DTRA Counter WMD Technologies
Fuzing & Instrumentation Technology

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Agenda

- DTRA Mission & Campaigns
- Why Smart Fuzes?
- Fuze Issues
- Current & Near Term Efforts
- Advocate Open Architecture
- Summary

DTRA Mission & Campaigns

- **Mission:**

  ...*reduce the threat to the United States and its allies from Weapons of Mass Destruction (CBRNE) by providing capabilities to reduce, eliminate, and counter the threat, and mitigate its effects.*

- **Functions:**

  Conduct RDT&E programs…in areas related to WMD and designated advanced weapons to include…WMD-related targets and the entire class of hard and deeply buried facilities.

- **Campaigns:**
  - Campaign 5: Transform the Deterrent - support the COCOMs' ability to hold WMD at risk through offensive means
    - **Objective 5.2.1: …leverage advances in …intelligent fuzing… to counter the most difficult targets**
- **Vision:**
  - Develop, test, and demonstrate to the Warfighters reliable and effective solutions to defeat WMD and WMD-related functions protected in Hard and Deeply Buried Targets

Why Intelligent Fuzes?
Critical to Counter WMD & HDBT Defeat

- Intelligence uncertainties
  - Target
    - Layering
    - Material strengths
    - Construction (columns/beams)
    - Location of vital centers
  - Geology
- Optimize detonation location – dependent upon desired effect
    - Minimize collateral damage
- Limitations of time fuzes
    - Uncertainty in weapon & target models makes fuze setting predictions difficult
    - Current fuzes have few time options





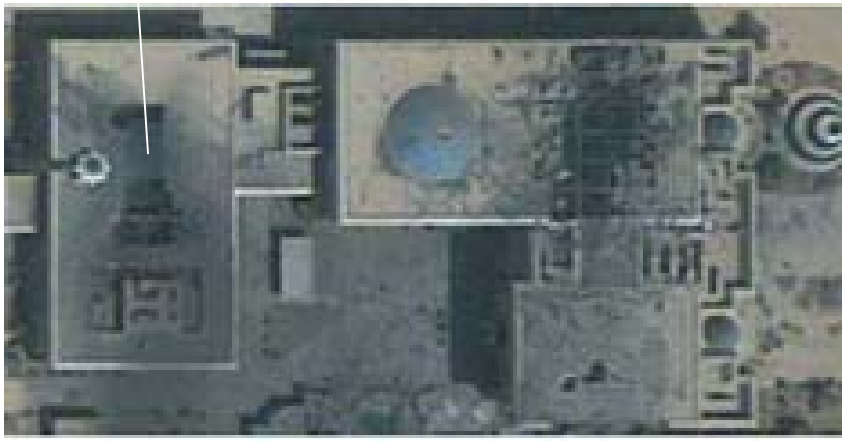

*Joint Vision 2010, Air Force Basic Doctrine (AFDD 1)

Photo sources: Various unclassified Internet sites

Hard & Deeply Buried Target (HDBT) Defeat Critical to Counter WMD Mission

- Use of HDBTs is widespread among both hostile states and terrorists to protect WMD and WMD-related functions including:
  - Production, storage, research
  - Delivery systems
  - Command and control
  - National/terrorist leadership

MOST VALUABLE ASSETS



- Hardened facilities (tunnels in particular) are an asymmetric response to U.S. Precision Engagement strategy*
  - Use depth for penetration protection

You can't defeat WMDs, if you can't defeat HDBTs!!

*Joint Vision 2010, Air Force Basic Doctrine (AFDD 1)

Photo sources: Various unclassified Internet sites

Increasing Importance of Hard or Deeply Buried Targets

"Underground Facilities. ***The rising importance of hardened or deeply buried facilities to potential adversarial nations and non-national organizations is becoming more apparent each year.*** *Whether those nations and non-government organizations are classified as* ***rogue, major, or emerging powers, or terrorist groups****, their critical military, leadership and* ***national security assets are increasingly protected by these facilities****.* ***The growth and sophistication of Hard and Deeply Buried Targets*** *(HDBTs) is especially significant* ***among countries whose support for terrorism and potential possession of WMD constitute threats to world peace and U.S. Security****…Their* ***new and modified facilities incorporate features that make them more survivable against known U.S. weapons****. Moreover, these countries are exporting underground construction techniques, and construction equipment."*

Source: "Statement for the Record to the Senate Armed Services Committee", Lt Gen Maples, Director, DIA, 27 February 2007, Page 29

Hard Target Fuzes Have Issues

- Current problems:
  - **Robust Survivability** in unknown targets
    - Buildings, bunkers and hard geology
    - Fuze should not be weak link in system
  - Targeting Flexibility (times, voids, void after?)
  - Reliability
  - Manufacturability
  - Cost
- Need high fidelity modeling and prediction capability for fuzes verified with testing
  - For algorithm development and verification testing
  - For component/subsystem survivability analysis

Hard Target Fuze Development Path

Multi-Layer
Multi-Story
Nth Void Detect

Multi-Story over Bunker
Nth Void Detect

Multi-layer
1st Void Detect

1st Void Detect

Reverse engineer target structure/characteristics (Look for slab thickness)

Integrated path length for optimal detonation depth

Multiple Void Sensing Capable Fuze **HTVS Fuze JCTD**

Void Sensing Capable Fuze **HTVS Fuze JCTD**

RELIABLE Hard Target Incrementally Selectable Time Fuze

MOP Tech Demo = Capability FY08

FMU-143 Workhorse (30, 60, 120 ms)

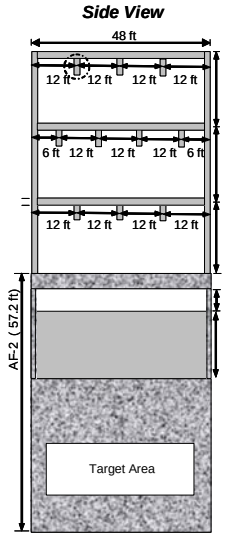
Capability

Today

Time

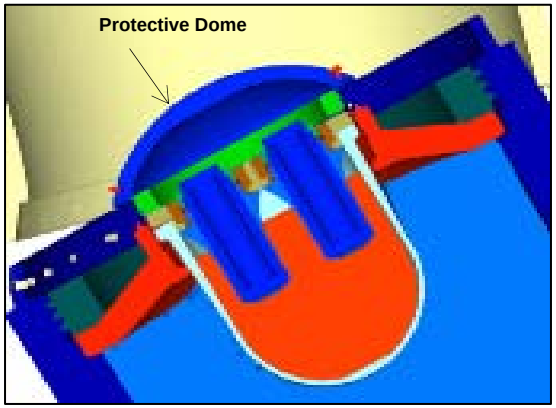
Current & Near Term Efforts
Fuze Development Activities

- **Short Term Activity (FY09-11)**
  - MOP Technology Demonstration (Modified SDB & MAFIS)
  - Sandia miniaturized FMP 2 technology development
    - Packaging into 3” form factor
    - SANDMAN fuze development – sled tests in 2008
  - Weapon Data & 3D Data Recorder Development
  - HTVS Fuze JCTD Test support
  - VSF Development (PIMPF repackaging)
- **Long Term Activity (FY11+)**
  - Mature fuze survivability technology
    - Follow-on Hard Target Fuze efforts
    - High speed munitions
  - Mature fuze system integration technology
    - Forward fuze package/jointed penetrator
    - Multi-point initiation fuze
    - RF/Communication technology
  - Integrate data recorder advances with fuze development

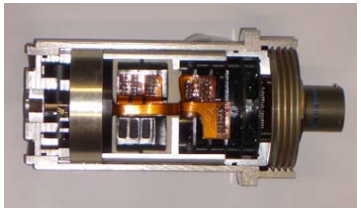


Current & Near Term Efforts
MOP Tech Demo Fuze Configuration

- MOP Tech Demo game plan to use off-the-shelf fuze technology
- Baseline configuration: Dual redundant Small Diameter Bomb (SDB) fuzes
  - In production – “Penetrator “ fuze
  - IM provisions
  - Cockpit programmable
  - Modified for longer time delays (0-255msec) in 1msec increments
- Preferred configuration:
  - One KDI SDB fuze
  - One Thales Multi-Application Fuze Initiation System (MAFIS)
  - Eliminates common-mode failure concern - If SDB fuze has “inherent” problem, both could be affected, causing total mission failure



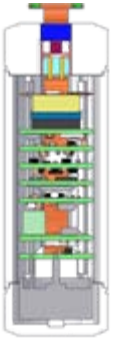
MAFIS Fuze

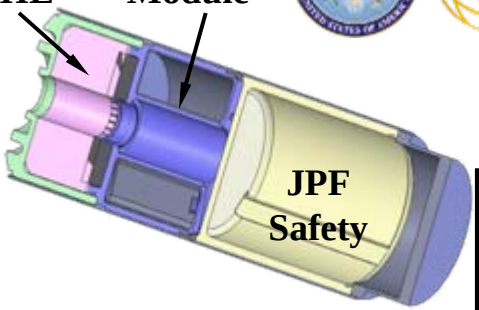


Current & Near Term Efforts
DTRA/SNL FMP 2 Family of Fuzing Efforts

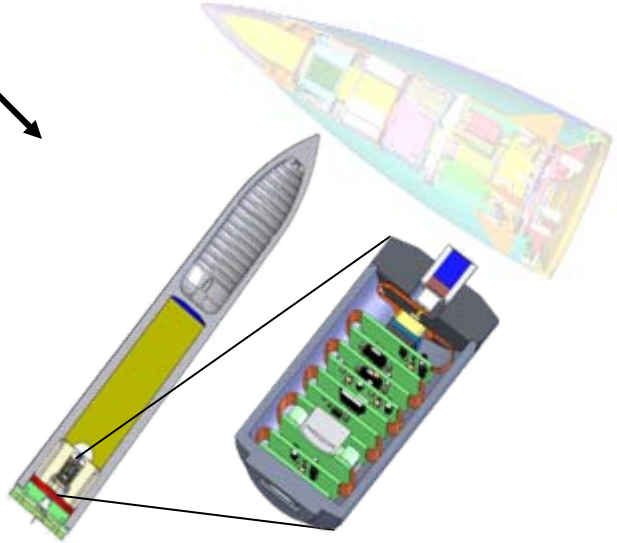
DTRA/Kaman/SNL Intelligent Fuze

FMP 2





SP-28 TACMS-P/ SANDMAN Fuze

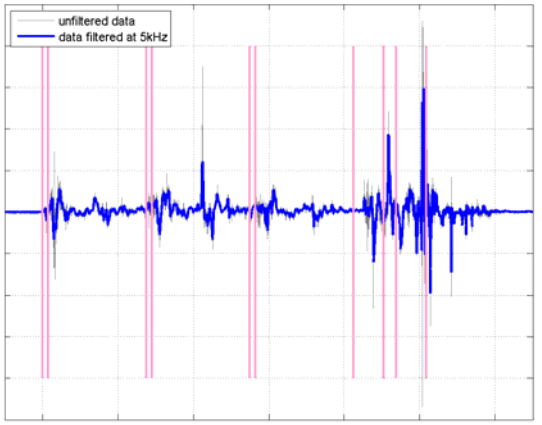


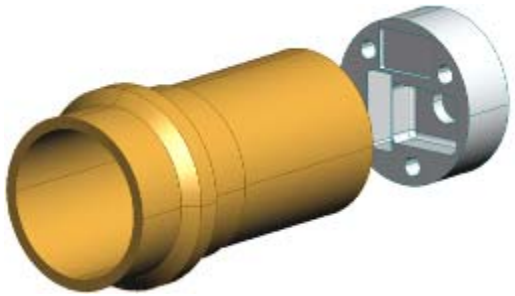
- 3” Standard Fuze Well Configuration
- Conventional Weapon Systems
- High Voltage in-line FMP2 Firing Set
- Linked to Kaman’s FMU-152 Safety Architecture
  - FMU-152 S&A - Safety Board Certified
- Intelligent, Void Counting Capable

- 1.5” Diameter x 3.5” Length Fuze
- High Velocity Systems e.g. TACMS-P
- High Voltage in-line FMP2 Firing Set
- Time Delay Fuze ONLY

Current & Near Term Efforts
Survivable Weapon Data Recorder

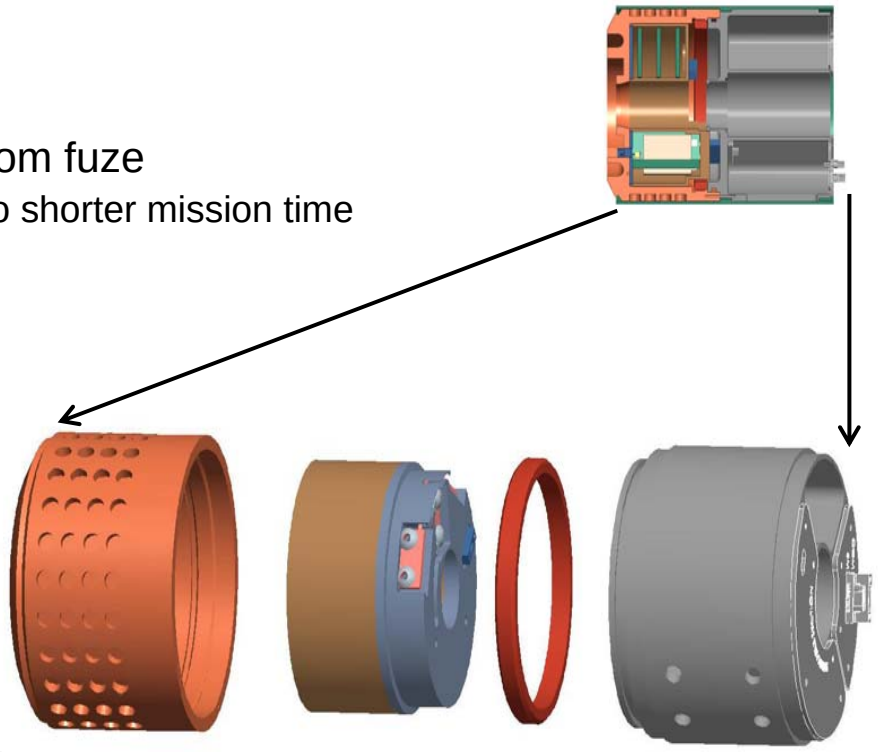
- Objective: Develop robust flight certified data recorder for use in sled and flight tests
- Requirements & Constraints
  - RELIABLE – tests costs
  - Size & weight of current legacy fuzes
  - Minimum of two redundant recorders
    - Plug & Play accelerometer packages
    - CD “Arm” (power-on) using electrical signal from Fuze
  - Integrate rechargeable batteries
  - Temperature compensation
  - Replaceable accelerometers
  - Capable of external inputs





Current & Near Term Efforts
DTRA/SNL 3D Data Recorder (3DDR)

- **Objective:** Develop flight certified booster cup data recorder for use in sled and flight tests compatible with current fuze architectures
- **Requirements & Constraints**
  - Fit within 3” fuze booster cup
  - “Arm” (power-on) using electrical signal from fuze
    - Permits reduction in battery capacity due to shorter mission time
  - Increase memory depth to 300msec
  - Integrate rechargeable batteries
  - Add temperature compensation
  - Replaceable accelerometers
    - Endevco 7270
    - SW offset adjustment
  - New μC/FPGA architecture
- **Intend to verify in**:
  - Gun experiments
  - Field in sled track and air drop experiments



Hard Target Void Sensing Fuze JCTD

- I want it all, and I want it now
- DTRA funding contributor
- Must test against realistic targets per Director of Operational Test and Evaluation (DOT&E)
  - Geology at WSMR for testing
  - Realistic HDBT's

Void Sensing Fuze (VSF) Product Improvement Program

Repackage the Programmable Intelligent Multi-Purpose Fuze (PIMPF) into a 3 inch form factor compatible with US weapon fuzewells.

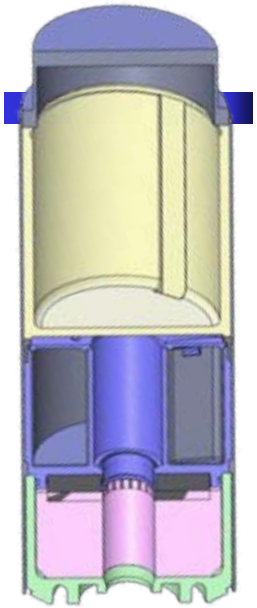
- Conduct trade studies to investigate compatibility with US weapon systems
- Demonstrate original void/layer sensing capability
- Conduct limited environmental / qualification testing
- Conduct cannon / sled testing to confirm functionality
- Investigate opportunities for transition (JMEWS)

3 inch

4.5 inch

Nov 2007 – May 2010

Fuze Component Architecture



- Currently fuzes designed
  - Stand-alone component (commodity)
  - Part of the system design e.g. missile fuzes
- Desire for “plug & play” compatibility of components e.g. S&A, fireset – future tailoring of fuzes to mission
- Preferred DoD acquisition policy is Modular Open Systems Approach (MOSA)
  - Intent: faster & ultimately lower cost weapons systems development and integration
    - “Plug & Play” compliant warheads/fuzes
    - Service & CTR Mix-N-Match
    - Predicted improvement in “-ilities”
      - Affordability, reliability, etc.
  - Piecewise capability development
    - Incremental acquisition strategy
    - Modular capability becomes “COTS” for integration
- More discussion to follow in AFRL MOSA (MAFIA) brief

Summary

- Capability to defeat HDBTs is critical to Counter-WMD mission
- Smart fuzes are critical to HDBT defeat capability
  - Survivable
  - Reliable
  - Cost effective
- Reliable data recorders are IMPORTANT
  - Data required for M&S validation to support weapon/fuze design
  - Effective use of full-scale test $$$
- Advocate for fuze open architecture and Universal Armament Interface (UAI) integration

Questions?