

NDIA's 60th Annual Fuze Conference NAVY S&T STRATEGY



Cincinnati, OH
10 May 2017



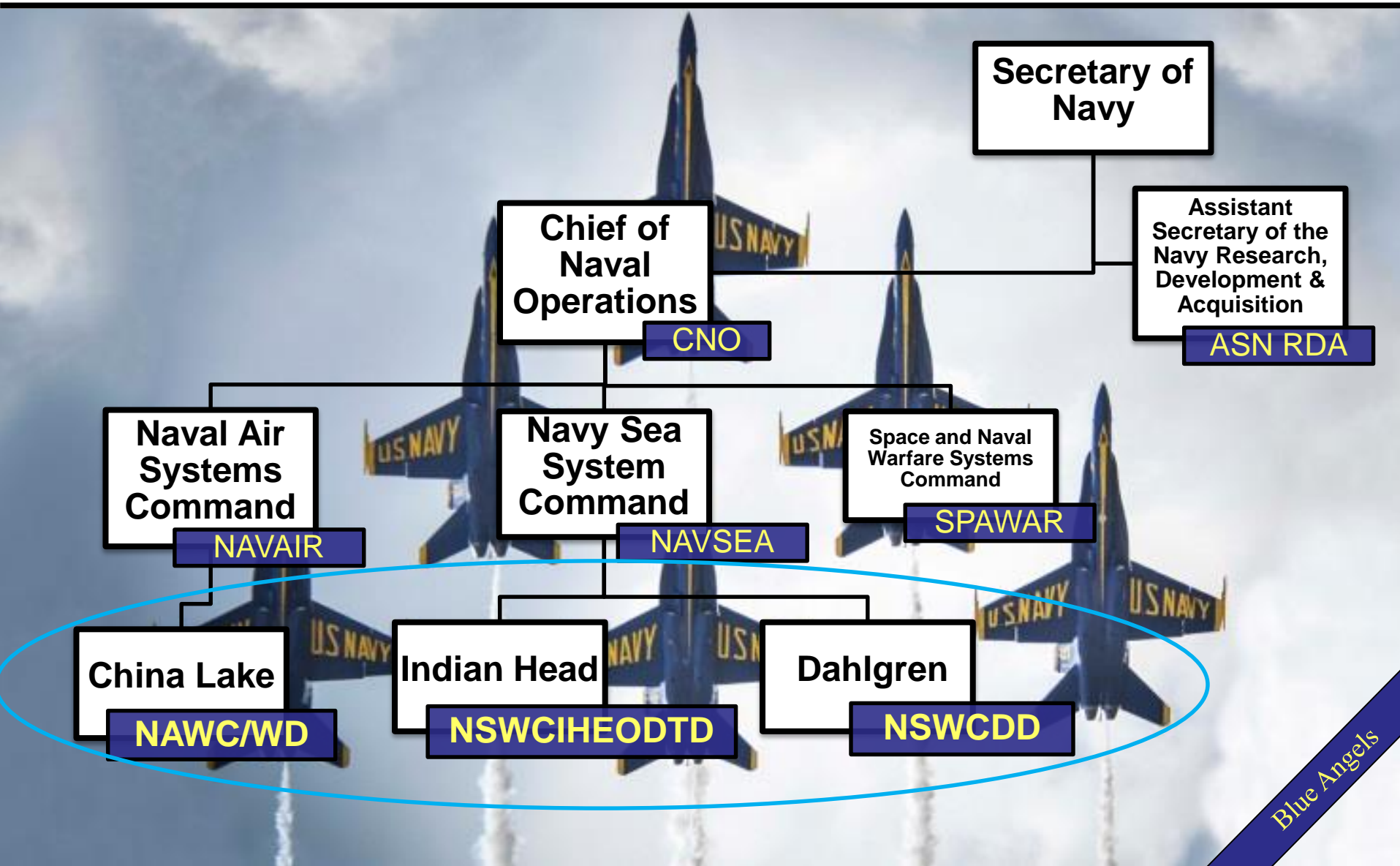
Dr. Michael Deeds
IHEODTD

Outline

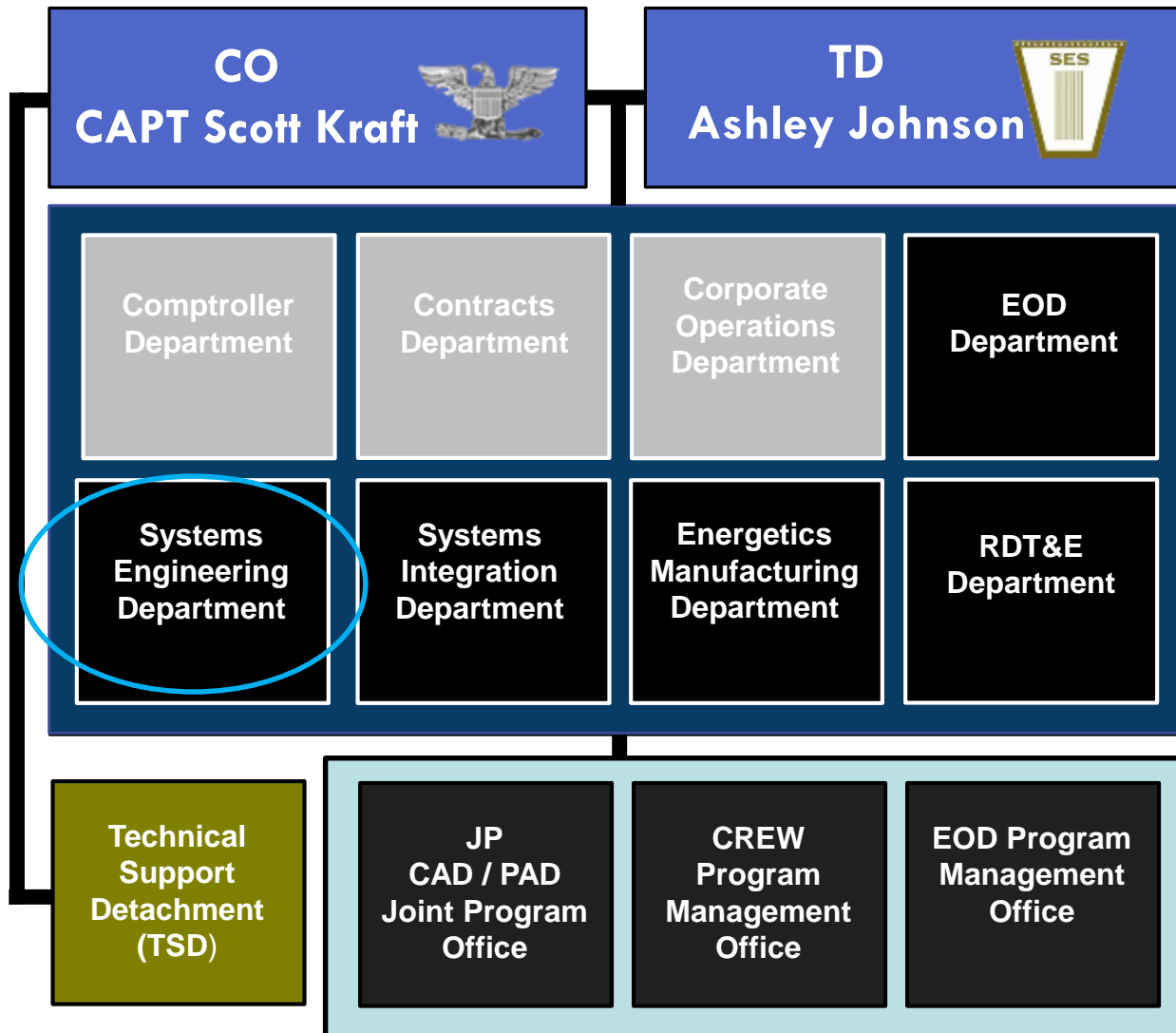
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- Navy Organizations
 - Navy Fuze R&D Highlights
 - Navy Fuze Conference Briefings
 - Summary

*Gerald R. Ford
CVN-78*

Navy Organization Fuzing R&D Activities



IHEODTD Organizational Structure



IHEODTD Locations

Indian Head, Md. (two sites): 1,589 civ., 1 mil. and 211 ctr.

- NAVSEA Center of Excellence (CoE) for Energetics
 - DoD EOD program lead
 - Combined Explosives Exploitation Cell platoons

Ogden, Utah: 21 civ. and 4 ctr.

- Co-located at Hill Air Force Base
- CAD / PAD Air Force Integrated Product Team

Camp Pendleton, Calif.: 4 civ., 2 ctr.

- Demonstration and Assessment Team
- Assigned to D Department

McAlester, Okla.
27 civ. and 7 ctr.

- Co-located at McAlester Army Ammunition Plant
- Navy Special Weapons

Louisville, Ky.: 11 civ.

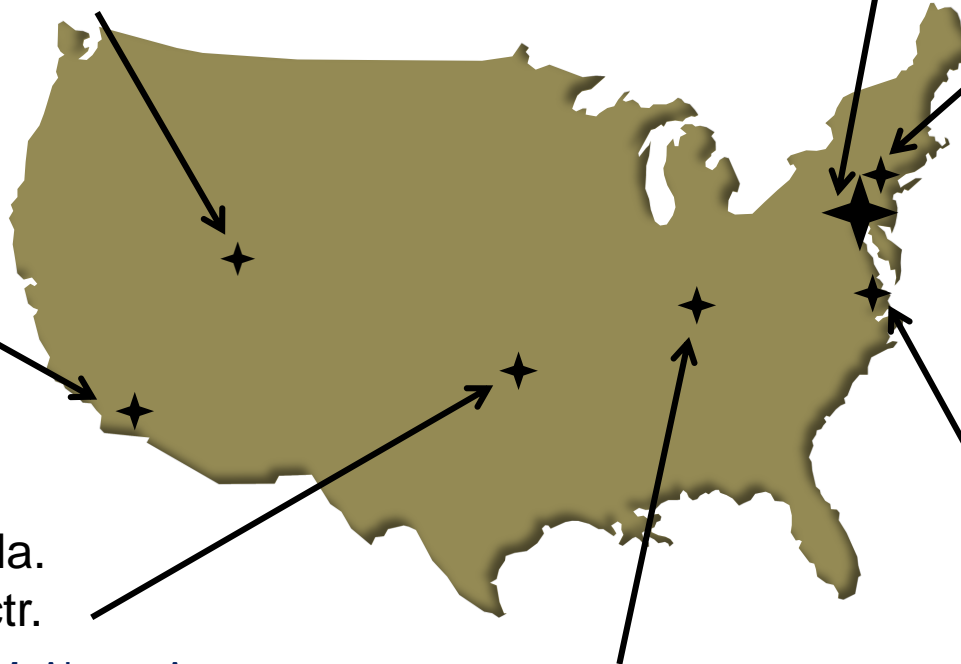
- Naval Guns

Picatinny, N.J.: 253 civ., 5 mil. and 9 ctr.

- Located at Picatinny Arsenal
 - Joint CoE for Guns and Ammo
- Navy Package, Handling, Storage and Transportation (PHST), Guns and Ammo

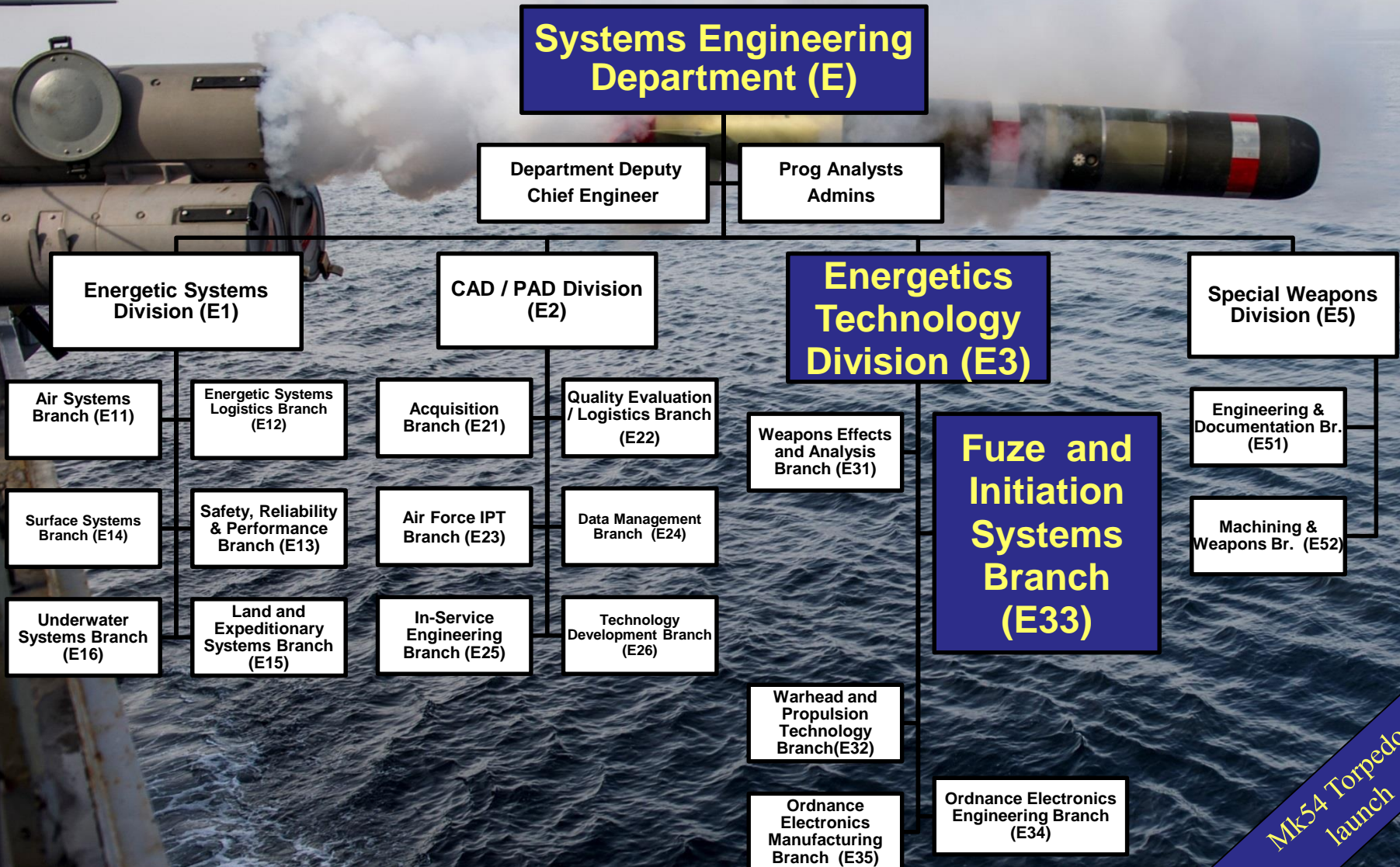
Norfolk, Va.: 2 civ., 3 ctr.

- Demonstration and Assessment Team
- Assigned to D Department



NSWC IHEODTD

Systems Engineering Dept (E)



Mk54 Torpedo launch

NSWC IHEODTD

Fuze & Initiation Branch Overview

Core Capabilities

- Fuze safety architecture
- Distributed fuzing
- Firesets
- Underwater fuzes
 - Torpedoes (e.g., Anti-Torpedo Torpedo)
 - Mine/mine neutralization
- MEMS and energetics integration (explosively certified cleanroom)
- Energy harvesting
- Powerless environmental sensors
- Foreign fuze exploitation
- Rapid prototyping/circuit board layout



Electrical Design and Test

- Electronic Safe Arm Devices (ESADs)
- Sensing technologies, imbedded systems, RF design



Initiation Systems Design and Test

- Micro-energetics
- Characterization (e.g., Photonic Doppler Velocimetry)



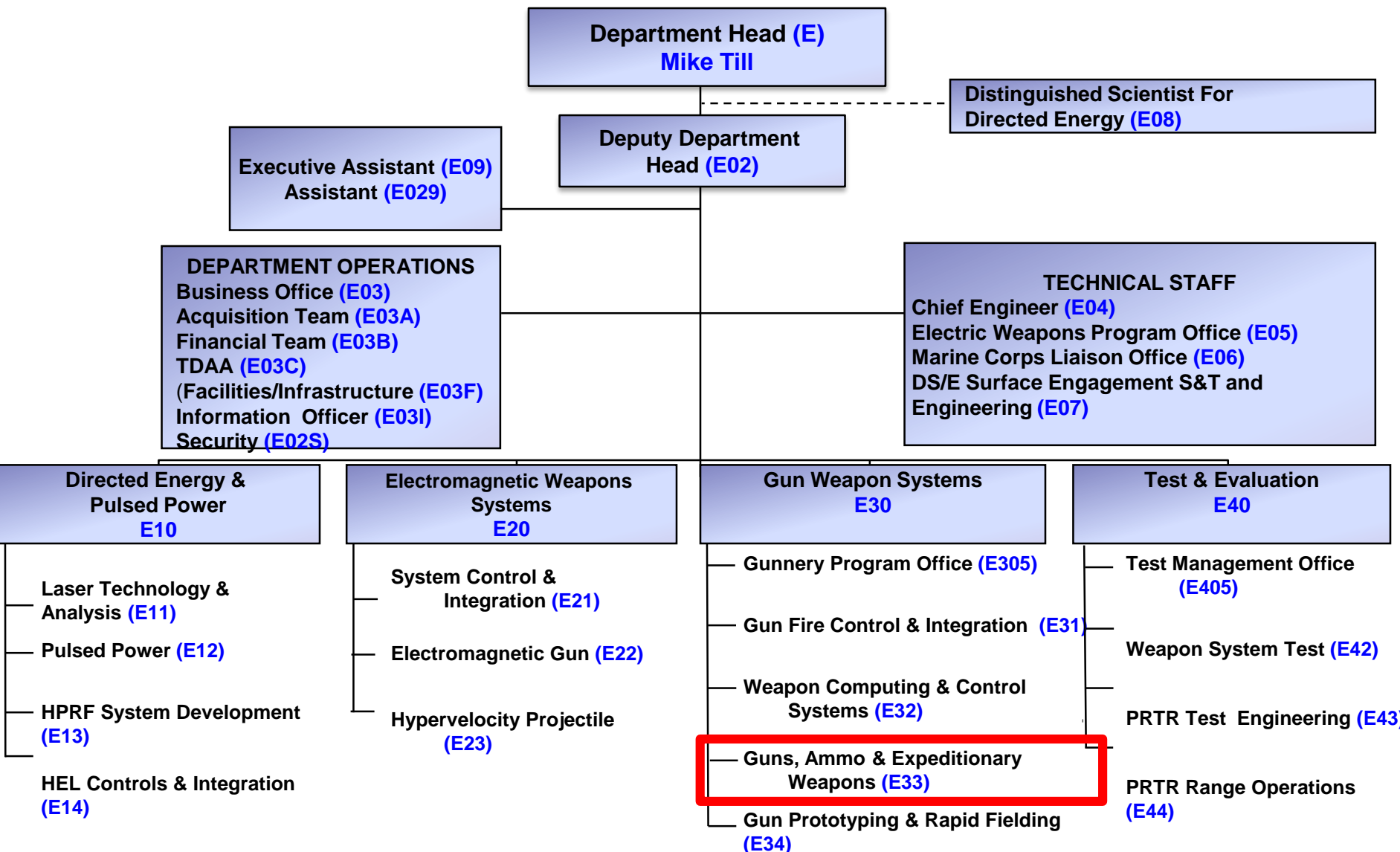
Mech. Design and Test

- Fuze packaging
- Full scale launch and impact testing
- Microelectromechanical Systems (MEMS)
- High G shock testing and survivability





NSWCDD Gun & Electric Weapon Systems Department (E)



NSWCDD Guns, Ammo & Expeditionary Weapons Branch (E33)

E33 Mission Statement

- *“Provide research, analysis, design and development, engineering, qualification, integration, and acquisition support of guns, ammunition, and expeditionary weapon systems to ensure battle space dominance for the warfighter.”*



25mm MK 38 Mod 2



MK45 5" Mod 2/4



Bofors 57mm



EFSS 120mm

Performance
Characterization and
Analysis

Ammunition



First Article and Lot
Acceptance Testing



Alamo



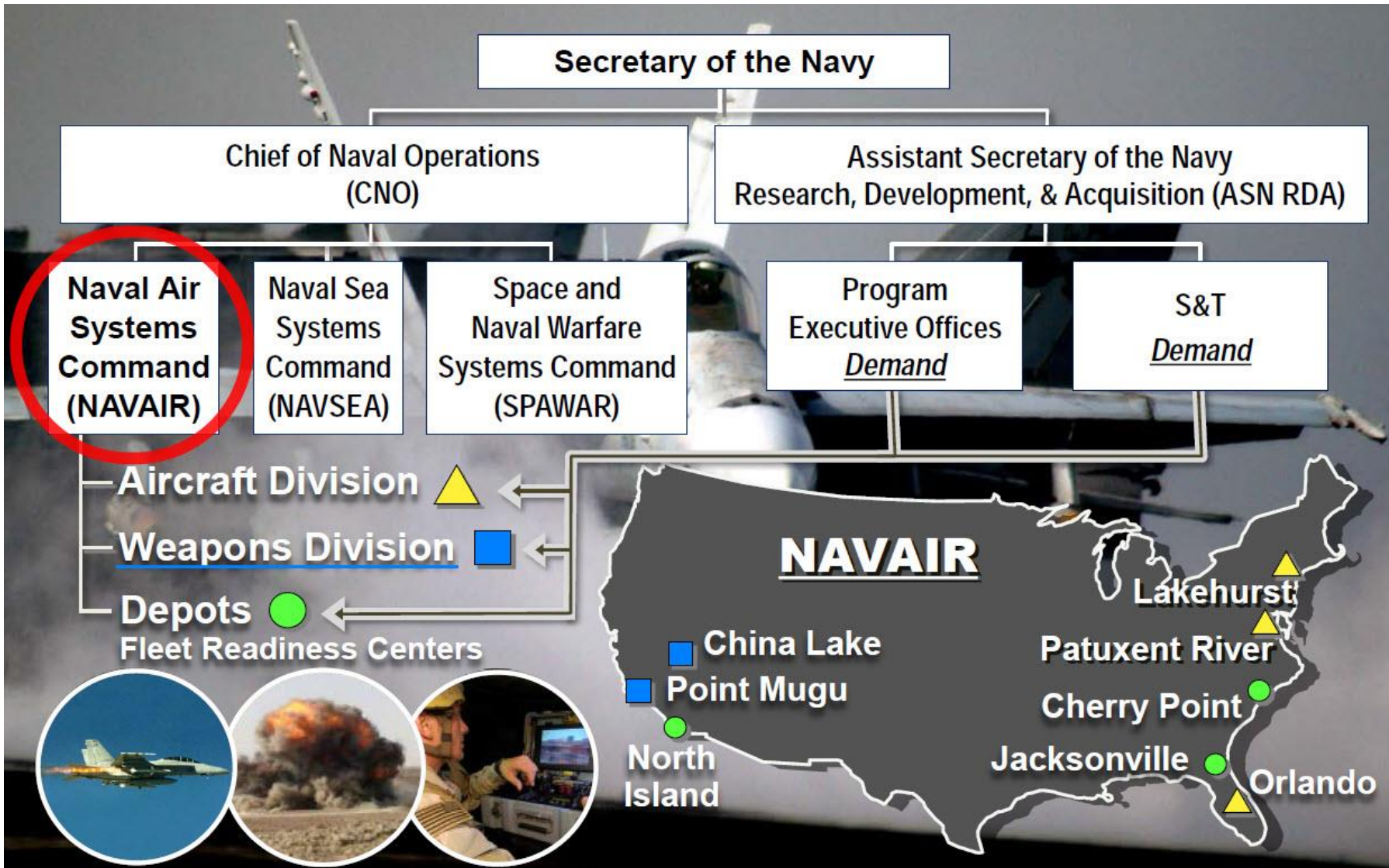
System and Product
Qualification and Certification

Fuzes

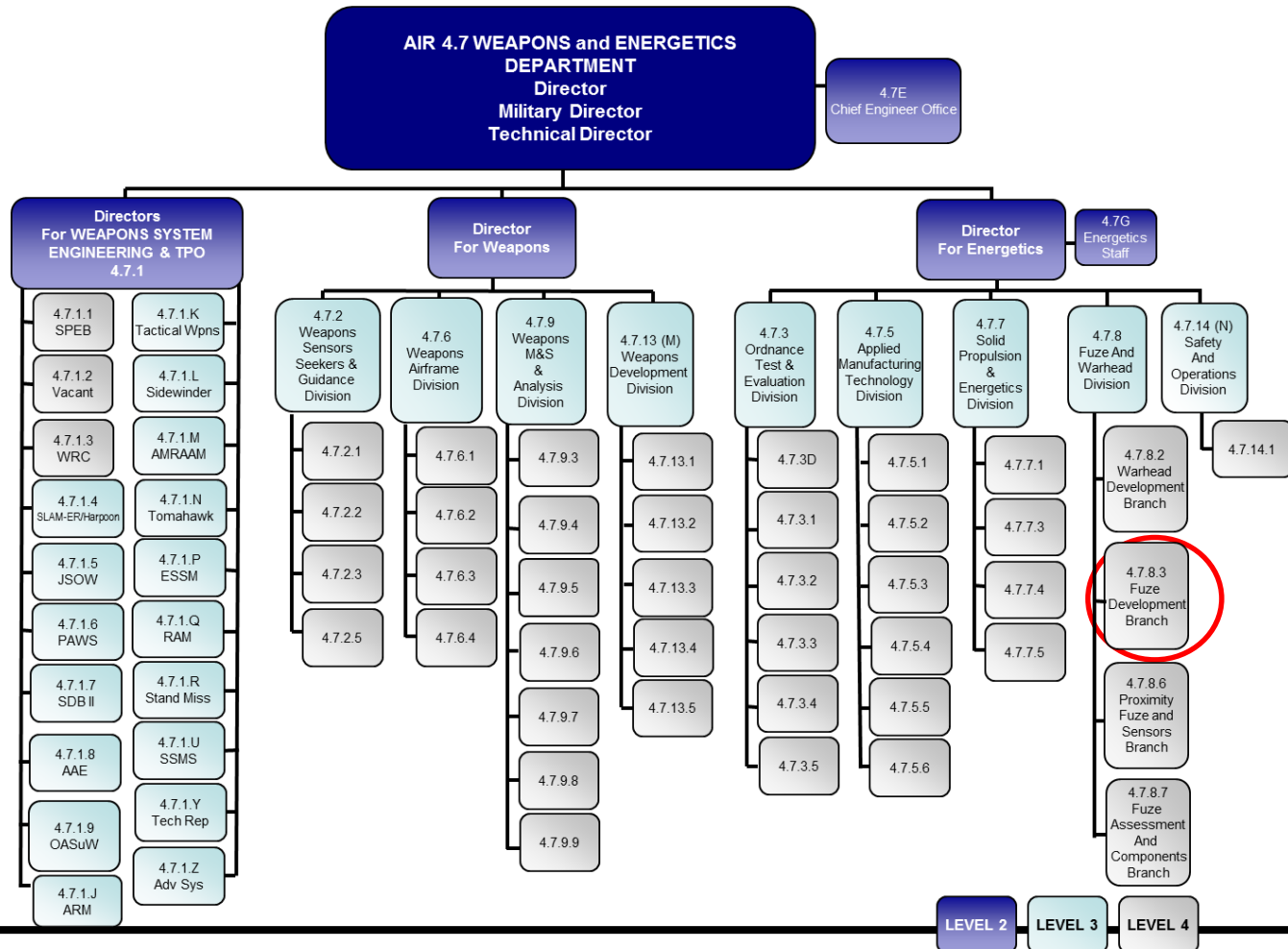


**Shoulder Launched
Multi-Purpose
Assault Weapon**

NAVAIR Organizational Alignment

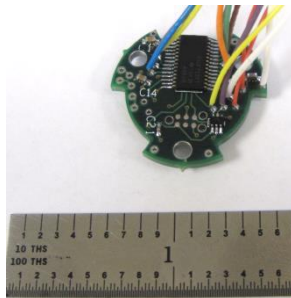


NAWC/WD Engineering Org Chart

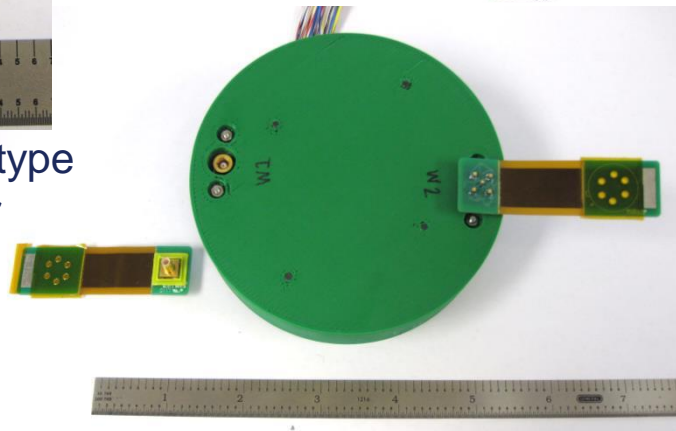
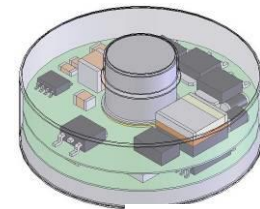
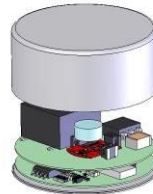


NAWC/WD Engineering Mission Statement/Overview

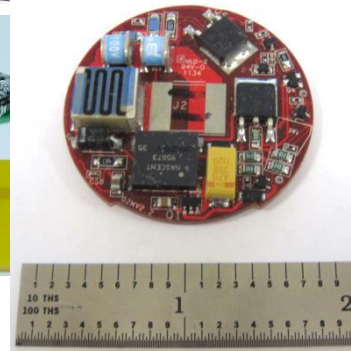
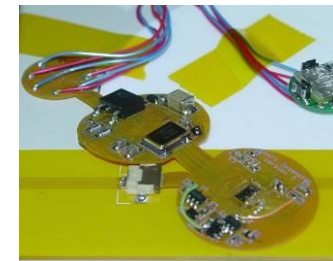
- The Fuze Development Branch has two basic Functions
 - Perform Engineering Design as well and Research on Fuzing and Fuzing related products
 - The Customers for this type of work are generally the JFTP, 219, TPOs, FNCs, ETC.
 - Support the In Service Engineering of Fuzing related products
 - Customers for this type of work are generally the TPOs and Ordnance Assessment



Artillery Prototype
ESAD Sensor

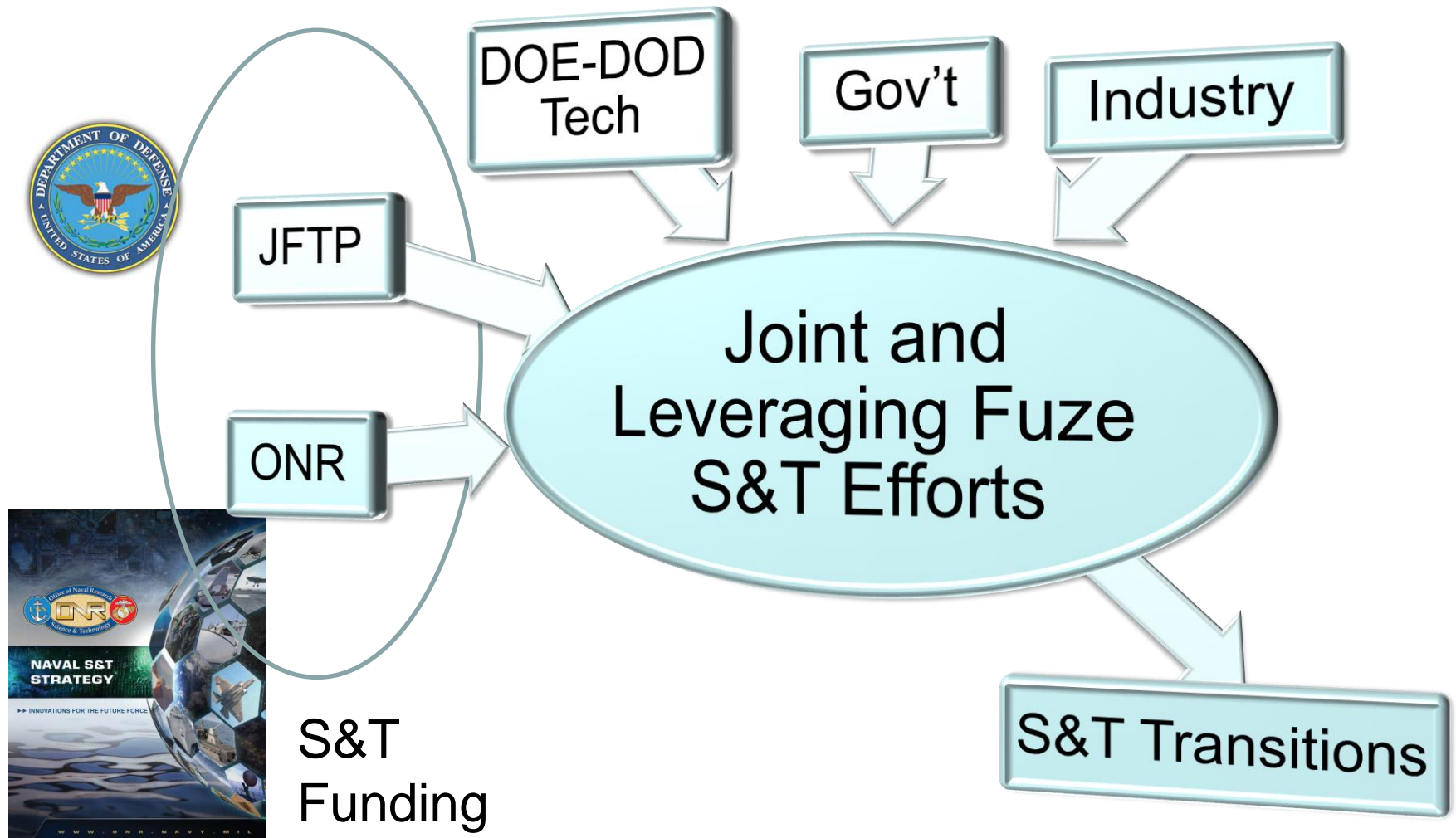


SMOKE ESAD – Dual LEEFI Output



G2M Mini ESAD
~1cu in., COTS

Navy Fuzing S&T



Navy Fuze S&T Efforts

- ONR: High Reliability DPICM Replacement (HRDR), Hyper Velocity Projectile Fuze
- JFTP (Joint Fuze Technology Program):
 - Advance proximity sensing
 - Hard Target Survivability – Modeling & Simulation, Testing, Encapsulation, Materials
 - MEMS and micro-explosive train reliability
- Navy Briefings at Conference:
 - High Reliability DPICM Replacement (HRDR) (Session IIIB) Cochran
 - Energy Harvesting for ESAF in Gravity Dropped Weapons (Session VB) Anderson
 - Stacked MOSFET in IGBT Pulse Discharge Switch (Session IIIB) Anderson
 - MEMS Fuze Explosive Train Evaluation and Enhancement (Session VA) Young
 - Vertically Integrating Switching Technology Progress & Test Results (Session IIIB) Mr. Brad Hanna, NSWC Dahlgren
 - Using Modeled Impact Response of 3-D Printed Materials for High-G Survivability (Session IVB) Ezra Chen
 - Fatigue and High Strain Rate Behavior of SAC305 Solder (Session VA) Joshi

High Reliability DPICM Replacement (HRDR)

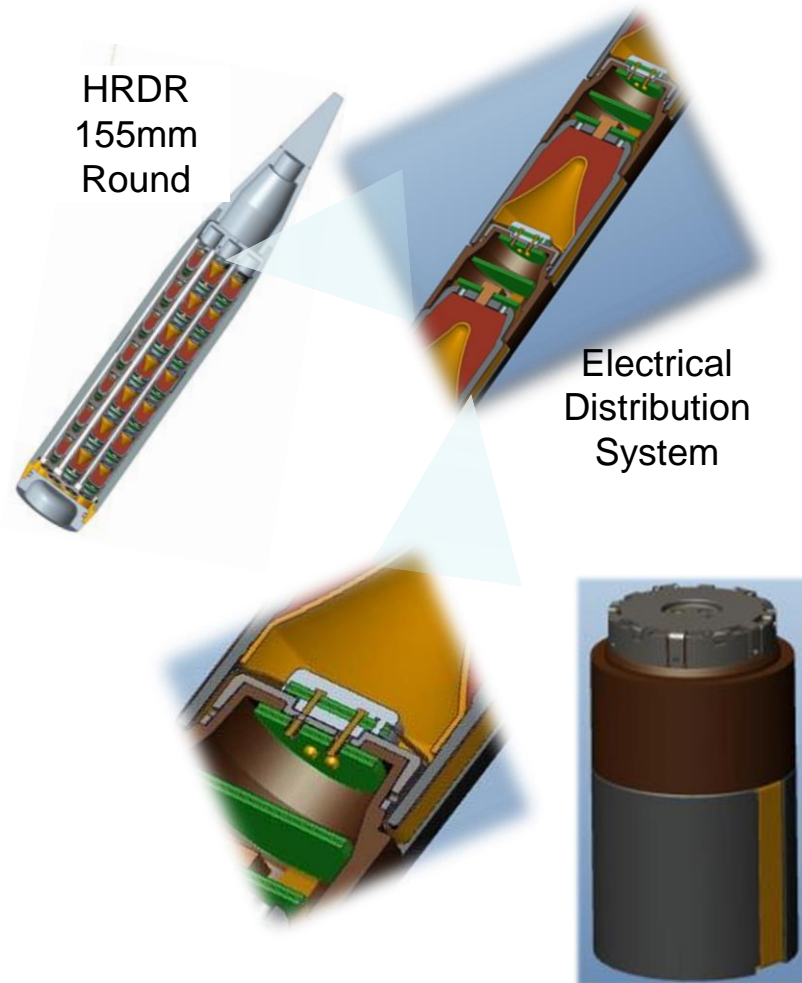


Objective: Develop a munition that is compliant with the 2008 OSD policy that limits submunitions to less than 1% UXO

Technologies

- Safe and Arming (S&A) architecture
- Signal distribution
- Target sensor

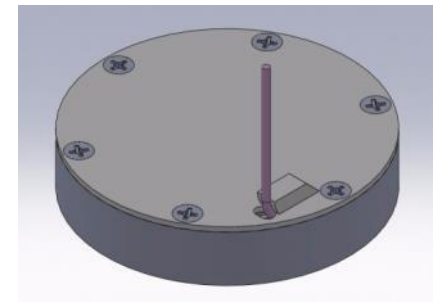
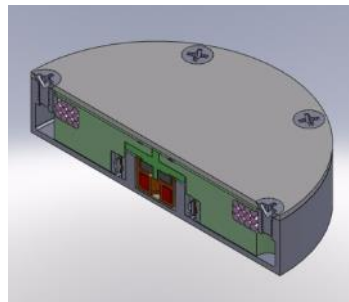
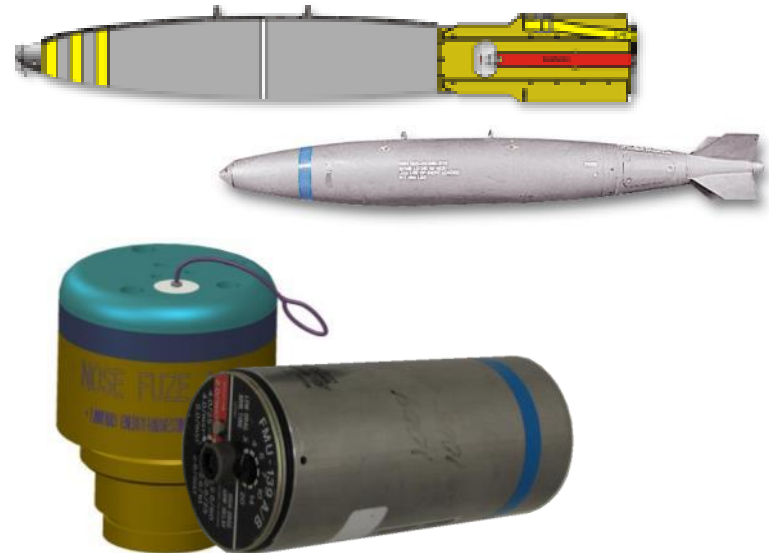
Closed Session IIIB briefing
provided by Kevin Cochran



Energy Harvesting for Event Detection for Electronic Safe Arm Fuzing (ESAF) in Gravity Dropped Weapons



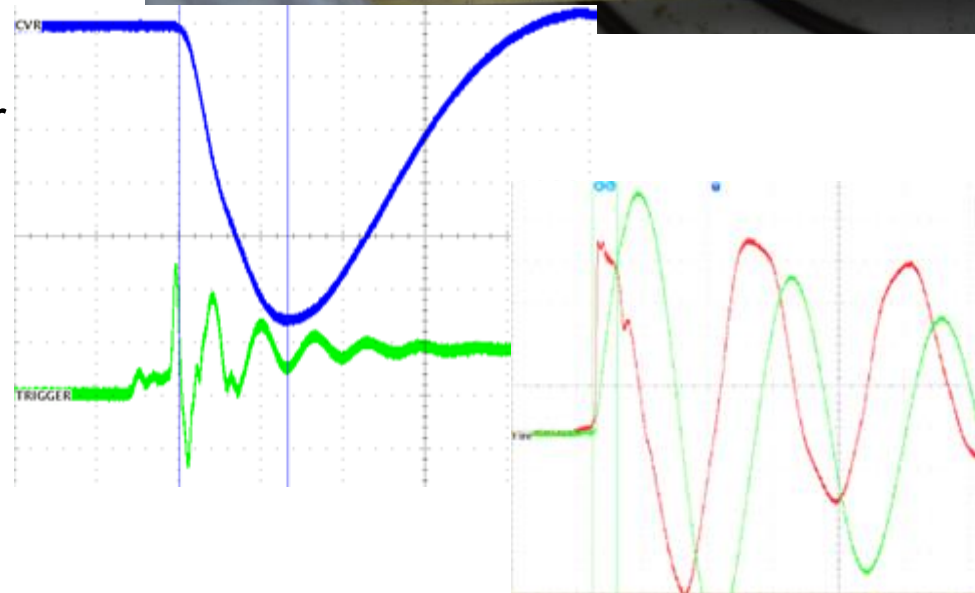
- Update on the development of the freefall energy-harvesting generator and event detector targeting future Gravity Dropped Weapon ESAF.
 - Lanyard pull energy-harvesting to power the fuze electronics and drop event detection
 - Two-environment drop event detection
 - Targeting application in general purpose bomb and future miniature munitions.



Closed Session VB briefing provided by Mr. Paul E. Anderson

Stacked MOSFET and IGBT Pulse Discharge Switch

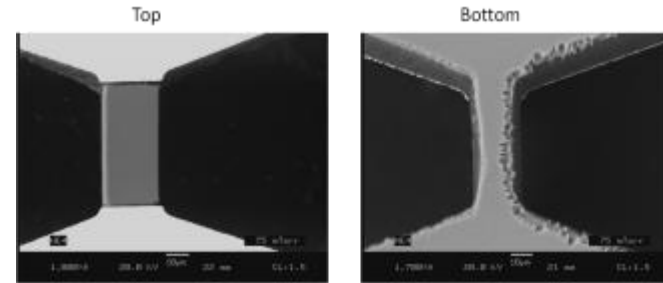
- Demonstrating a novel pulse discharge switch topology based around a series stacked IGBT.
 - Built around COTS IGBTs
 - \$20-50 per switch
 - Achieved 500+ shots into 0.5Ω load, several shots into 0Ω load
 - Live Fire testing planned for later this year on prototype configuration
 - Packaging study planned for continuing FY16 effort
 - Targeting application in any ESAF



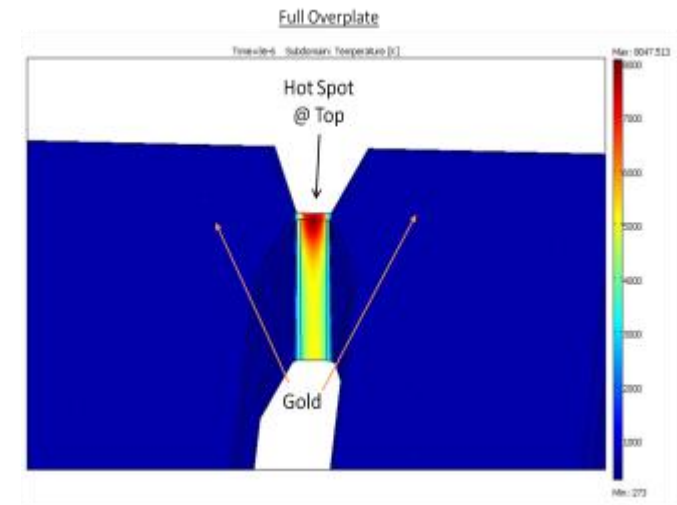
Closed Session IIIB briefing
provided by Mr. Paul E. Anderson

MEMS Fuze Explosive Train Evaluation and Enhancement

- Produce calculated reliability predictions for MEMS based explosive trains
- Characterize shock initiation and material properties of EDF-11
- Combined analysis of (100+) test data sets to determine a reliability of MEMS explosive interface



Model Hot Spots



Open Session VA briefing
provided by Taylor Young

Vertically Integrating Switching Technology Progress & Test Results

Government Collaboration Overview of Industry JFTP 6.3 task 15-I-044 Chip Level Switch Integration in Commercial In-Line Initiators

- Successful integration of breakdown switch on EFI microchips
- Compatible with 80% of RSI detonator platforms

Closed Session IIIB briefing
on behalf of Brad Hanna

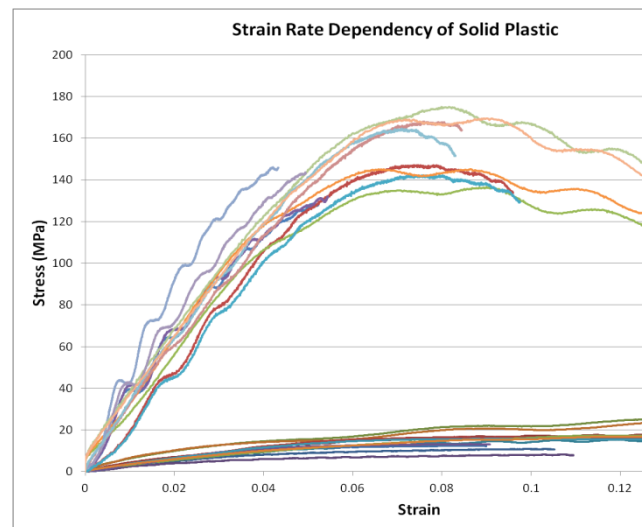
RSI REYNOLDS SYSTEMS INC.



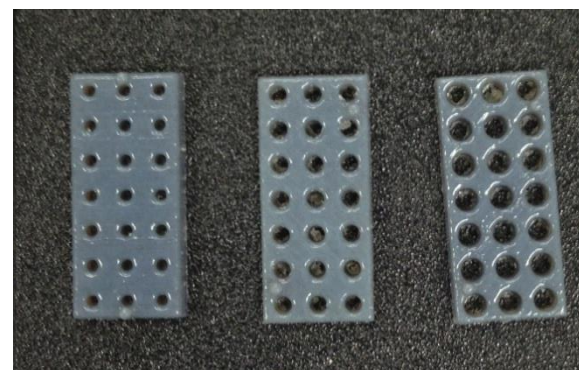
Using Modeled Impact Response of 3-D Printed Materials for High-G Survivability

- Use 3-D printed structure to enhance shock survivability of vulnerable fuze components
- Approach is to convert high acceleration-short duration shock to low acceleration-long duration impulse using 3-D printed structures

Closed Session IVB briefing
provided by Ezra Chen



Stress-Strain curves at different strain rates

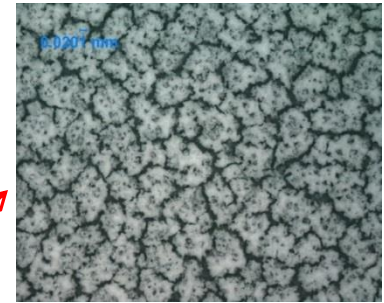


Test Samples

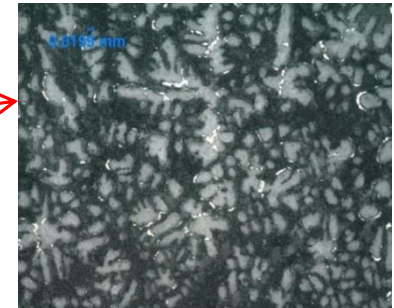
Fatigue and High Strain Rate Behavior of SAC305 Solder

- Predict fatigue life of lead-free solder based on its microstructural characteristics
- Characterize high strain rate behavior of lead-free solder
- Generate modeling parameters for lead-free solder for simulating high G loading environment for fuze application

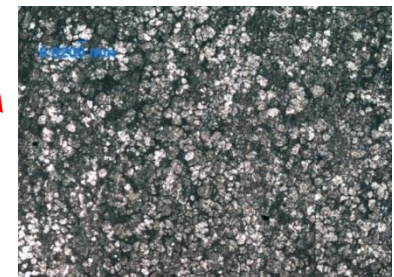
Open Session VA briefing
provided by Vasant Joshi



Triangle 100x



Large Cylinder 100x



Small Cylinder 100x

Summary

- Navy fuze S&T is executed at Navy labs with core capabilities in ESADs and MEMS
- Detailed, Navy S&T briefs to follow as part of the 60th Fuze Conference



USS Jackson
LCS-6