workforce with 25,000 scientists, engineers, and technicians (with more than 2,000 Ph.D.s)
- 20 commands across the NAVAIR/NAVSEA Warfare Centers, SPAWAR Systems Centers, ONR and NRL
- Conducts RDT&E for the DoN to discover, develop, transition and field technologically superior naval warfighting capabilities.
- Unique Naval RDT&E facilities including laboratories, test facilities and test ranges
- Serves as principal R&D agents for Navy and Marine Corps Program Executive Offices
- Organizationally aligned to Naval Systems Commands and ONR
 - Naval Sea Systems Command (NSWCs, NUWCs)
 - Naval Air Systems Command (NAWCs)
 - Space and Naval Warfare Systems Command (SSCs)

Aggressive Research, Development, Test & Evaluation for reliable real world solutions.

Notional Battlespace Depiction

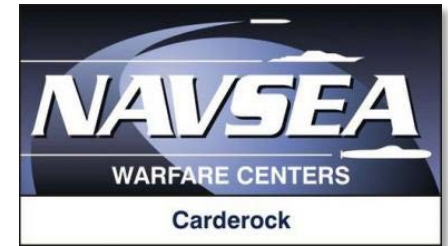
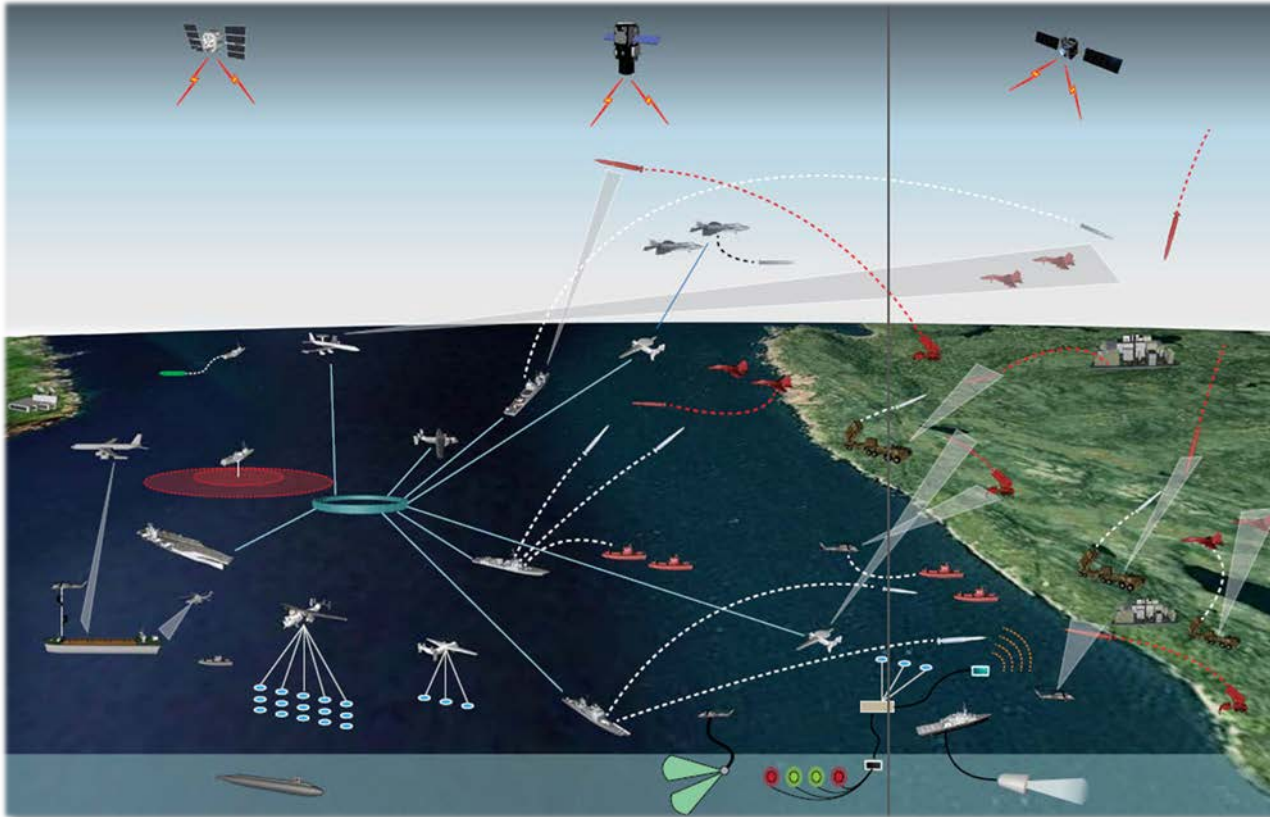


Systems of Systems Engineering Guidance Figure 3. – William F. Ormsby



Warfare Center Support of Battlespace

Power & Energy Specific



Workforce

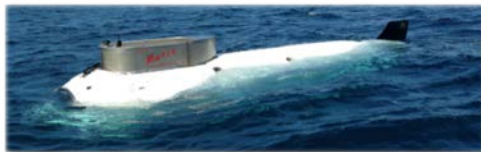
- 143 Government Professionals
- 30 (+) Contractor Partners
- 2000 (+) Years Combined Experience

Education

- PhD – 5
- Master's Degree – 23
- Bachelor's Degree – 66
- Associate Degree - 24

Engineering Assignments

- PMS NSW Engineering Agent for Battery Systems
- Technical Direction Agent (TDA)
 - Standard Missile Batteries (NAVSEA)
- Special Warfare Batteries (WARCOM)
 - AN/WSN-2, 2A & 5 System Batteries
- In-Service Engineering Agent (ISEA)
 - Submarine and Submersible Main Storage Batteries (NAVSEA)
 - Seal Delivery Vehicle Automated Battery Charger (WARCOM)
- Qualifying Agent
 - Trident, Seawolf & Virginia Class Submarine Batteries (NAVSEA)
- Acquisition Agent
 - Submarine and Submersible Main Storage Batteries (NAVSEA)
- Lead Maintenance Technology Center Electrochemical Systems (NAVAIR)





Advanced Power & Energy Branch (APEB)

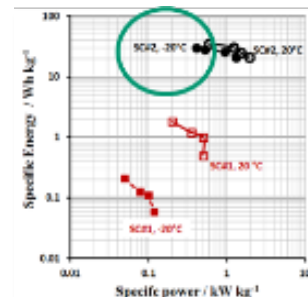
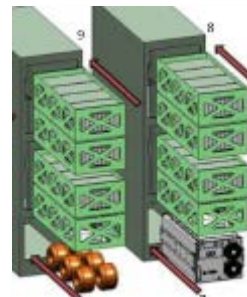
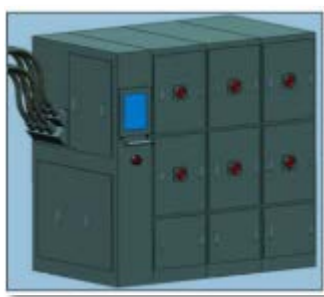
NSWC Carderock

Personnel: 32 (34) *26 Civilians, 7 Contractors, 2 interns*

Location: NSWC Carderock - West Bethesda

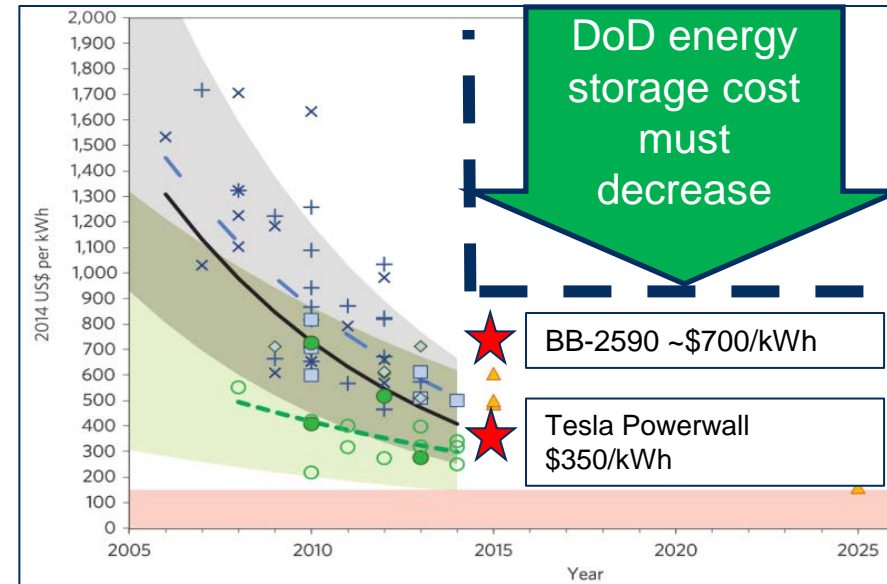
TC: CD16 Alternative Energy and Power Sources R&D

Provides the research and development (R&D) personnel, equipment, facilities, and necessary body of knowledge **to investigate, develop and implement programs in emerging alternative energy source technologies**. Combines the strengths of the Navy's recognized leaders in **electrochemical power sources (e.g. batteries and fuel cells)** R&D and leadership in marinization and ship integration with other disciplines such as nuclear technologies, biotechnology, physics, materials science, and shipboard electric power systems enabling the development of energy source specifications, which effectively address safety and environmental issues as well as performance requirements. Includes certification of advanced technology energy/power sources.



The Lithium Battery Affordability Problem

- Commercial lithium-ion batteries have dropped 90% in price of the past 10 years
- Many Navy lithium-ion batteries cost 20 - 30x the price of comparable commercial batteries
- The DoN operational requirements drive unique and expensive solutions (Safety Evaluation Costs per system up to \$5M and 2 year effort)
- Goal is to supplement DoN and OPNAV initiatives (i.e. Task Force Energy) thru development of a coordinated plan to address the affordability through commonality and other initiatives
- Focus is primarily on addressing current and future lithium-ion operational energy needs




Bjorn Nykvist and Mans Nilsson, Stockholm
 Environmental Institute Journal of Nature Climate Change 5, 329-332
<http://www.rtcc.org/2015/03/23/falling-battery-prices-boost-outlook-for-electric-vehicles/>

Commercial Standardization

- Family of Common Batteries
- Single Battery Interface
- Multiple Energy Densities
- Multi-platform
- Safe
- Cost Effective
- Upgrade as technology advances




Examples of Operational & Fiscal Impacts



Commercial Standardization

- Family of Common Batteries
- Single Battery Interface
- Multiple Energy Densities
- Multi-platform
- Safe
- Cost Effective
- Upgrade as technology advances





Present Operational Impacts

- Custom battery charging lockers makes fielding mine sweeping UUVS difficult
- Anti-Tank systems can't be operated by Marines immediately landing on a beach. The battery is flown in separately.
- Platforms requiring custom charging battery room on ships

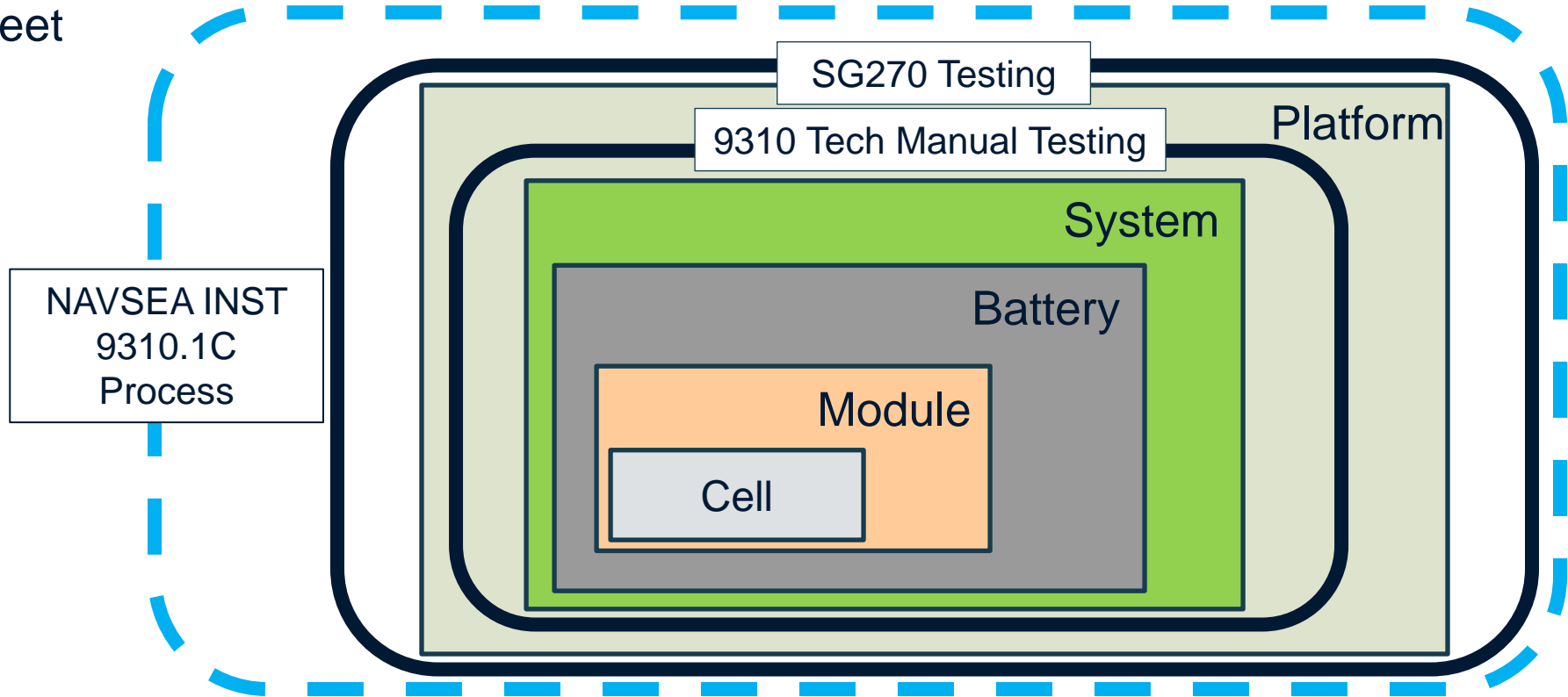
Fiscal/Manpower Impacts

- Certain aircraft batteries, being custom and low volume, cost > 400x commercially available equivalent
- Full safety testing of a large fielded lithium battery may cost \$2-5M per battery

This problem is expected to get worse as unmanned systems proliferate

The Navy's Safety Certification Process

The Navy has two levels of certification for deploying lithium batteries in the fleet

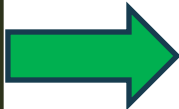


*NAVSEAINST 9310.1C - Certifies a battery, on some platforms, in a system, made of modules & cells

*SG270-BV-SAF-010 – Takes that certification and adds a step to characterize and accept risk and impact to the platform in a large format/high-risk battery casualty

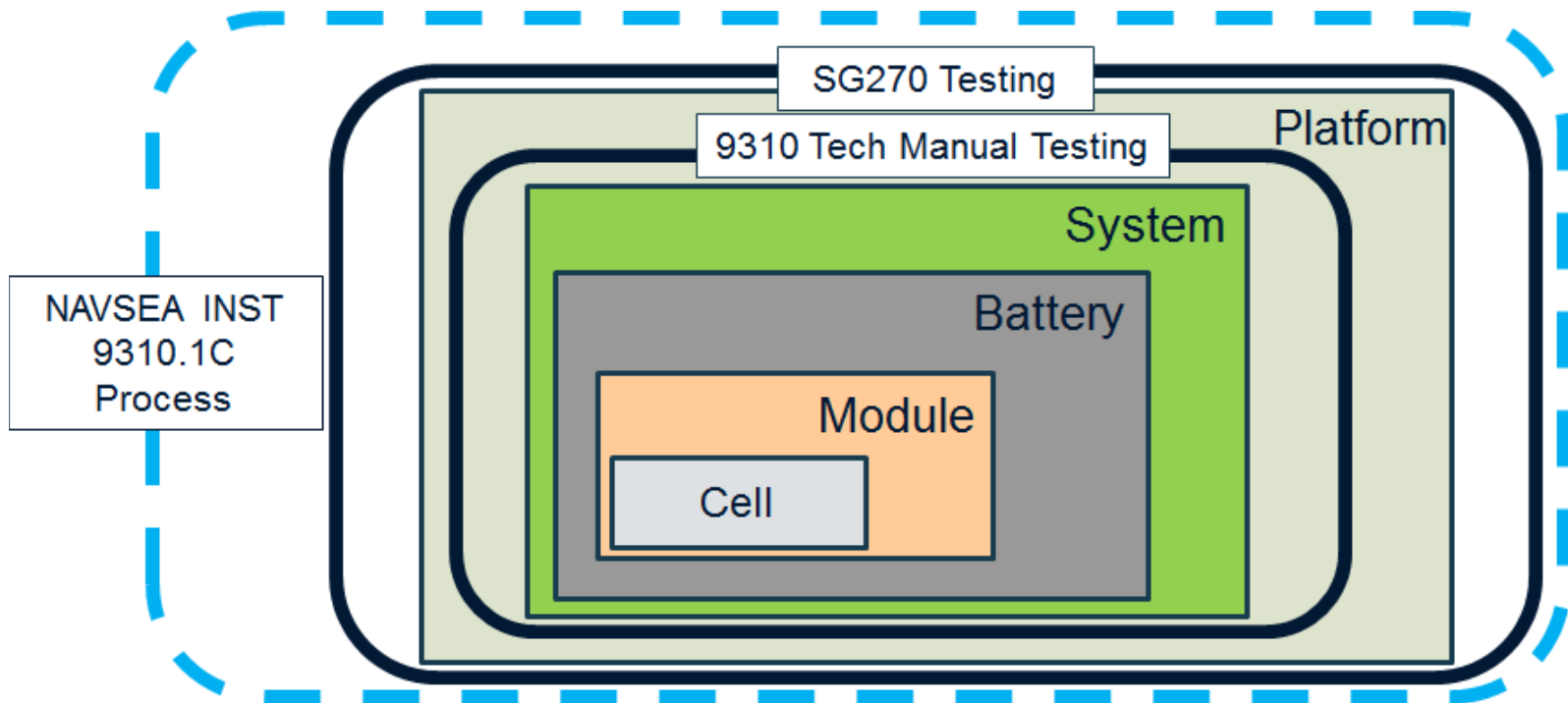
The Navy's Safety Testing

Program Office



To certify the safety of these systems, it tests the:

- \$ Cells (9310)
- \$\$ Modules (9310)
- \$\$\$ Battery (9310)
- \$\$\$ Battery in the system (9310)
- \$\$\$\$ Battery in the system in the platform (SG270)





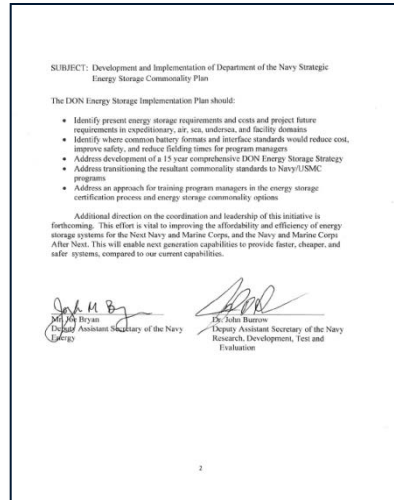
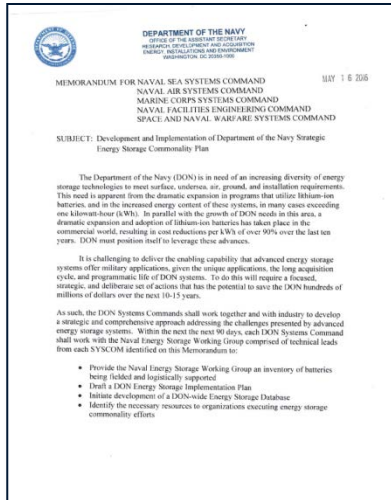
Navy Leadership Support

Energy Storage Commonality Plan MEMO

Signed May 16th 2016

Dr. Burrow, (DASN RDT&E) | Mr. Bryan (DASN Energy)

- Directed the Naval Research & Development Establishment to develop a plan to improve battery commonality in the Department of the Navy and to reduce costs



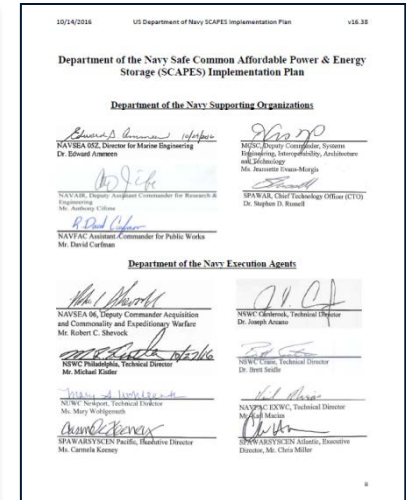
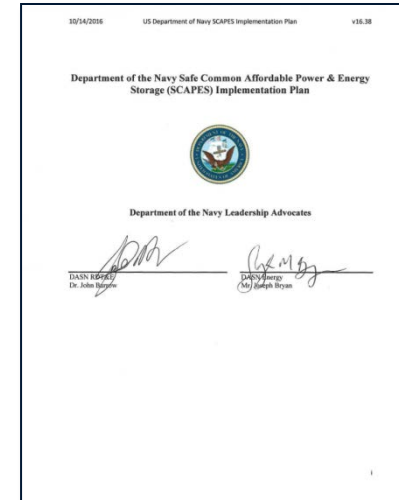
DoN Safe Common Affordable Power & Energy Storage (SCAPES) Implementation Plan

Signed October 14th 2016 by:

DASN RDT&E – Dr. Burrow | DASN Energy – Mr. Bryan

- *NAVSEA05Z
- *MARCORSYSCOM
- *NAVAIR
- *NAVFAC
- *NAVSEA06
- *NSWC Crane

- *NSWC Carderock
- *NSWC Philadelphia
- *NUWC Newport
- *NAVFAC EXWC
- *SPAWAR Pacific
- *SPAWAR Atlantic



DON-wide Energy Storage Database

- Initiated development of a DON-specific lithium battery database which will be made available to Naval System Commands, technical labs, the modeling community, and other stakeholders.
- To date, the prototype battery database has been used for more than 30 lithium battery certifications. The database has been shared with MARCORSSYSCOM and NAVSEA for evaluation and incorporation, with the goal of Navy-wide implementation.

Naval Lithium Battery Safety Program

System

Originating Organization: Select...

Correspondence Log #

Date Obtained

Title

Sponsor Code

Sponsor E-Mail

Devices

Number of Batteries

Battery

Battery Manufacturer

Application: Select or type...

Configuration: Select or type...

Battery Model #

Weight Capacity

Voltage Energy Capacity

of Cells

Cell Manufacturer

Cell Model #

Voltage Capacity

Energy Capacity

NDN Chemistry: Select or type...

Expiration

Expiration, if applicable

Platforms

Air Class

AH13W

AH-1Z

A48

C-130

C-17

Submarine Class

SSN

SSB

SSF

SSX

Surface Class

AF

AF5

AGOS

AK2

AD

Approvals

Comments and Limitations

Save Submit Submit for Signature Approve

Click here to attach a file

Insert Doc

Blank entry form for lithium battery database

Battery Database

All Documents Battery and Cell msg ...

#	Item Status	File Number	Date Entered	Name	Sponsor Code	Sponsor Email	Device	Number of Batteries	Battery Manufacturer	Battery Application	Battery Configuration	Battery Model	Battery Weight	Battery Voltage	Battery Capacity	Battery Energy Capacity	Battery Cells	Cell Manufacturer	Cell Model
1	Approved	16-243	9/2/2016	Certification for MISC 224 Test Operations	Unmanned Systems Integrated Programs Team Lead	matthew.south@navy.mil		6	Inoki, EaglePicher			Inoki 350-0000343-000 and 350-0000303-000 and EaglePicher LTC-79N	22.2 V 32.2Wh	4 Ahx 4 40Wh	89 Whx 26 Wh	6 for the Inoki 350-0000343-000 and 500-0000303-000		DOW Kikame	
2	Submitted		8/20/2016	Certification for the Lithium Batteries Contained in the Harvest Hawk Plus	PMA-207	dkw@hhepp@navy.mil	Harvest Hawk Plus (EUPS) 1000-S-10-W19600-000	3	Synco	UPS		UPS: 1200-S-10-W19600-000	293 V	9.6 Ahx	284 Whx	24	XALT Energy	SUP804312H	
3	test 1	8/9/2016	MISC Test 1	SIAT Energy		scott.lalith@navy.mil	robotics	3	PATCO	Main Power	Series	88 2590 5MB 1400 grams / 1.46g (0.1 lbs)	Series Mode: 20.0V min.; 29.0V max.; 33.0V max. C (747) Parallel Mode: 10.0V min.; 14.0V max.; 16.0V max. C (747)	Series Mode: 7.2 Ah @ 29.0V max.; 33.0V max. C (747) Parallel Mode: 14.4 Ah @ 29.0V min.; 15.4 @ 23°C (747)	132 Wh/kg 249 Wh/l				
4	Submitted		7/6/2016	Safety Certification for use of the SAFT 56 Cell Battery in the AN-550-123 (EN-5) Sonobuoy	PMA-264	john.wambaugh@navy.mil	AN-550-123 Sonobuoy	1	SAFT	Sonobuoy	Series		156.8 V	5 Ahx		56	SAFT	SAFT L0435HX cells	
5	Approved	16-041	6/13/2016	Safety certification of Lithium Batteries Contained in the CACADA Unit	Naval Research Laboratory			2	Panasonic AA Portable Power Corp.			CR123-PL-402544	6.0V 3.7V	1.4 Ahx 0.5 Ahx					
6	Approved	16-144	6/7/2016	Certification for the GLEAD-M Data Logger Battery Used on the F-35					Graphlec			G-569	7.2V	2.8 Ahx				Toyo Systems	
7	Approved	16-133	5/27/2016	Certification for Lithium Batteries Contained in the D/E Phantom 3	Program Manager: Navy & Marine Corps Small Technical Unmanned Aircraft Systems (STUAS)			3	DE				15.2V 7.4Ah 3.7V	4.48 Ahx 6.0 Ahx 2.8 Ahx					

Examples of lithium battery information stored in the database



Special Thanks

- DASN-Energy and DASN-RDT&E offices
 - James Caley and Marty Irvine
- SCAPES Program Management
 - Alex Askari (NSWC Carderock)
 - Eric Shields (NSWC Carderock)
- Undersea Working Group
 - Joe Fontaine (NUWC Newport)
- Surface Working Group
 - John Heinzel (NSWC Philadelphia)
- Expeditionary Working Group
 - Matt Huffman (NSWC Carderock)
- Aviation Working Group
 - Bert Frowein (NAWCAD Pax River)
- Facilities Working Group
 - Ken Ho (NAVFAC EXWC)