Outline

• Naval Energetics Enterprise Overview
• Fuze Safety Review Process & Panel
• Navy Fuze Acquisition
• Navy Fuze Work Highlights
• Summary
Navy Energetics Enterprise Vision

One Team
Dedicated to providing ordnance solutions to the Warfighters

NAVAIR China Lake & Point Mugu
NAVSEA Indian Head, Dahlgren & Crane
NEE Goals

• Provide stewardship of unique Navy capabilities to ensure current and future Navy warfighting requirements are attainable and supportable

• Speak with a coordinated Navy voice

• Work together to improve efficiency and rationalize resources to provide responsive, safe and affordable ordnance solutions
Navy Fuze Safety Review Process

Weapon System Explosives Safety Review Board – WSESRB

Fuze Initiator System Technical Review Panel
FISTRP

Software System Safety Technical Review Panel
SSSTRP

Joint Programs

Army Fuze Safety Review Board

AF Non Nuclear Weapons Safety Board
Fuze and Initiation Systems
Technical Review Panel (FISTRP)

Panel Chair – Gabriel Soto
Panel Members –

Raymond Ash  Ralph Balestieri  Brian Will
Randy Cope  Micheal Demmick  Bradley Hanna
John Hendershot  John Hughes  George Hennings
John Kandell  David Libbon  Eugene Marquis
Scott Pomeroy  Tinya Coles-Cieply
Melissa Milani

Current Topics of Interest/Challenge
1978 Joint Fuze Management Board Policy on Safe Separation Analysis
Emerging FESWG Guidance on Charge-Based Memory

MIL-STD-1316  STANAG 4187
MIL-STD-1901  STANAG 4368
MIL-STD-1911  STANAG 4497
Navy Fuze Acquisition
FMU-164

- Requirements
  - Improved reliability - 97% @ 90% confidence
  - Backward compatible to FMU-139 interfaces
  - Hard target penetration
    - FMU-143 specification
  - New arming & function delay times
    - Serial data interface programmability

- Schedule
  - RFP released on 22 December 2009
  - Source selection starting April 2010
  - Contract award scheduled 4th Qtr 2010
  - IOC scheduled in 2017
5”/54 Gun Fuzes

- **MK 432 Electronic Time (ET)**
  - First production 2002
  - ET only, no PD backup
  - KE-ET & HE-ET

- **MK 437 Multi Option Fuze Navy (MOFN)**
  - Design Initiated 2002
  - ET, PD, PD Delay & HOB
  - Lacks AAW capability
  - Land Attack & ASuW

- **MK419 Multi-Function Fuze (MFF)**
  - Design Initiated 1995
  - USN Unique Fuze
  - ET, HOB, PD, AIR Prox, AUTO
  - Selectable HOB
  - Rain Reliability
  - Sea Clutter Filter – AIR
  - Land Attack, ASuW, & AAW
5”/54 Gun Fuze Roadmap

**PAST**
- MK91 Mod 1: Infra-Red
- MK399 Mod 0: Point Detonate

**CURRENT**
- MK73 Mod 11/13: Variable Time
- MK342 Mod 1: Mechanical Time/Point Detonate
- MK407 Mod 1: Point Detonate/Delay
- M732: Controlled Variable Time

**FY15**
- MK404 Mod 1: Infra-Red

**BYND FYDP**
- MK419 Mod 0: Multi-Function Fuze
- MK432 Mod 0: Electronic Time
- MK419 Mod 1: Multi-Function Fuze
- MK437 Mod 0: Multi-Option Fuze Navy
Navy Guided Projectiles

- 155mm Long Range Land Attack Projectile (LRLAP)
  - Gun-launched, rocket-assisted guided projectile
  - Currently in EMD phase as part of the Advanced Gun System on DDG-1000 Class destroyers
  - Qualification and guided flight testing underway, completion scheduled in 2012
  - LRIP to begin in FY13
  - Range > 63nmi
  - Electronic S&A and electro-mechanical ISD

- 5” guided projectile development is not currently funded
  - Joint Fires AOA study pending
Additional Navy Gun Ammunition

• 57mm/L70 MK 295 Mod 0 – High Explosive – 3P Cartridge (HE-3P)
  • Pre-fragmented explosive projectile with programmable, proximity fuze
  • 6 Fuze Modes:
    • Time Gated Proximity (TGP), Time Gated Prox with Impact Priority (TGIP), Point Detonating (PD), Point Detonating Delay (PD/D), Electronic Time (ET), Proximity with Self Destruct

• 30mm X 173 MK266 Mod 1 – High Explosive Incendiary – Traced (HEI-T)
  • Super Quick FMU-151 Fuzed PBXN-5 projectile
  • High Order Blast/Fragmentation w/ Incendiary Effects
Navy Fuze Work Highlights

- NAVAIR: Impact Switch Investigation
- NAVAIR: Dynamic Impact Simulation of “High G Hardened Fuzes”
- Joint JFTP / NAVSEA PMS495: MEMS Fuzing for High Reliability Systems
- Joint NAVSEA PMS495 / ONR: Versatile Explosive Train Integrated into a MEMS S&A Device
- ONR: MEMS Fuze for Marine Corp Flight Control Mortar
- JIMTP: Extremely Insensitive Detonating Substance (EIDS) Initiation System
- JFTP: MEMS Retard & Impact Sensors
Impact Switch Investigation

- Investigation objective is to characterize switch vibration response
- FY09 start schedule for FY10 completion
- Switch becoming more sensitive to vibration as exposure is accumulated
- Switch characterization conducted using flight test vibration levels
- Reporting on preliminary results

Open Session VA Briefing provided by Mr. Sam Tuey
Dynamic Impact Simulation of “High G Hardened Fuzes”

- Evaluation of latest LS-DYNA Impact Simulation Software
- Creating LS-DYNA input templates for hard target penetration application
- Impact deceleration, stress & strain calculated for penetrator Fuzes
- Results compared to NAVAIR cannon and sled test data

Open Session IIIA Briefing provided by Dr. Paul Glance
MEMS Fuzing for High Reliability Systems

• Development of G-hardened miniature Fuze component technology mine defeat penetrator application
  • Silicon on Insulator (SOI) MEMS S&A
  • Micro detonator
  • MEMS initiator
• Low-cost miniature fire-set

Closed Session IVB Briefing provided by Dr. Michael Deeds
A Versatile Explosive Train
Integrated into a MEMS S&A Device

- Development of integrated initiation and explosive train component technology for MEMS based S&A application
- Developed for small volume applications turning tight corners
- Employs Cl-20 based explosives RSI-007 & EDF-11 ink

Vaporization of an IHDIV MEMS initiator

Closed Session IVB Briefing provided by Mr. Alex Parkhill
Navy MEMS Fuze
For Marine Corp Flight Control Mortar

• S&A for 81 mm Precision Urban Mortar Attack (PUMA) – Future Naval Capability (FNC)
  • Joint Navy / Army S&T system development
  • Supports Marine Corps Conventional Weapons (CW) Science & Technology Objectives
  • System demonstration in FY14
• MEMS based S&A

Closed Session IVB Briefing provided by Dr. Dan Jean
Extremely Insensitive Detonating Substance (EIDS) Initiation System

• An Initiation System that emulates large diameter boosters for use in initiating EIDS materials
• OSD funded through Joint Insensitive Munition Technology Program
• Joint Navy (NEE) led effort with Air Force, Army, & Los Alamos participation
• Improved IM performance through elimination of large, relatively sensitive booster
• System requires simultaneous initiation of multiple detonation points
**MEMS Retard & Impact Sensors**

- **Objective:** Obtain DoD retard and impact sensors with precision, reliability, producibility and cost effectiveness by exploiting existing MEMS microfabrication and packaging technologies

- **Traditional coil spring-mass technology:**
  - Wide performance variability per mechanical spring tolerances
  - Difficult to precisely sense low G’s with “macro world” springs

- **MEMS technology appears well-suited for making improved low-G sensors per DoD exploratory work to date:**
  - NAWCWD: precision-electroplated G-sensors
  - NSWCIH: silicon G-sensors and packaging
  - ARDEC: metal G-sensors and packaging

- **FY10 Focus:** low-G impact sensors (<100G) & very low-G retard sensors (<5G)

Illustration and Photograph Courtesy of NAWCWD

Illustration and Photographs Courtesy of NSWCIH

Illustration and Photographs Courtesy of ARDEC

Closed Session IVA Briefing provided by Mr. Walt Maurer
Summary

Today’s Navy

- NEE - Leveraging the abilities of multiple installations
- FISTRP / FESWG / Joint Reviews - Safety conscious
- Cradle to grave support of the warfighter
  - Concept
  - Advanced Development
  - Research and Development
  - In-Service Support
  - Quality Assurance