Outline

▪ Navy Organizations
  – NSWC IHEODTD
  – NSWC DD
  – NAWCWD CL

▪ Navy Safety Overview
  – FISTRP
  – FESWG

▪ Navy Fuze R&D Highlights

▪ Conference Papers
NSWC IHEODTD Fuzing Overview

- 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
**NSWC IHEODTD Core Capabilities**

### 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

Located on the Potomac River, 60 miles south of DC
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 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
In-Service Fuze 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
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 and Joint Services Safety

Navy Safety

- Weapon Systems Explosives Safety Review Board (WSESRB)
- Fuze and Initiation System Technical Review Panel (FISTRP)
- Software System Safety Technical Review Panel (SSSTRP)

Joint Fuze Safety

- Army Ignition Systems Safety Review Board
- Army Fuze Safety Review Board
- Air Force Non Nuclear Weapons Safety Review Board
Navy Ammunition Safety

▪ WSES RB formed after 1968 fire aboard USS Forrestal (CV-59)
  – Investigation recommended independent review process be established

▪ NAVSEAINST 8020.6E
  – “…the WSES RB is the Navy’s independent oversight for safety compliance of all DON military munitions…”
  – “The FISTRP reviews specific safety aspects requiring expertise in the area of design, analyses, and testing of fuzes, initiators, safe/arm devices and ignition systems contained in weapon systems.”
FISTRP Process

- **Formal Reviews**
  - FISTRP will draft meeting notes and record action items
  - FISTRP chair briefs WSES RB, who formally release FISTRP findings to Program
  - SSSTRP has similar process for software reviews

- **Technical Assists**
  - Informal meetings
  - Treated as SME opinion from available FISTRP members
  - Program can record meeting minutes, which FISTRP will review
FISTRP Membership

- **Panel Chair:**
  - Gabriel Soto - NAWCWD CL

- **Panel Members:**
  - Ralph Balestrieri - IHEODTD
  - Tinya Coles-Cieply - NOSSA
  - Michael Demmick - NOSSA
  - Michael Haddon - NAWCWD CL
  - Bradley Hanna - NSWC DD
  - John Hughes - NAWCWD CL
  - John Kandell - NAWCWD CL
  - Jason Koonts - NSWC DD
  - Daniel Lanterman - IHEODTD
  - Melissa Milani - IHEODTD
  - Adedayo Oyelowo - IHEODTD
  - Ciarra Villa - NAWCWD CL
Fuze Engineering Standardization Working Group

- Chartered as a Joint Standardization Board (JSB) by the Defense Standardization Program (DSP)
  - Approaching the 100th meeting, originated in the 1970’s
- Objective is to achieve common, mutually satisfactory solutions to shared requirements and problems

Chairperson

- Homesh Lalbahadur, US Army, Picatinny Arsenal, NJ
Current FESWG Efforts

- Guidelines for evaluation of electronic safety and arming systems
- MIL-STD-1911B for hand-emplaced munitions
- MIL-STD-1901B for ignition safety devices
- Design requirements for remotely controlled safety, arming, and functioning (SAF) systems
- Safety design criteria for command and control of directed energy weapons
- Interface with NATO groups for international fuzing safety requirements
Fuzing Technology

Joint and Leveraging Fuze S&T Efforts

S&T Funding

Gov

Industry

DOE-DOD Tech

S&T Transitions

JFTP

ONR
Navy Fuze S&T Efforts

- ONR: High Reliability Dual-Purpose Improved Conventional Munition (DPICM) Replacement
- JFTP (Joint Fuze Technology Program)
  - Advance proximity sensing
  - Hard Target Survivability – Modeling & Simulation, Testing, Encapsulation, Materials
  - MEMS and micro-explosive train reliability
Summary of Navy Conference Briefs

**Session 4A (Open)**
- DoD MEMS Fuze Explosive Train Evaluation and Enhancement (8:00am-8:20am)
  - David Muzzey, NSWC IHEODTD

**Session 4B (Closed)**
- Electrical Transmission Line Replacement for Det-Cords in Flight Termination Systems (8:20am-8:40am)
  - Dustin Atwood, NAWCWD CL
- EFI Fire Pulse Delay Circuit (10:40am-11:00am)
  - Michael Haddon, NAWCWD CL
Summary of Navy Conference Briefs

- **Session 5A (Open)**
  - Survivability and Reliability of Silicon MEMS Components (2:20pm-2:40pm)
    - Caitlyn May, NSWC IHEODTD

- **Session 5B (Closed)**
  - Small-Scale Testing of Electronic Components in Shock Loading (2:00pm-2:20pm)
    - Vasant Joshi, NSWC IHEODTD