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

Cincinnati, OH
10 May 2017

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IHEODTD
Outline

• Navy Organizations
• Navy Fuze R&D Highlights
• Navy Fuze Conference Briefings
• Summary
Navy Organization
Fuzing R&D Activities

Chief of Naval Operations

Secretary of Navy

Assistant Secretary of the Navy Research, Development & Acquisition

ASN RDA

Naval Air Systems Command

Naval Sea System Command

Space and Naval Warfare Systems Command

NAVAIR

NAVSEA

SPAWAR

China Lake

Indian Head

Dahlgren

NAWC/WD

NSWCIHEODTD

NSWCDD
IHEODTD Organizational Structure

CO
CAPT Scott Kraft

TD
Ashley Johnson

- Comptroller Department
- Contracts Department
- Corporate Operations Department
- EOD Department
- Systems Engineering Department
- Systems Integration Department
- Energetics Manufacturing Department
- RDT&E Department

Technical Support Detachment (TSD)

- JP CAD / PAD Joint Program Office
- CREW Program Management Office
- EOD Program Management Office
IHEODTD Locations

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

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

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

Louisville, Ky.: 11 civ.
- Naval Guns

Norfolk, Va.: 2 civ., 3 ctr.
- Demonstration and Assessment Team
- Assigned to D Department
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
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.”
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

Joint and Leveraging Fuze S&T Efforts

DOE-DOD Tech
Gov’t
Industry
JFTP
ONR
S&T Funding
S&T Transitions
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
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

Open Session VA briefing provided by Taylor Young
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
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
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
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