NDIA's 61st Annual Fuze Conference
NAVY S&T STRATEGY OVERVIEW

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Outline

Navy Organizations

- NSWC IHEODTD
- NSWC DD
- NAWC/WD

Navy Fuze R&D Highlights

Summary

STRATEGIC LOCATIONS

Ogden, Utah: 21 civ. and 4 ctr.
- Co-located at Hill Air Force Base
- CAD / PAD Air Force Integrated Product Team

Indian Head, Md. (two sites): 1,674 civ., 3 mil. and 211 ctr.
- NAVSEA Center of Excellence (CoE) for Energetics
- DoD EOD program lead
  - Combined Explosives Exploitation Cell platoons

Camp Pendleton, Calif.: 4 civ., 2 ctr.
- Demonstration and Assessment Team
- Assigned to D Department

Rock Island, Ill.: 2 civ.
- Quad-Cities Caliber Cartridge Case Facility
- Aligned with G Department

Picatinny, N.J.: 242 civ., 2 mil. and 45 ctr.
- Located at Picatinny Arsenal

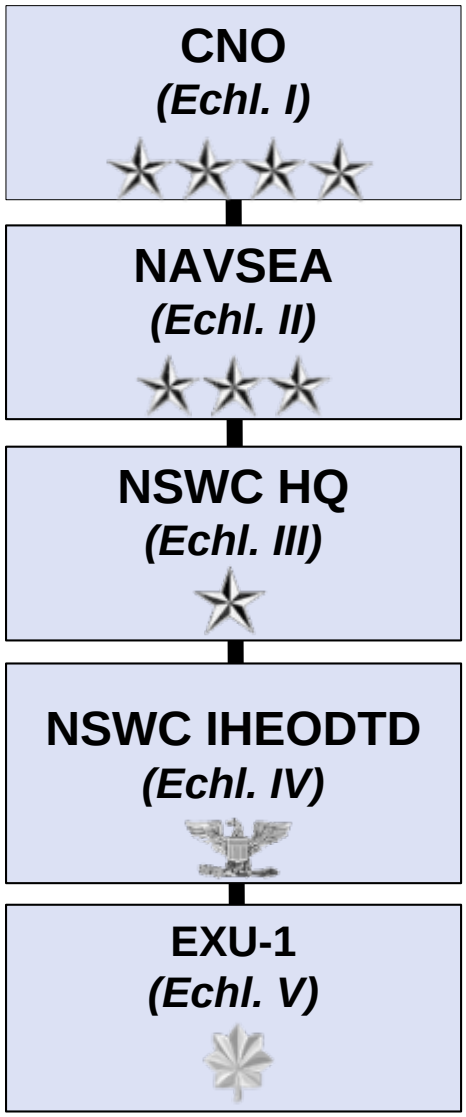
- Joint CoE for Guns and Ammo
- Navy Package, Handling, Storage and Transportation, Guns and Ammo

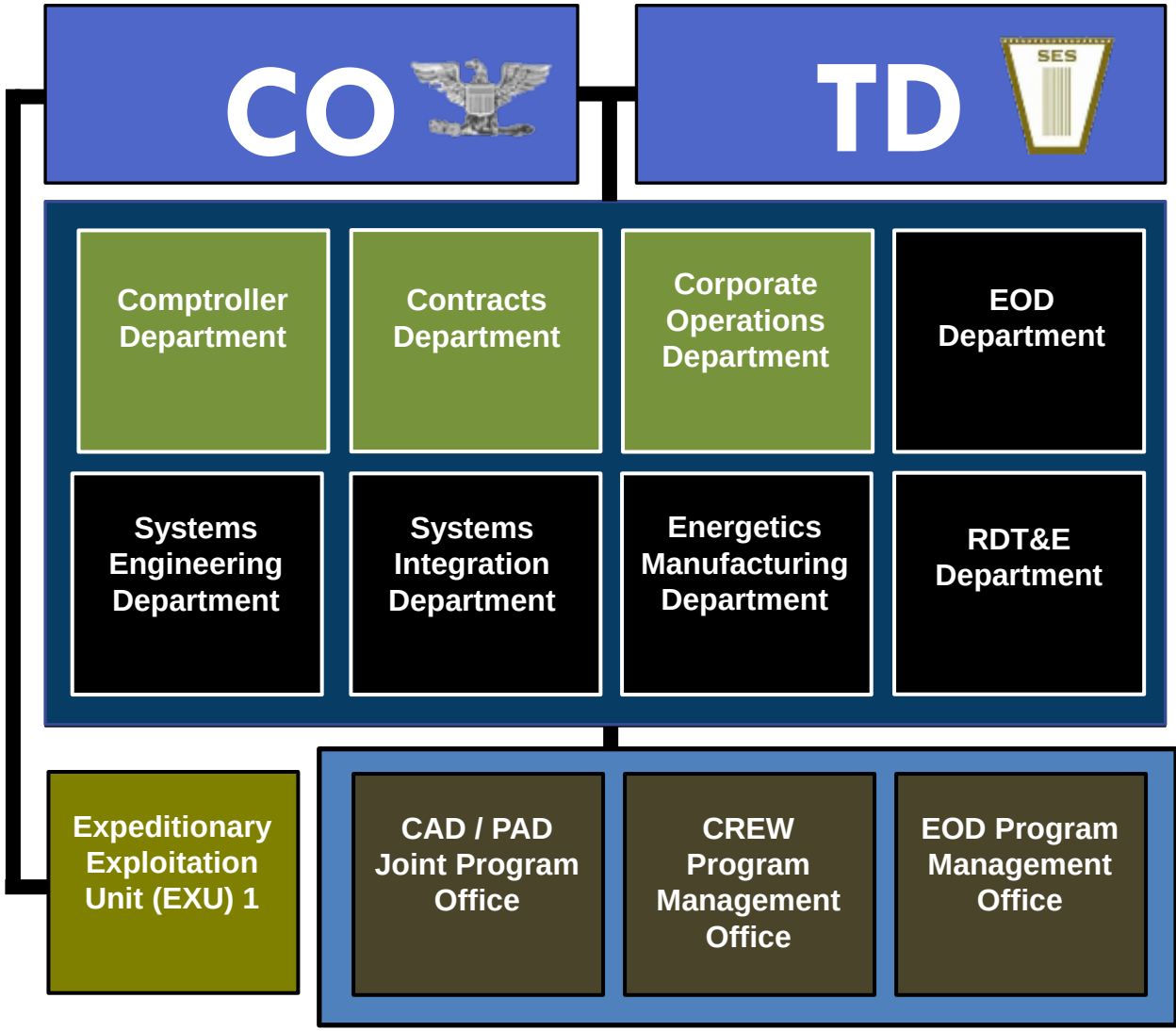
McAlester, Okla.: 39 civ. and 4 ctr.
- McAlester Army Ammunition Plant
- Navy Special Weapons

Louisville, Ky.: 12 civ.
Naval Guns

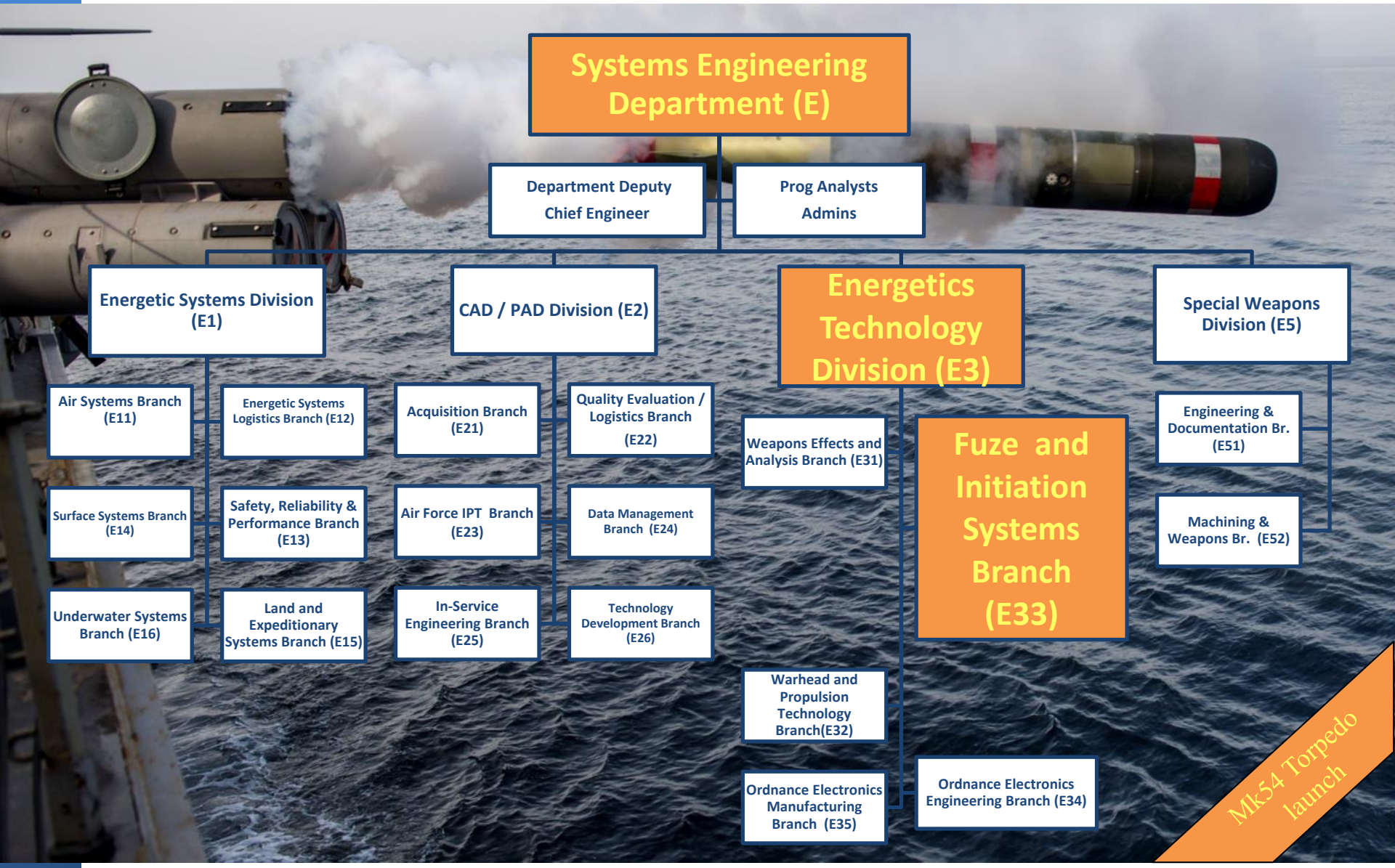
Norfolk, Va.: 12 civ., 3 ctr.
- Demonstration and Assessment Team
- Assigned to D Department

IHEODTD Organizational Structure





NSWC IHEODTD Systems Engineering Dept (E)



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
- Rapid prototyping/circuit board layout

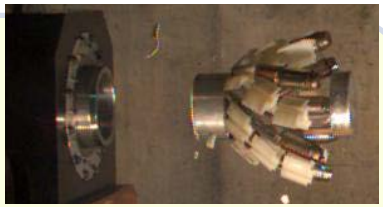
Electrical Design and Test

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

Initiation Systems Design and Test

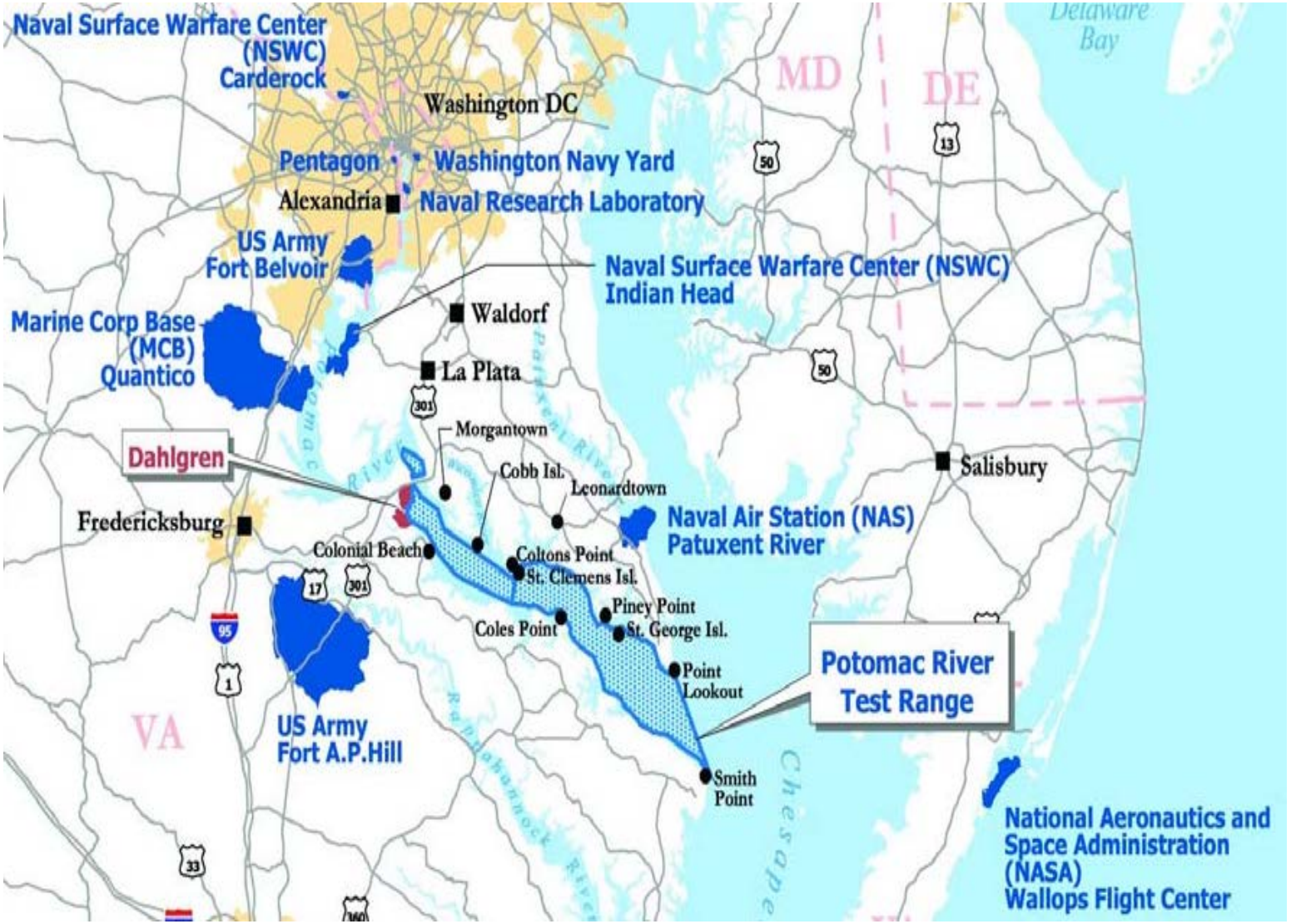
- Micro-energetics
- Characterization (e.g., Photonic Doppler Velocimetry)

Mech. Design and Test

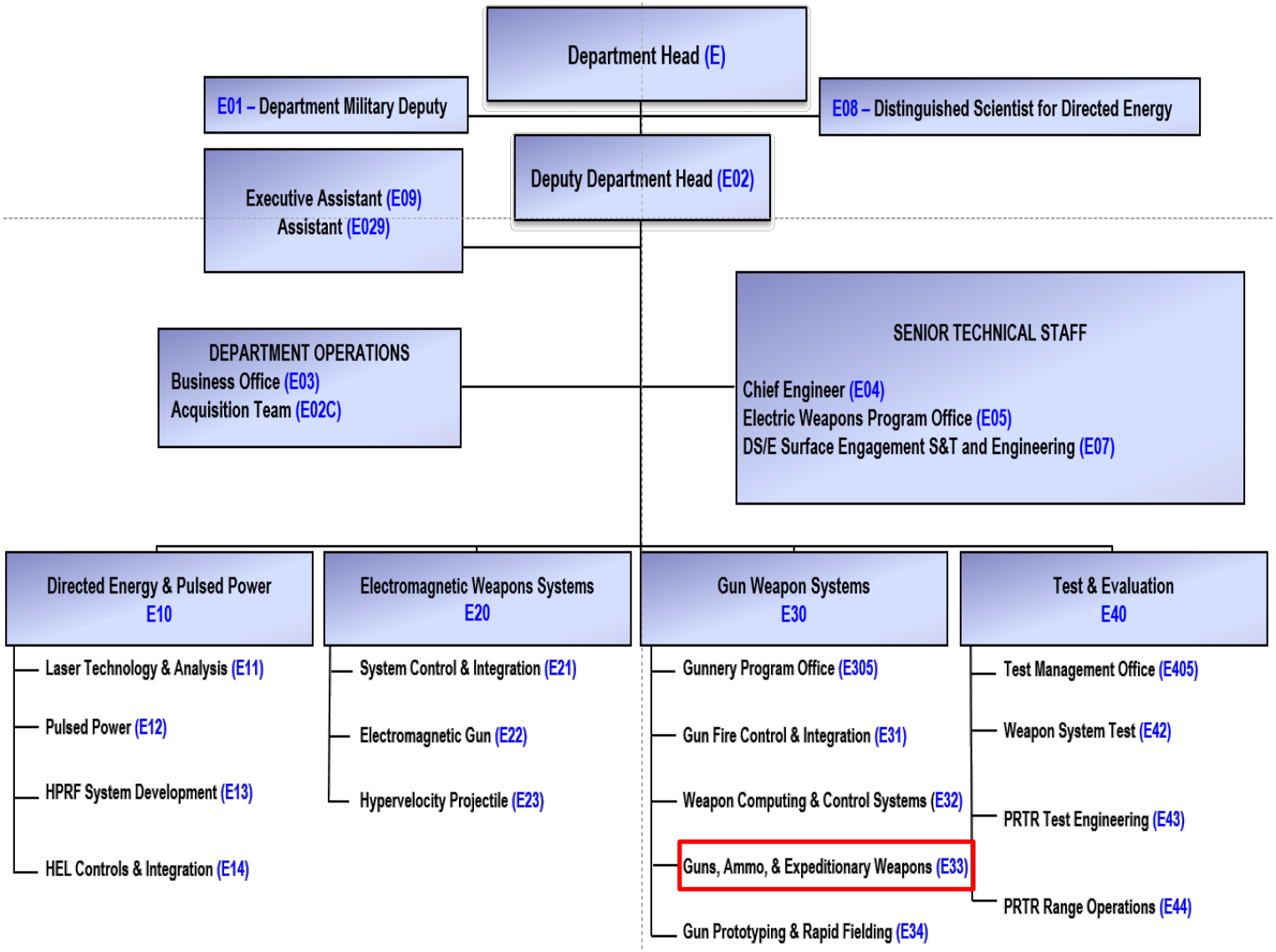


- Fuze packaging
- Full scale launch and impact testing
- Microelectromechanical Systems (MEMS)
- High G shock testing and survivability

NSWC Dahlgren



NSWC Dahlgren E Department Org Chart



NSWC Dahlgren and E33 Mission Statements

NSWC Dahlgren:

Mission: *NSWCDD's mission is to provide research, development, test and evaluation, analysis, systems engineering, integration and certification of complex naval warfare systems related to surface warfare, strategic systems, combat and weapons systems associated with surface warfare. Provide system integration and certification for weapons, combat systems and warfare systems. Execute other responsibilities as assigned by the Commander, Naval Surface Warfare Center.*

Guns, Ammo, and Expeditionary Weapons Branch (Code E33):

Mission: *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


Fuzes


Alamo


Ammunition

Core Fuzing Capabilities

DEVELOPMENT

- Gun-launched, conventional ammo fuzing
- S&A design
- Preparing specs and requirements
- Benchtop electronics testing
- CAD modeling and finite element analysis
- Rapid prototyping

QUALIFICATION

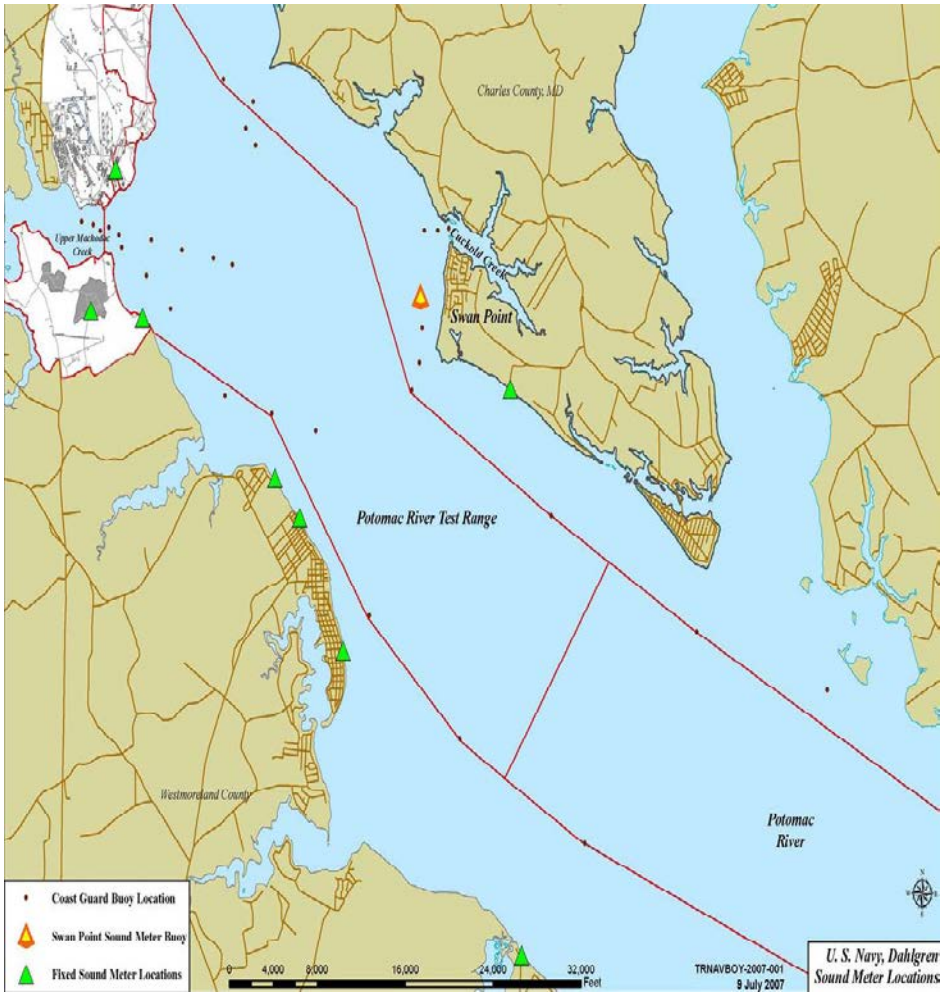
- Closed and open loop HWIL testing
- Execute and approve qualification testing
- Energetics and ballistic testing
- Extensive safety support with FISTRP representation

FLEET SUPPORT

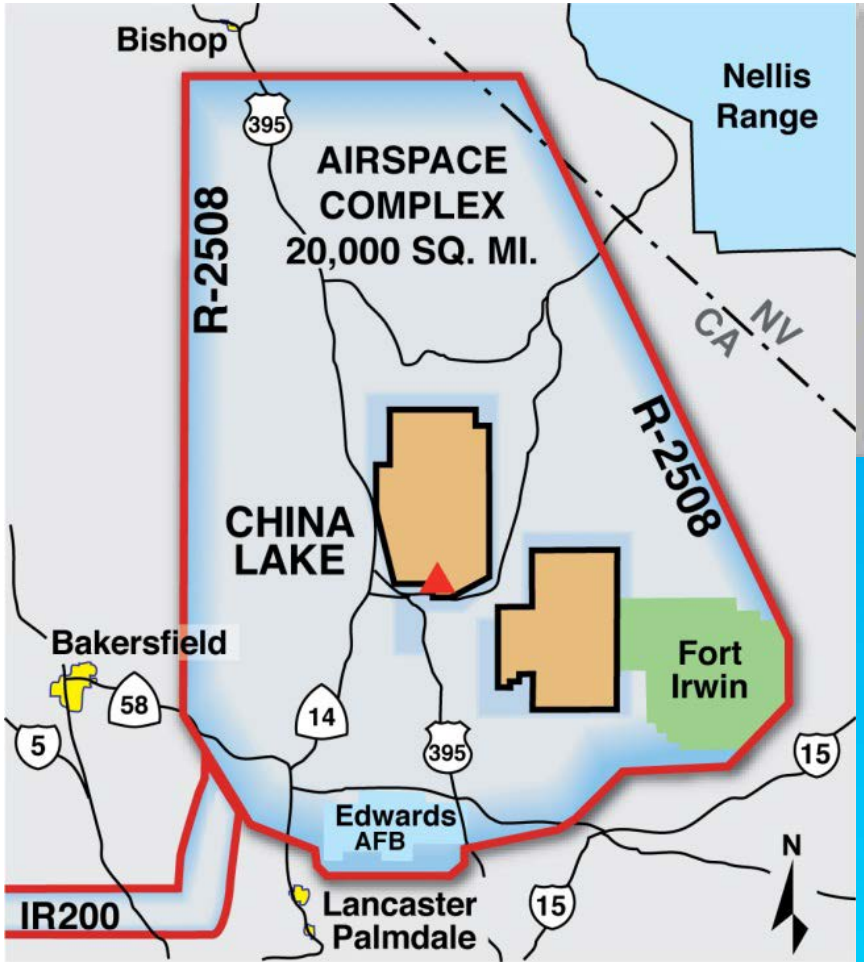
- Direct communication with fleet
- Support various at-sea test events
- Respond to Conventional Ordnance Deficiency Reports (CODRs)
- Provide SME support/training

Potomac River Test Range

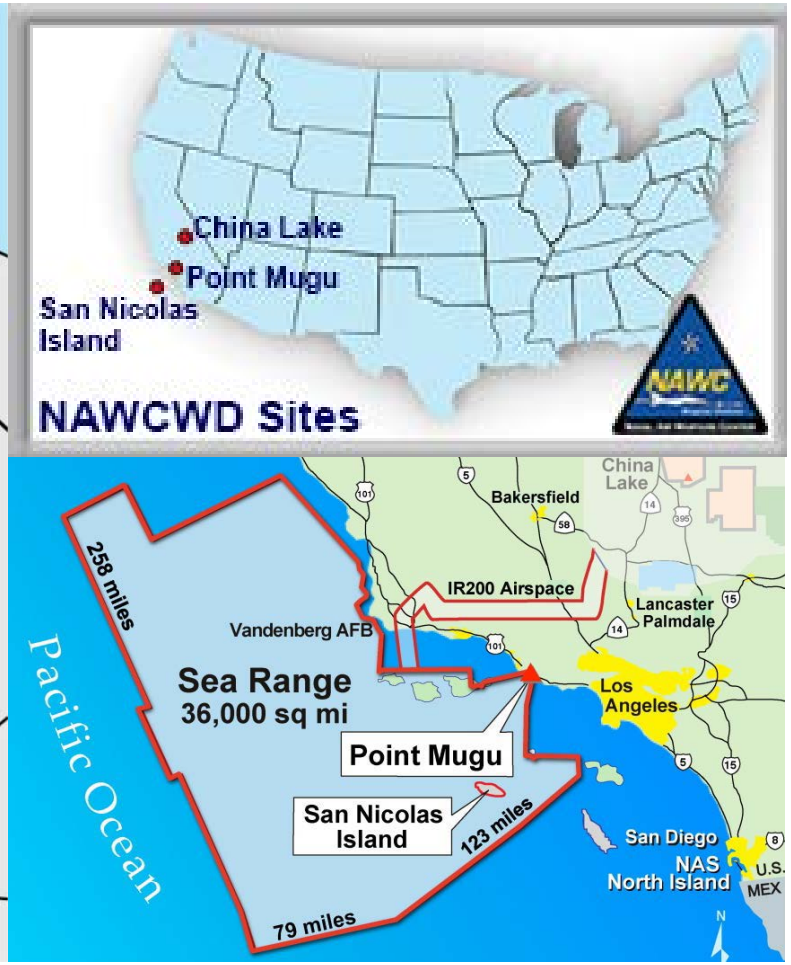
- 169 square miles of controlled water
  - Ballistic range of up to 20 nautical miles
  - Airspace clearance to 60,000 feet
- Fully instrumented network of range stations along VA shore of the Potomac River
- Over 2,300 acres of explosive ranges provide full spectrum of capabilities for live fire testing of energetics and directed energy systems
- Test range supports legacy, emergent, and “Navy after Next” programs
- Fuze test facility capable of:
  - S&A spin testing
  - Battery activation testing
  - Detonator time and explosive output testing
  - Fuze electronics testing
  - RF target simulation
  - Environmental testing



NAWCWD Locations

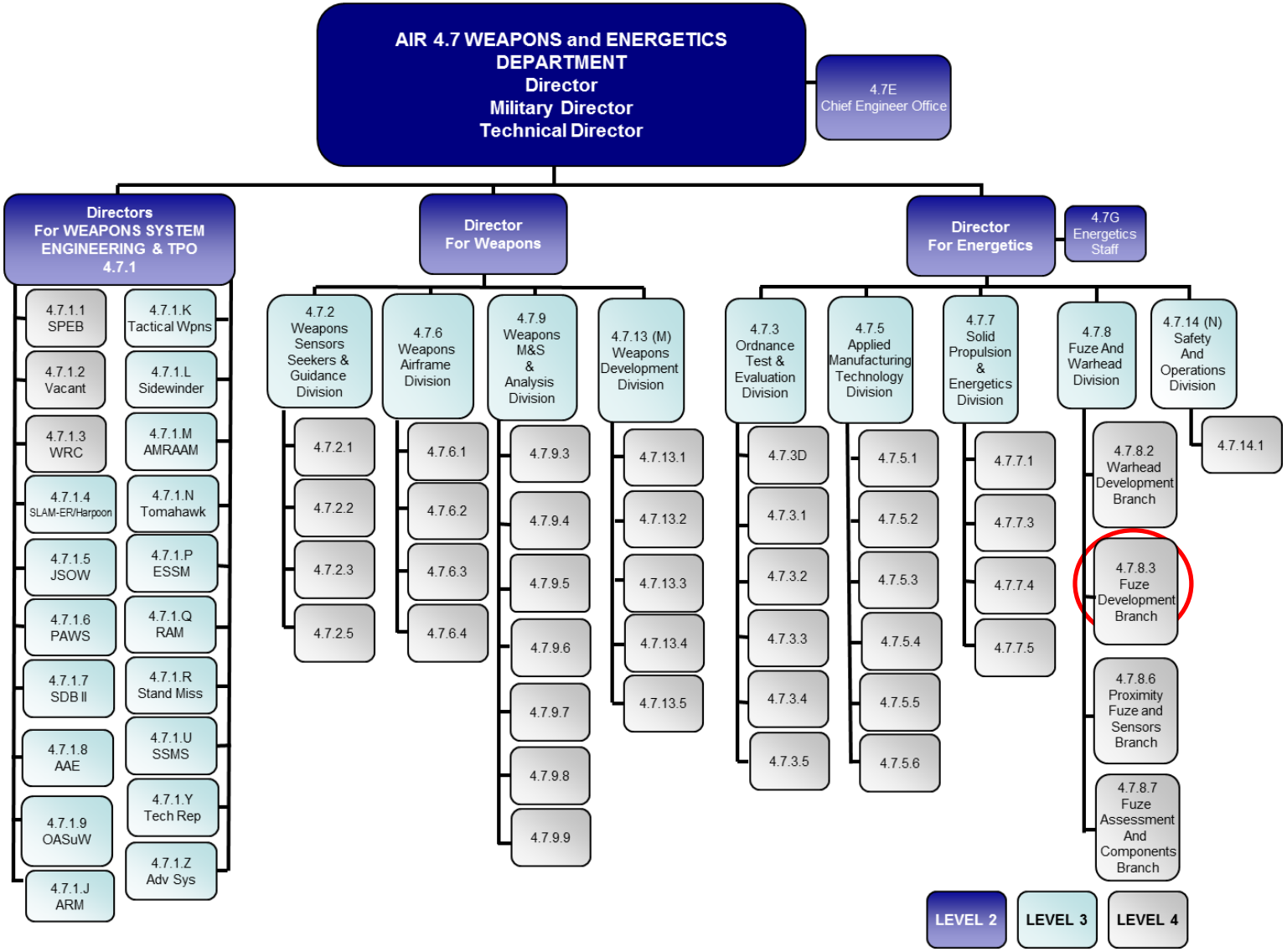


China Lake



Point Mugu

NAWC/WD Engineering Org Chart

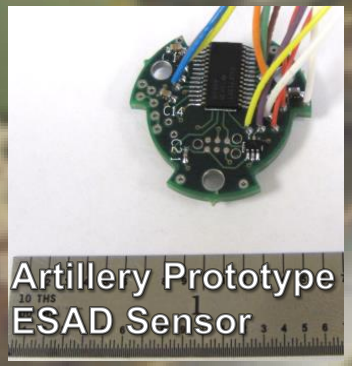


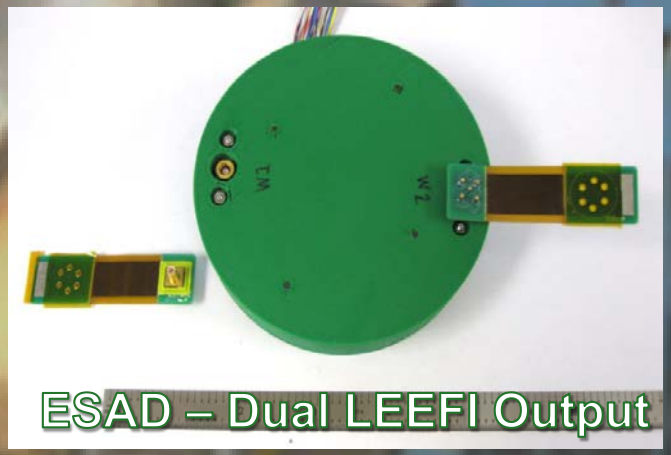
NAWC/WD Engineering Mission Statement/Overview

- ***Mission Statement:*** *"Provide the core technical expertise for research, design, development, fielding, production, and sustainment of fuzing, initiation, and sensor systems to support the fleet."*
- **Overview**
  - Design & Develop New Fuzing Concepts
  - In-Service Fuze SME Support
    - Production Support
    - Life Cycle Sustainment
  - Fuze Testing Capabilities

NAWC/WD Engineering Overview

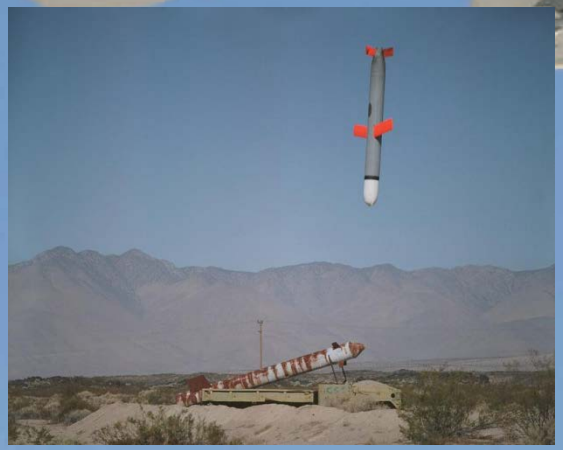
- Design & Develop New Fuzing Concepts
  - Rapid Prototyping (3D print or machined)
  - FPGA development and logic analysis (up to 208 channel)
  - ESADs, ISDs, FTSAs, Test Range Fire-sets.





NAWC/WD Engineering Overview

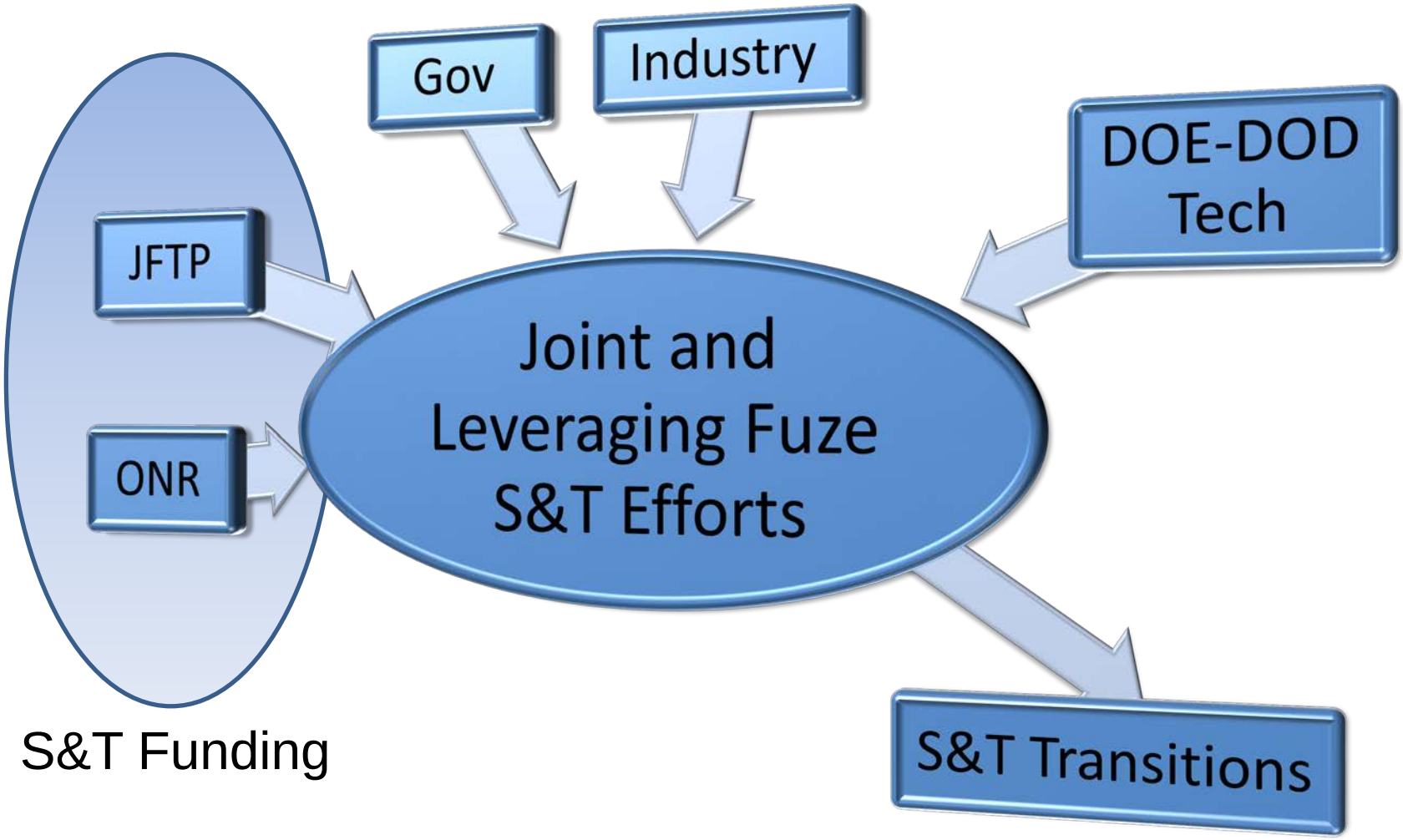
- In-Service Fuze SME Support
  - Over 50 years of combined experience
  - Program support from Production through Sustainment and Ordnance Assessment
  - Respond to Conventional Ordnance Deficiency Reports (CODR) from the fleet



NAWC/WD Engineering Overview

- Fuze Testing Capabilities
  - Environmental/Functional test sites to support Qualification, LAT, Ordnance Assessment(OA), Recertification, and experimental testing.
  - Capability on-site to test AUR configurations with both multi-shaker underwing and 6DOF capabilities
  - Full suite of Insensitive Munitions (IM) test facilities.
  - Sled test capability

Navy Fuzing Technology

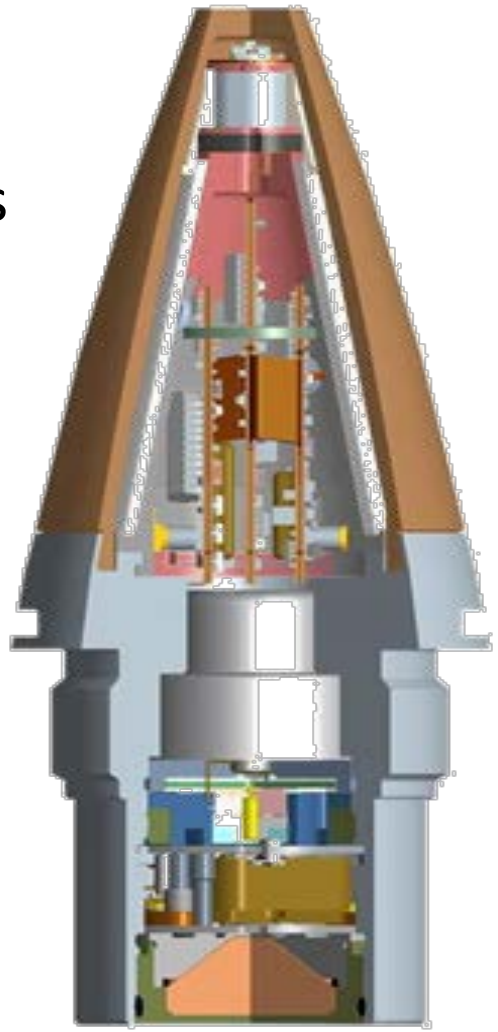


Navy Fuze S&T Efforts

- ONR: High Reliability DPICM Replacement, 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:
  1) Defeating HSMSTS with MK 419 - Session IIIB briefing by Jason Koonts (USN) and Jim Ring (OATK)
  2) High Reliability DPICM Replacement (HRDR) - Session IIIB briefing by Kevin Cochran
  3) DoD MEMS Fuze Explosive Train Evaluation and Enhancement Session IIIA briefing by Taylor Young
  4) Using Modeled Impact Response of 3-D Printed Materials for High-G Survivability - Session IIIB briefing by Ezra Chen
  5) Dynamic Characterization of Damping Materials for Electronics Assemblies – Session IVA briefing by Dr. Vasant Joshi
  6) 40mm C-UAS Grenade Fuzing Technology – Session IVB briefing by Tim Hoang
  7) Gun Hardened Command Armed MEMS Fuze - Session VB briefing by Dr. Daniel Jean

Defeating High Speed Surface Targets with MFF

- Unconventional use of Multi-Function Fuze (MFF) to engage high speed surface targets
- Speed-to-fleet effort to field improved tactics for MFF projectile
  - Overcome standard errors associated with ballistic, unguided projectile
- Various land-based and at sea tests to validate updates
- Direct interaction with the fleet and warfighter to improve ship self defense
- Less than 2 year effort from proposal to fielding



Closed Session IIIB briefing provided by Mr. Jason Koonts (USN) and Mr. Jim Ring (OATK)

High Reliability DPICM Replacement (HRDR)

Objective: Demonstrate a 155mm cannon-delivered area effect munition (C-DAEM) that is in compliance with the 2017 DoD Policy on Cluster Munitions and matches or exceeds the lethality of the legacy M483A1

HRDR 155mm C-DAEM

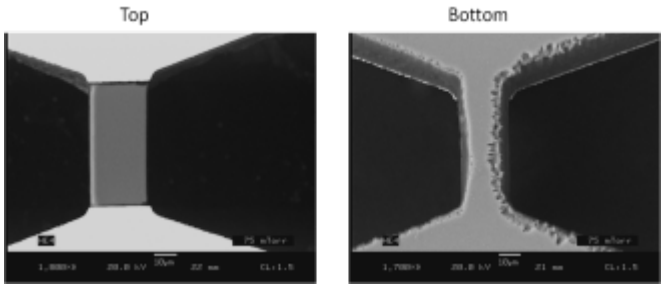
Fuze Technologies

- Distributed Fuze Architecture (DFA)
- Networked signal distribution
- Electronic target detection, initiation, & self destruct

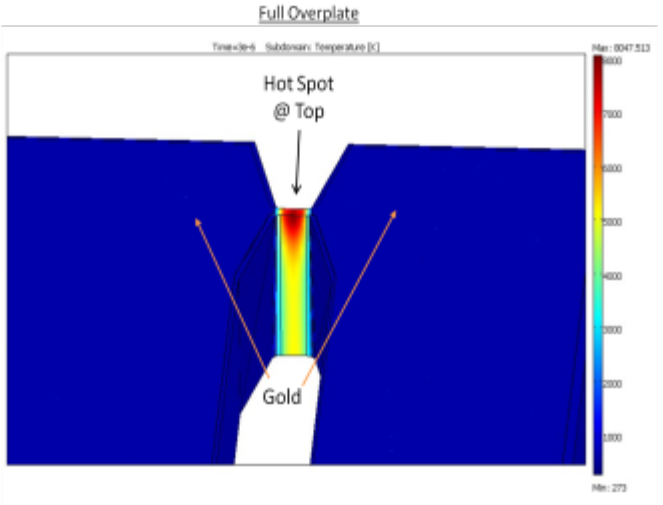
Closed Session IIIB briefing provided by Kevin Cochran

DoD MEMS Fuze Explosive Train Evaluation

- 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 IIIA briefing provided by Taylor Young

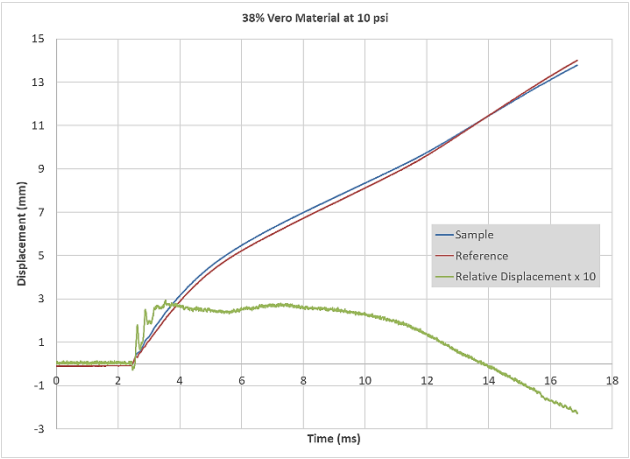
Using Modeled Impact Response of 3-D Printed

- Use 3-D printed structure to enhance shock survivability of vulnerable fuze components

- Various polymers tested on VHG
  - Deformation measured
  - Input and output frequency spectrum observed

Closed Session IIIB briefing provided by Ezra Chen

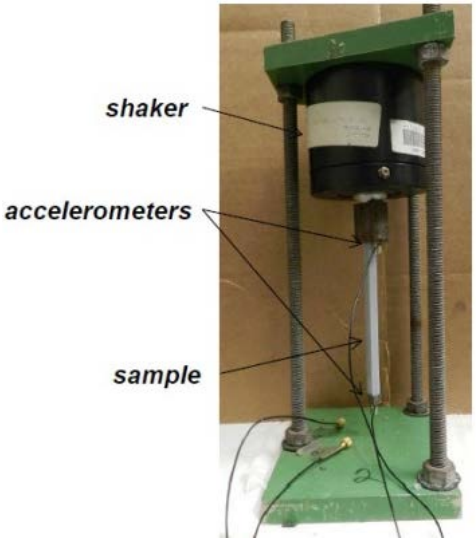
VHG Test Configuration

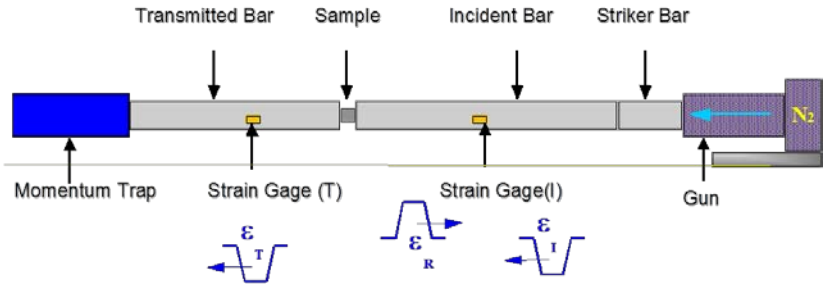


Sample, base, and relative displacement

Dynamic Characterization of Damping Materials for Electronics Assemblies

- Develop an experimental suite of tests to quantify the dynamic response and appropriate rate of loading for damping materials and provide data for numerical models of fuzes under shock.
- Develop new methods to characterize very high G loading on fuze components and sub-assemblies



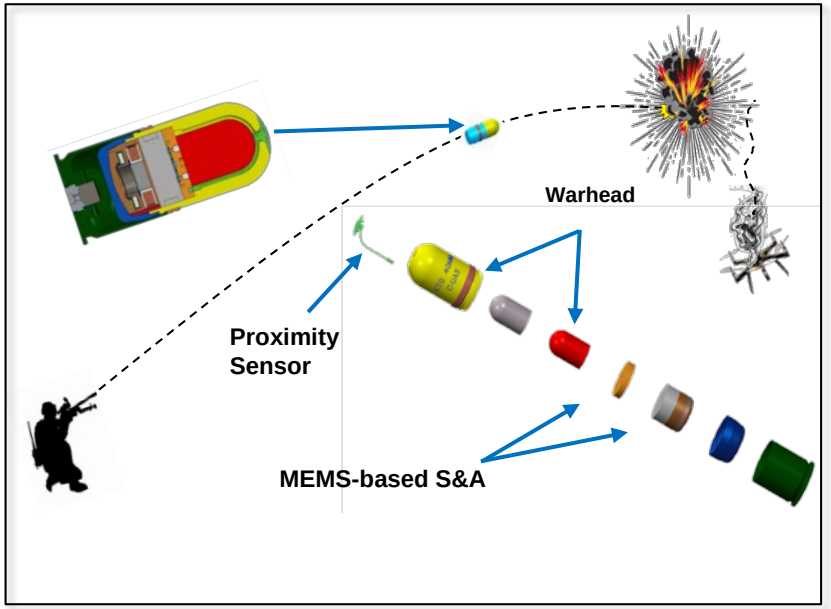


Open Session IVA briefing provided by Dr. Vasant Joshi

40mm C-UAS Grenade Fuzing Technology for Today and Tomorrow's Threats

Application:

- Develop enabling fuze technologies for a 40mm Counter-Unmanned Aircraft System (C-UAS) grenade to effectively neutralize UAS threats while reducing collateral damage



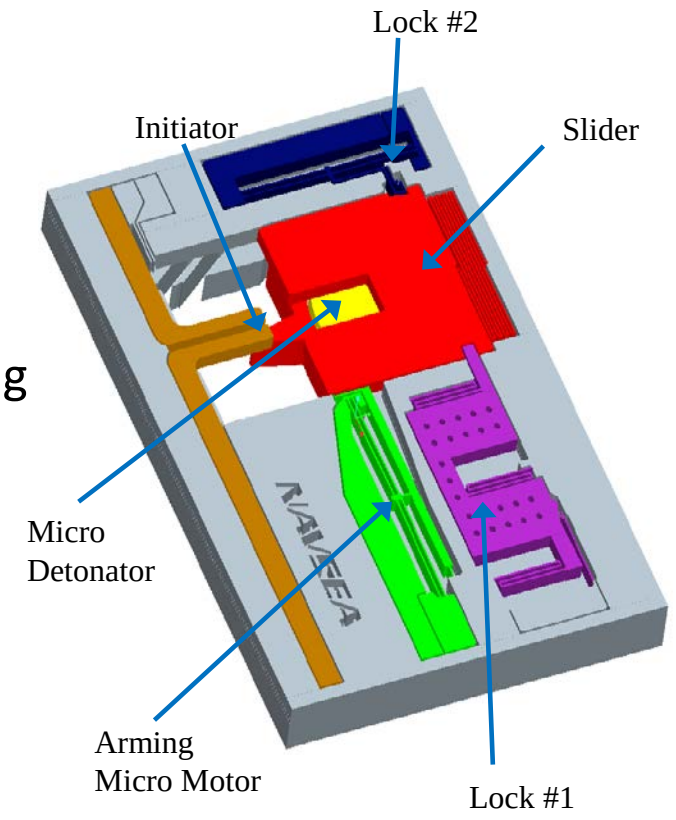
Fuzing technologies to be presented:

- MEMS-based Safe and Arm
- Proximity target & Omni-directional impact sensors
- Self-destruct for misses to reduce UXO

Closed Session IVB briefing provided by Tim Hoang

Gun Hardened Command Armed MEMS Fuze

- MEMS fuze components survived laboratory high-G testing and gun fire high-G testing (29 kG)
- Fuze Attributes
  - Small (<1.5 in^3 with electronics)
  - Command arm
  - Resettable / resafing
- Fuze function demonstrated in laboratory testing
  - MEMS unlocking and arming
  - Explosive train transfer
- MEMS Fuze Applications
  - Gun launched munitions
  - Underwater applications



Closed Session VB briefing provided by Dr. Daniel Jean

Summary

- Navy R&D fuze activity focused on ESADs, Proximity Sensors and High-G Survivability.
- Detailed, Navy briefs to follow as part of the 61st Fuze Conference