AIR FORCE
FUZE TECHNOLOGY

10 May 2006

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Branch Chief

Fuzes Branch

Munitions Directorate

Air Force Research Laboratory

Outline

- **High Level Visibility**
- **Air Force Research Laboratory Planning Process**
- **Program Status**

PEOs Publicly Summing Up Fuzing Need at a High Level

July 2005 Air Force Magazine –

"Holes in the Pipeline"

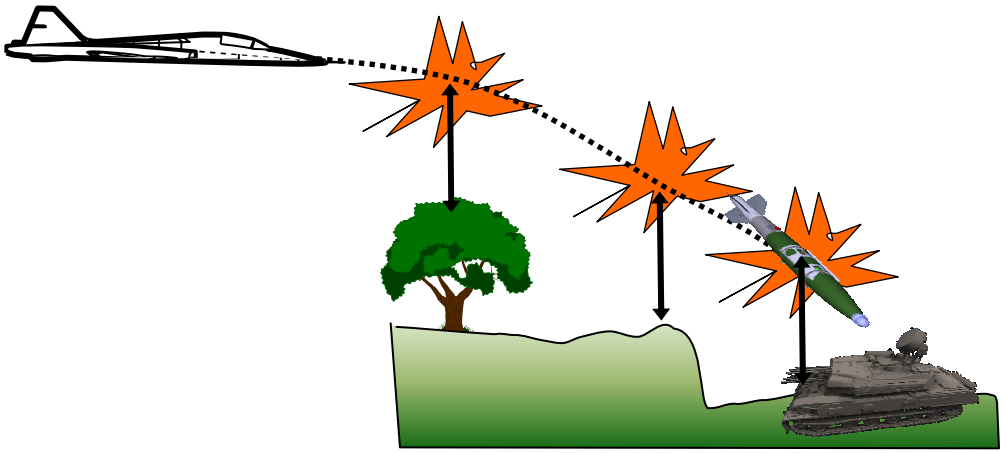
Asked where there are "holes" in the munitions pipeline, Chedister (Maj. Gen. Robert W. Chedister, Air Force program executive officer for weapons and commander of USAF's Air Armament Center at Eglin AFB, Fla.) said more money is needed in the research end.

"So, some of us worry that we're not working on the new technologies of the future that we need to be. **On the top of that list is fuzes**, Chedister said. . . . fuzes on hand are "**not smart enough, ... not rugged enough, ... not durable enough** at the price we've been paying for them, and we're **not putting enough money into the R&D** of making them better." This is the "**biggest hole in the weapons world."**

Fuze Capability Enabler
Example: Fuze Proximity Sensor

Inventory: DSU-33 B/B

- **Single fixed height of burst**
- **20 ft HOB**
- **Fuze on closest return**
- **Uni-Functional**



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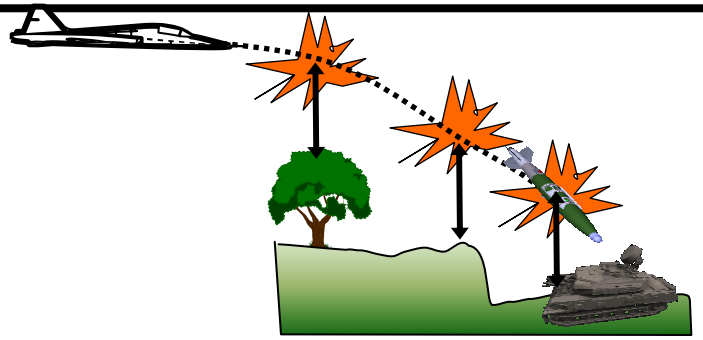
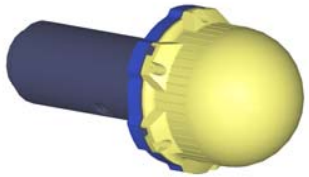
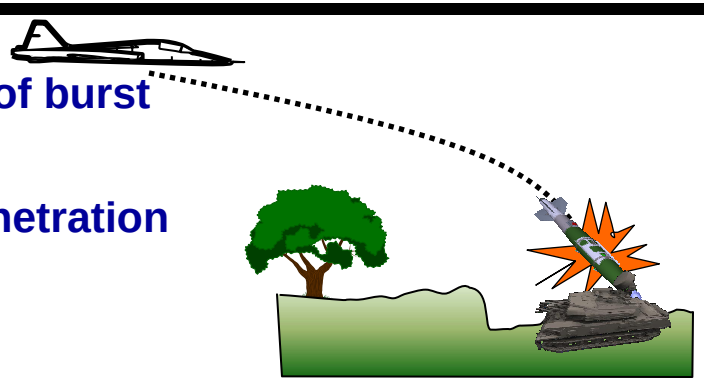
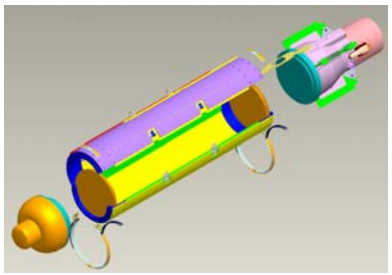


Fuze Air to Surface Technology (FAST)

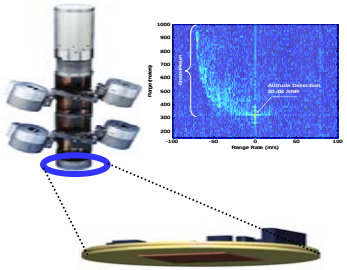


- Electrically selectable height of burst
- 0 – 20 m @ 0.5 m increments
- Ground profiling & foliage penetration
- Extended range 20 – 3000 m
- Low cost digital components
- Expandable capability for receive





High Altitude Sensor



•Low Cost Altimeter for BLU-108

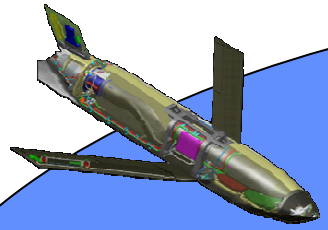
Link 16 Receive

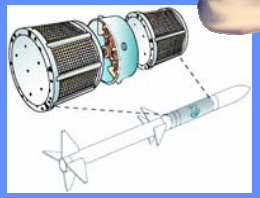
Technology Focus

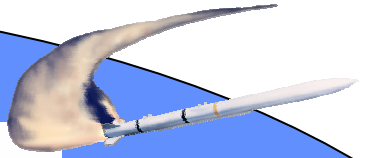
Battlespace Access

Area Dominance

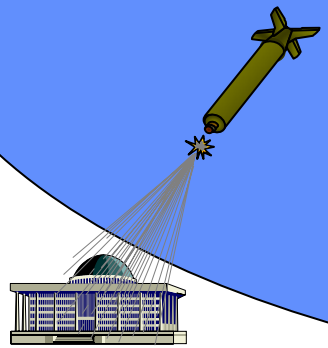
Air Supremacy

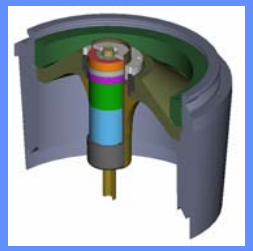


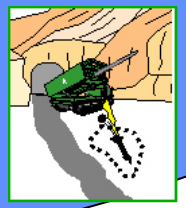


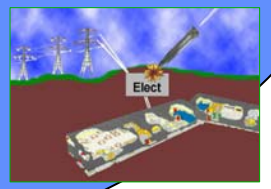


FUZING TECHNOLOGY









Irregular/Catastrophic Threat Neutralization

Revolutionary Technology

Facility Neutralization

Fuzing is crucial to every Integrating Concept

Focused Long Term Challenges

Focused Long Term Challenges

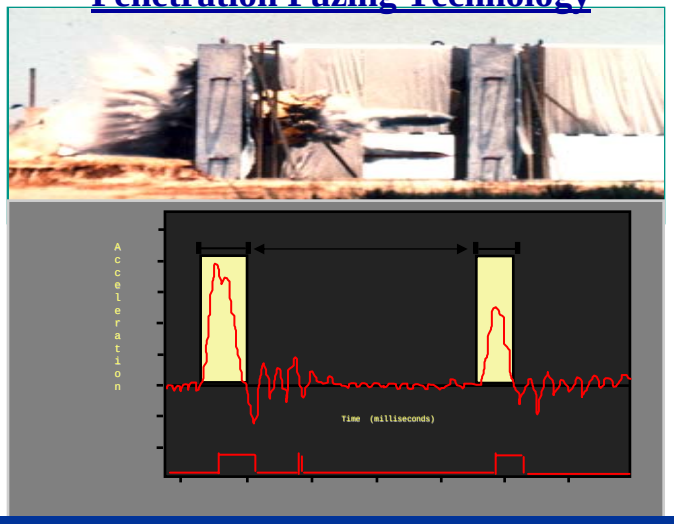
Delivering the Air Force S&T Vision Through Leadership, Discovery, Innovation, and Integration.

- **Anticipatory Command, Control & Intelligence (C2I)**
- **Unprecedented Proactive Surveillance & Reconnaissance (S&R)**
- **Dominant Difficult Surface Target Engagement/Defeat**
- **Persistent & Responsive Precision Engagement**
- **Assured Operations in High Threat Environments**
- **Dominant Offensive Cyber Engagement**
- **On-demand Theater Force Projection, Anywhere**
- **Affordable Mission Generation & Sustainment**

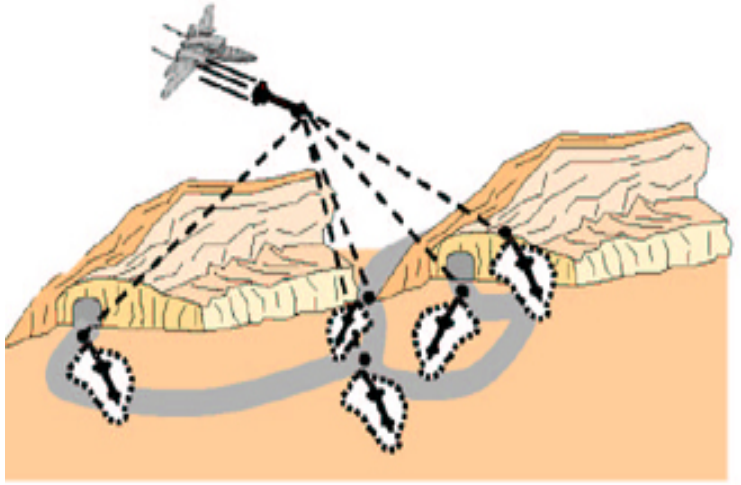
Fuze Challenges

- **Penetration Fuzing**
  - **Target Defeat**
  - **Target Denial**

Penetration Fuzing Technology



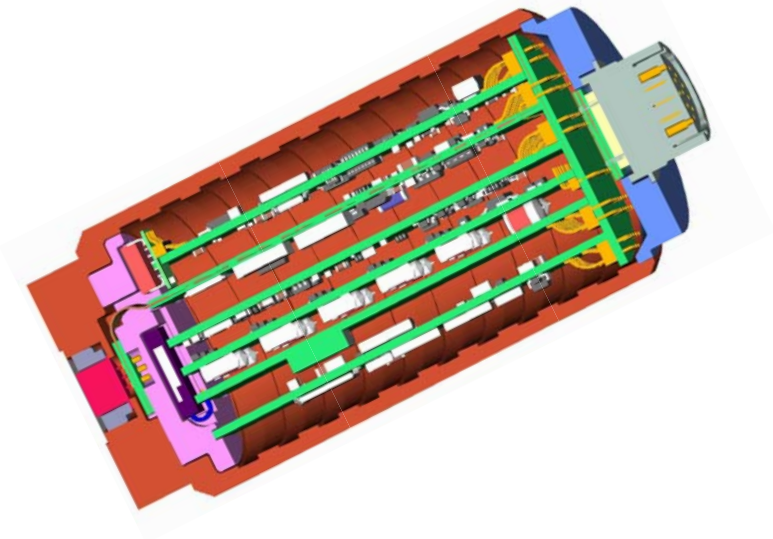
Penetration Fuzing Technology



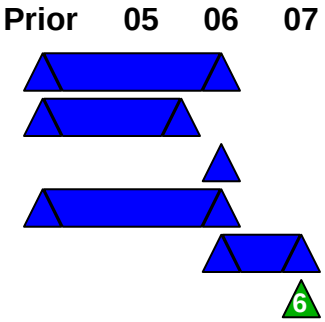
Survivable Thermostable Robust Intelligent Fuze (STRIFE)

Munitions Directorate

AFRL/MN



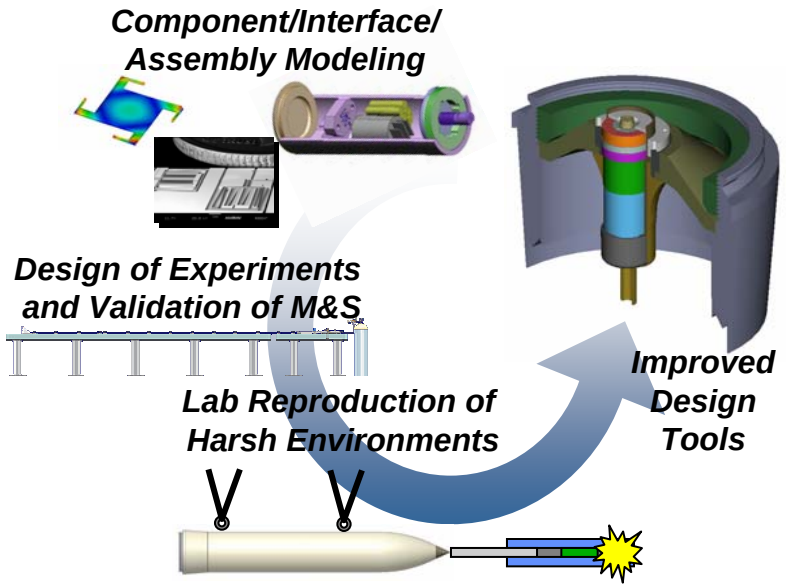
Technology Investment Schedule (FY)



Description	Benefits to the Warfighter
• Provide interoperability between a smart fuze and the CAV flight vehicle. • Provide inert/live fuzes for the inert HSP 1000 sled test and MTD-3B/CAV flight test.	• Ability to reach hardened and deeply buried targets which cannot currently be reached. • Fuze capable of surviving and functioning in the projected CAV environments. • Fuze capable of void, layer and depth of burial (DoB) modes of operation. • Design work will mature intelligent hard target fuzing.
Technology	

• Perform required fuze modifications for CAV integration
  • Development of weapon to fuze electrical interface design.
  • Development of safety architecture and detailed safety design for this unique weapon application.
• Provide fuzes for inert HSP sled tests and live HSP sled and CAV flight demonstrations.	

*H*arsh *E*nvironment *F*uze *T*echnology (HEFTY)



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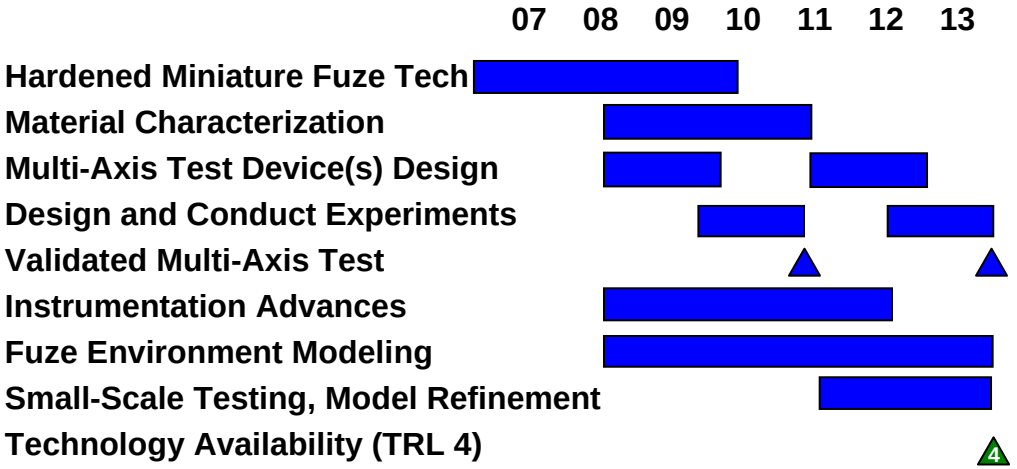


Description

- Develop the capability to model, characterize, design, and test fuzes in relevant environments based on requirements for current and future munitions.

Technology

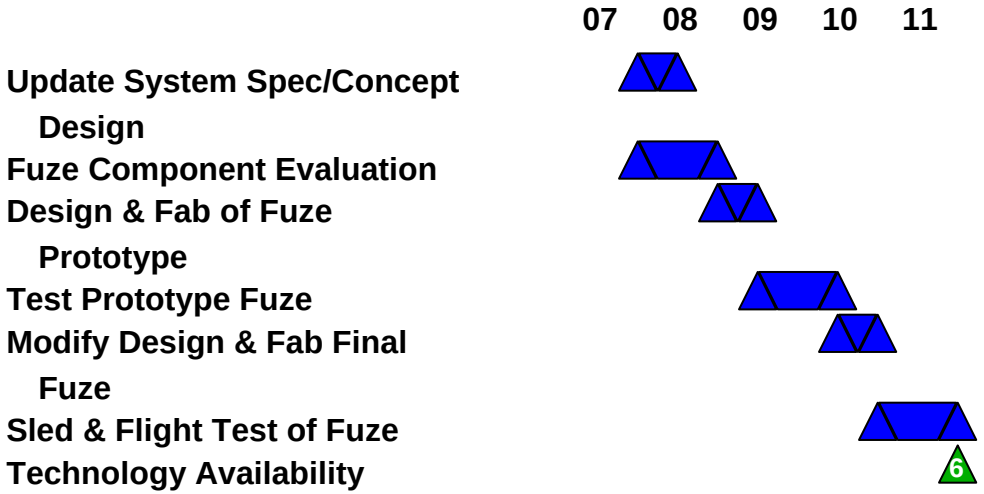
- Survivable fuze technology
- Microelectronics for harsh environments
- Validated M&S of fuzewell environment
- Model-based design of experiments
- Scaling of models for harsh environment prediction
- Dynamic test apparatus and methodology

Benefits to the War Fighter

- Enhanced fuze reliability and performance in harsh environments of Global Strike weapons
- Increase Global Attack capability (Time Critical Targets)
  - •Hypersonic cruise missile
  - •High speed conventional ballistic missiles
  - •Hold high value, time-critical targets at risk

Hard Target Influence Fuze (HTIF)

Technology Investment Schedule (FY)



Description

- Develop a fuze to provide active detection of vehicular traffic and deny/limit access to hardened and strategic targets such as tunnels, very deep / hard targets, WMD targets, mountain passes, and bridges
- Single fuze compatible with existing precision guided weapons
- Application for hard and soft terrain
- Future remote Command and Control features

Technology

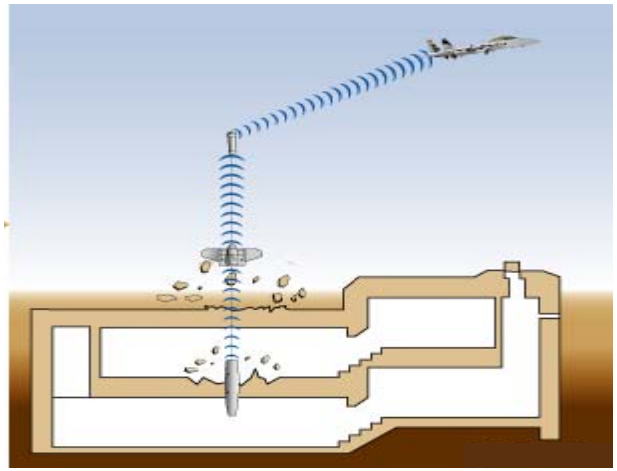
- Shock hardened, cooperative seismic, acoustic and/or magnetic vehicle sensors
- Shock hardened, extended-life power source
- Target discrimination algorithm
- Shock hardened safe & arm and fuze electronics

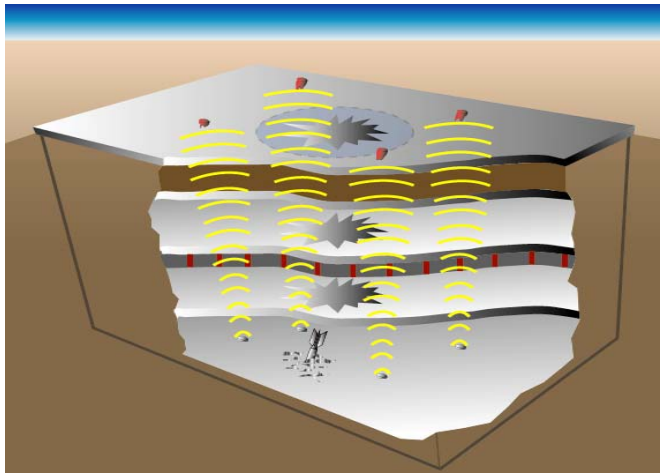
Benefits to the Warfighter

- Highly shock survivable allowing for extreme delivery conditions
- Long-delay activation for functional denial
- Vehicle discrimination (programmable sensitivity) for increased safety
- Compatible with inventory weapons
- Compatible with existing guidance kits for precision delivery
- Application to hard and soft terrain
- Presidential Policy 30 compliant
  - Humanitarian de-mining of anti-personnel landmines

Fuze Challenges

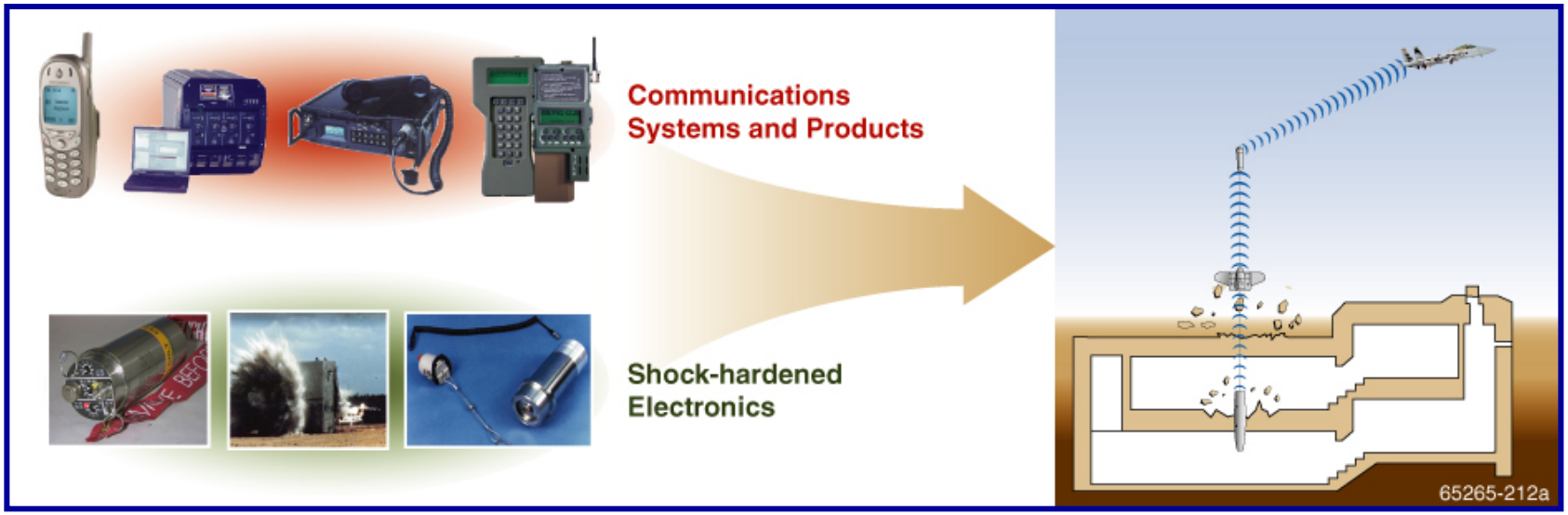
- Penetration Fuzing
  - Target Defeat
  - Target Denial
- **Bomb Damage Sensing**
  - **Real-time bomb damage information from hard target weapon to airborne platform**
  - **Two way, shock hard, through earth communications**



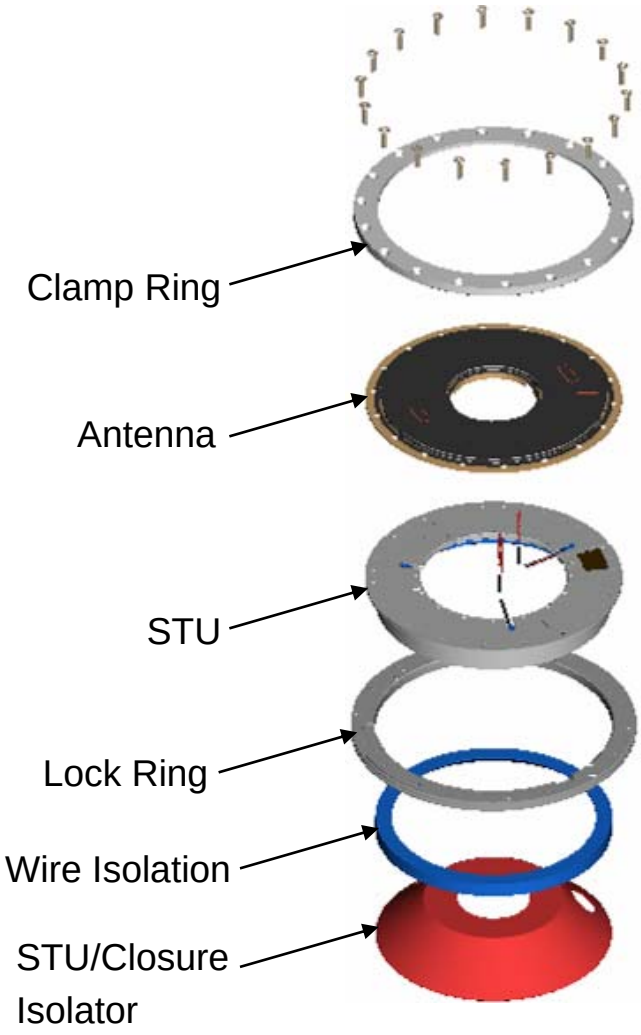


Fuze Integrated Bomb Damage Information Demonstration (FIBDID)

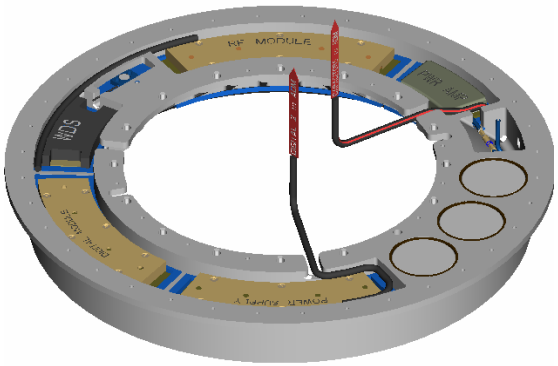
- **Radio system that overcomes severe signal attenuation and distortion**
- **Hardware that operates as the weapon penetrates through hard target**

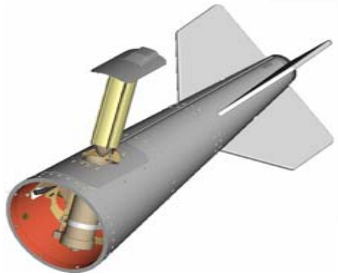


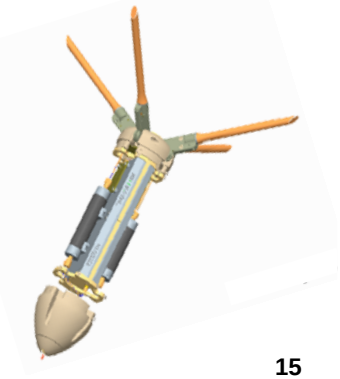
Key FIBDID Technologies



- **Shock Hardened BDI Electronics**
  - **Shock hardening of hand-held radio transmitter**
  - **High losses in transmission through soil/concrete**
  - **Hardened accelerometer sensor module**
- **Antenna Designs To Efficiently Couple RF to Soil**
  - **Design limited by weapon size and space constraints**
  - **Requires shock hardening**
- **Repeater Assembly & Deployment Design**
  - **JDAM/BLU-109 and EGBU-27 deployment designs**

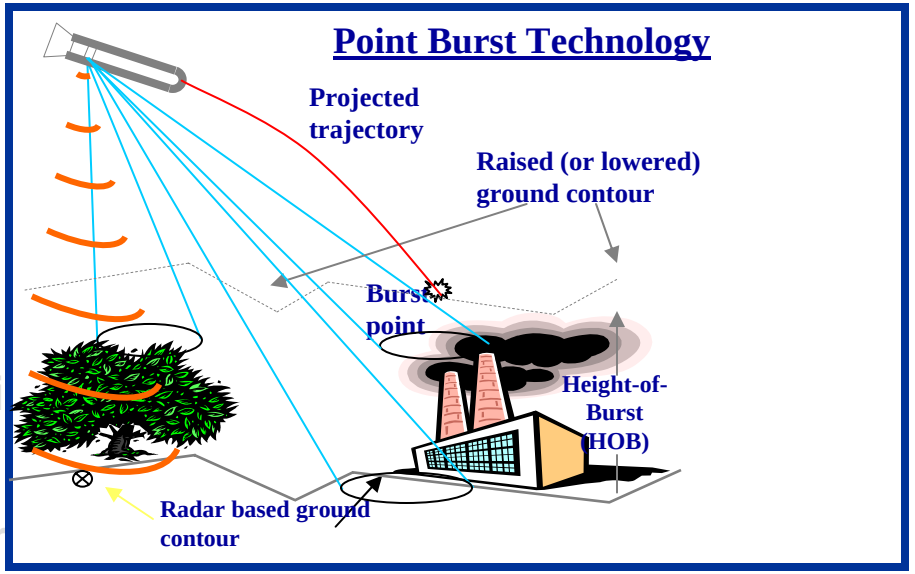


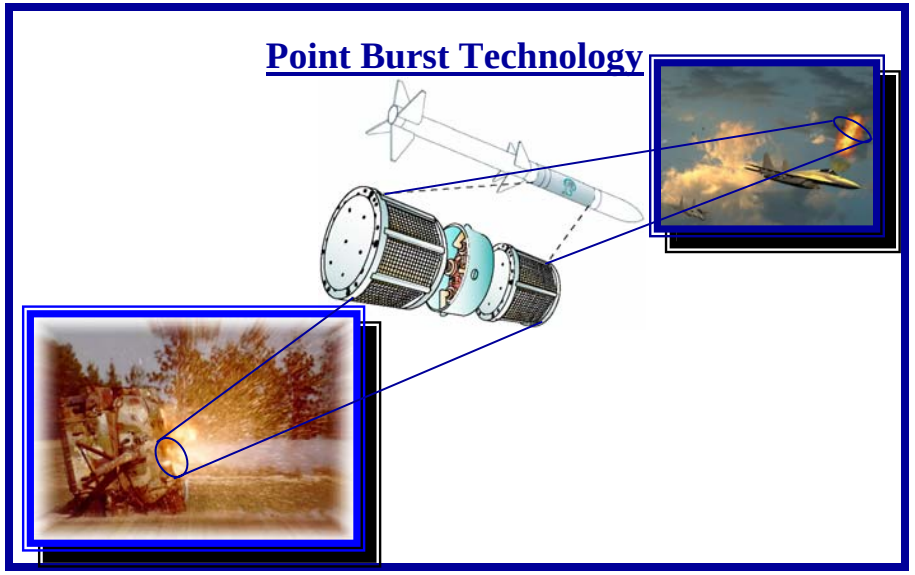




Fuze Challenges

- Penetration Fuzing
  - Target Defeat
  - Target Denial
- Bomb Damage Sensing
  - Real-time bomb damage informati
    platform
  - Two way, shock hard, through ear
- **Point Burst**
  - **Ground profiling radar**
  - **Active imaging fuze sensor**





Fuze Air to Surface Technology (FAST)

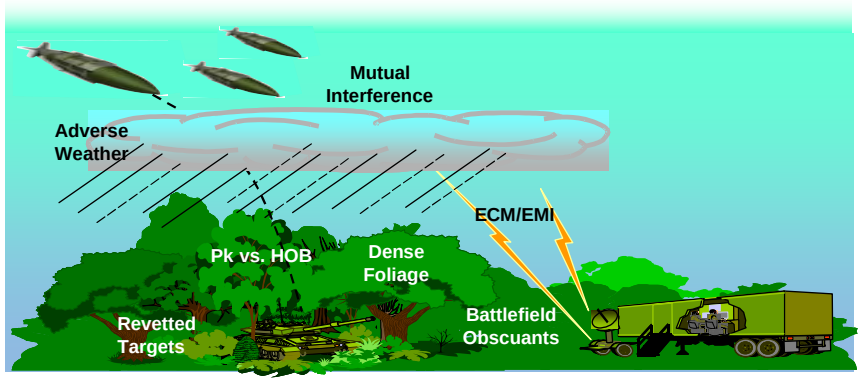
A Precision HOB, Low Cost Ground Profiling Radar

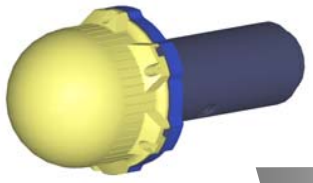
Common Fuze Sensor for a Broad Spectrum of Weapons

UHF to L-Band Pulse Doppler Radar Using Low Cost COTS Components

Nose and Tail Mount Configurations Only Differ in the Antenna Structure

Small Volume Common Design Provides Identical Requirements for Any Weapon



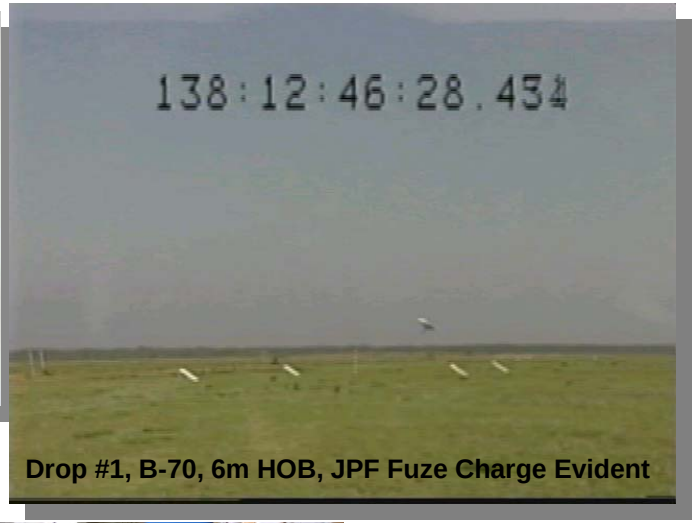


Nose-Mounted Configuration (DSU-33 Form Factor)

Tail-Mounted Configuration (MK-82 Demo)

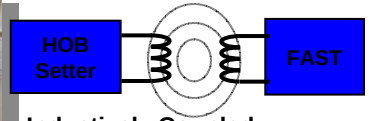
100% Common Low Cost Electronics and Operational Software

Operational Field Validation Testing (F-16, Mk-82 Unguided Inert Drops)



Drop #1, B-70, 6m HOB, JPF Fuze Charge Evident

- Drop Tests (Piggybacking with DSU-33 VECP Testing)
- 4 FAST Drops on Mk-82s (B-70 & C-52)
- Demo HOB in Operational Environment (TRL 7!!)
  - Bomb Bodies Drilled to observe flash from Fuze charge
  - Telemetry (FAST equipped) and Range Data Analysis
  - HOB set (Inductive) at bomb dump after bomb buildup



Inductively Coupled Programming w/o system power

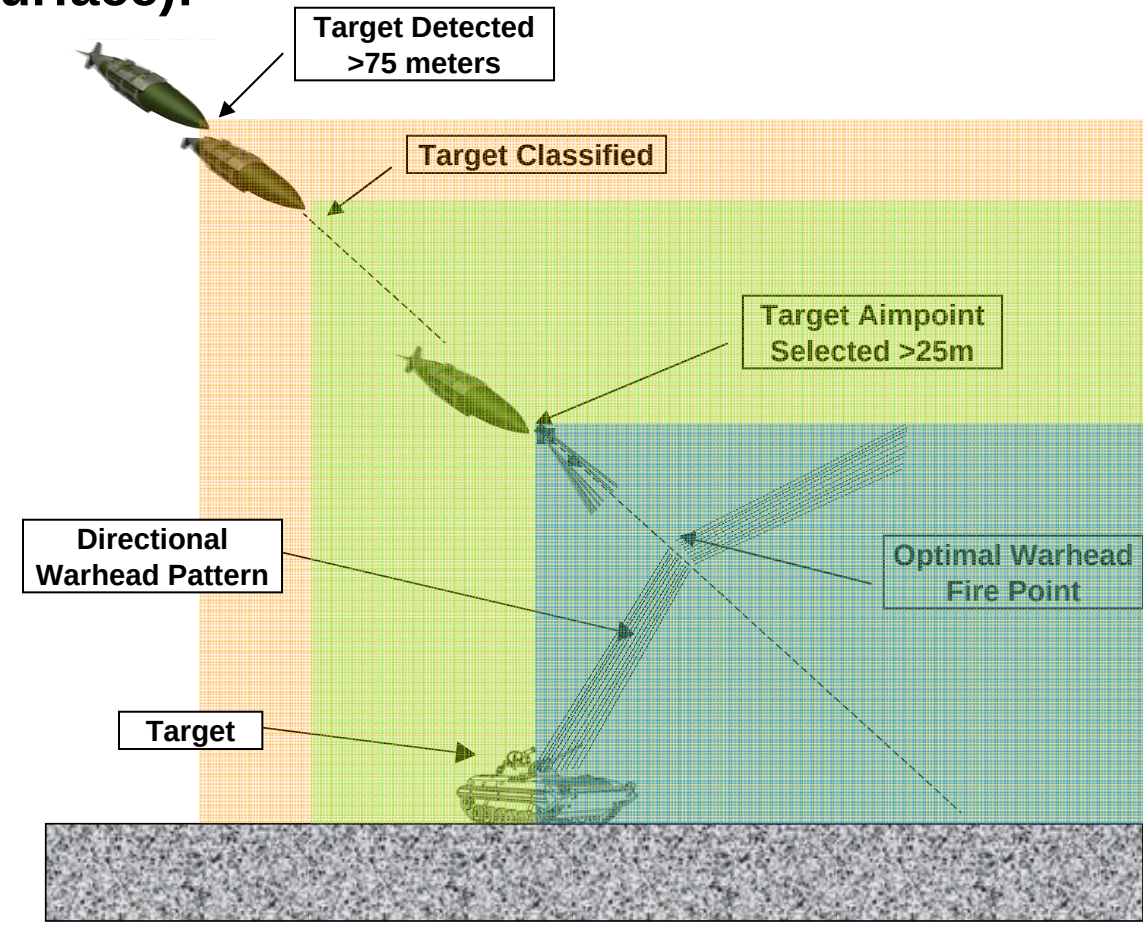
TM Setup, B-70

FOCAS Concept

- **Notional Engagement (Air-Surface):**

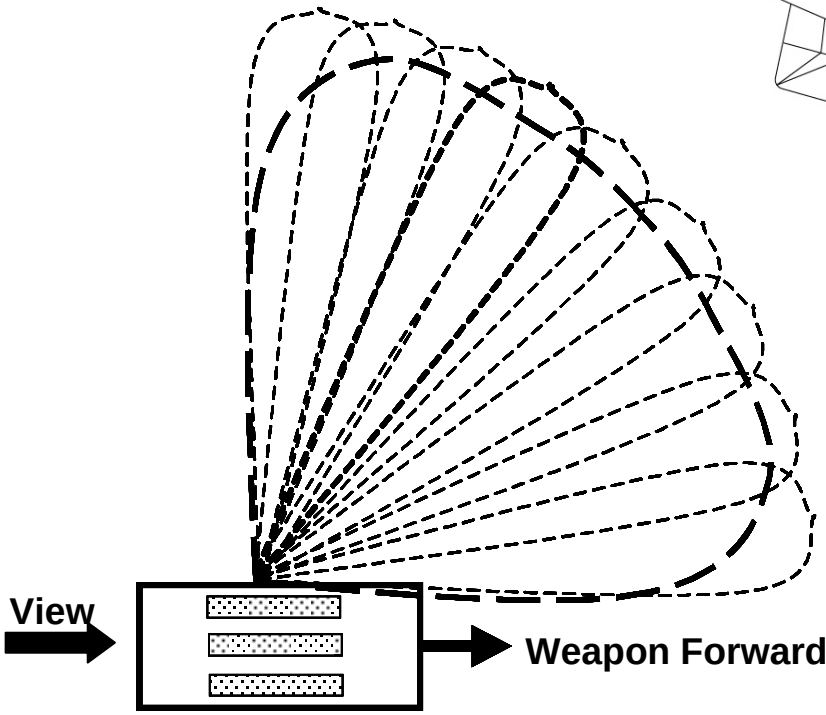
A Proximity Fuze Sensor That:

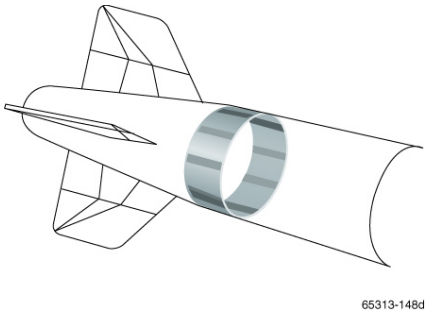
- **Separates The Target From Background Clutter**
- **Calculates And Tracks The Target's Aimpoint**
- **Selects The Correct Warhead Mode For The Given Encounter**
- **Communicates The Warhead Mode And Firing Time To The Warhead Initiation System**
- **Updates Solution Until Burst Time Is Reached**

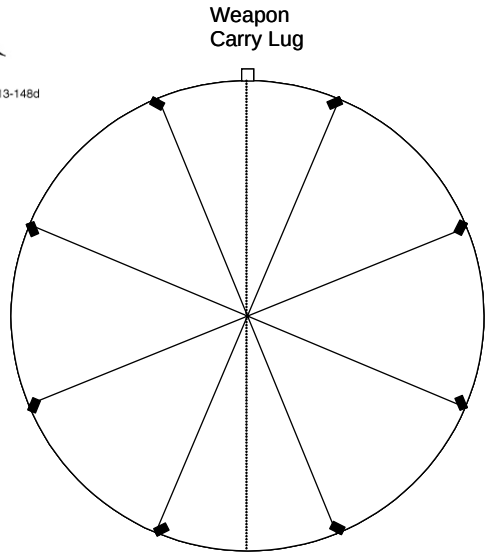


Imaging Millimeter Wave Antennas

Digitally Formed Beams





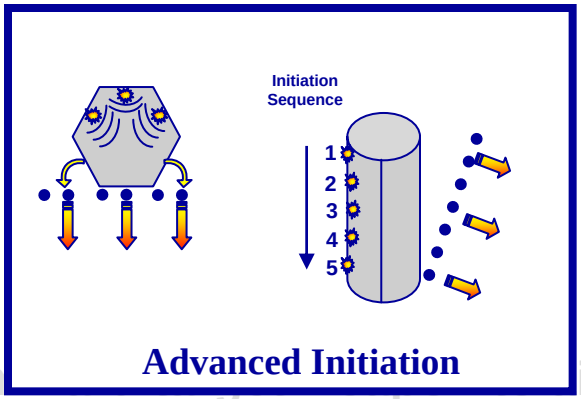


Viewed from Behind

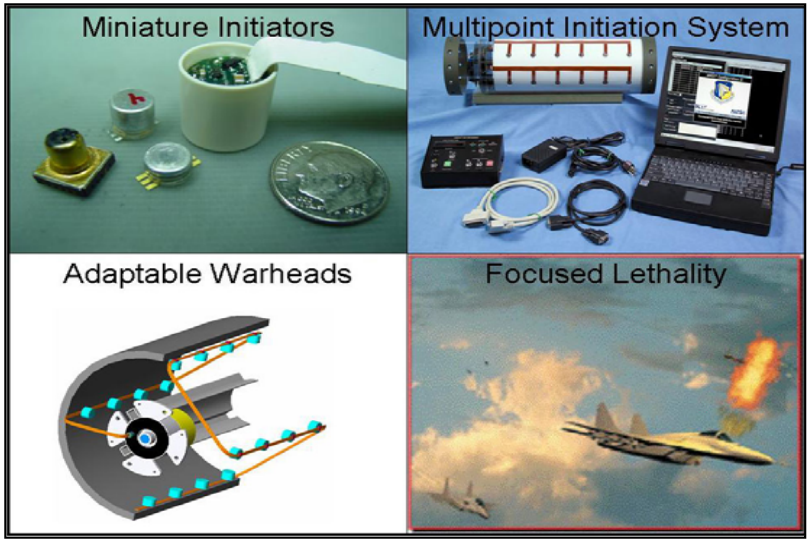
Simultaneously Receive on all Elements, Form Beams with Software

Fuze Challenges

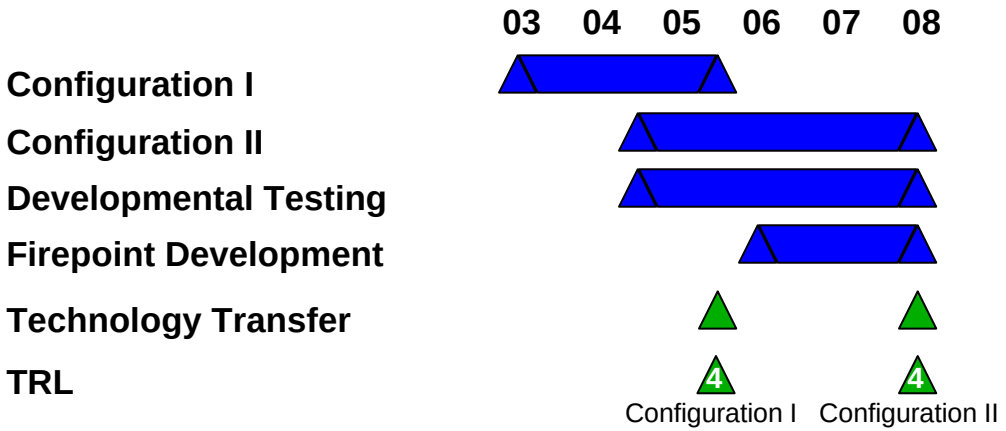
- Penetration Fuzing
  - Target Defeat
  - Target Denial
- Bomb Damage Sensing
  - Real-time bomb damage information from [illegible] airborne platform
  - Two way, shock hard, through eart[illegible]
- Point Burst
  - Ground profiling radar
  - Active imaging fuze sensor
- **Advanced Initiation**
  - **Individually control multiple initiation points**



Adaptable Miniature Initiation System Technology (AMIST)



Technology Investment Schedule (FY)



Description

- Develop two initiation configurations, each capable of controlling individual detonation points
- Configuration I provides non-autonomous capability only (requires continuous connection to mode controller)
- Configuration II provides fire point networking capability and fire point independence from mode controller

Technology

- Miniature Initiation System Technology (MIST)
- Low Energy Initiators
- Pulse Discharge Switch Technologies

Benefits to the Warfighter

- Increases warhead lethality
- Decreases collateral damage
- Enables multiple kill mechanisms
- Provides multirole munition capability

Summary and Way Ahead

- **High level AF recognition of fuze issues**
- **AFRL utilizing new construct for technology investment throught Future Long Term Challenges**
- **Addressing fuzing technology scientific challenges with innovative solutions**
  - **Shock hardening electronics for extreme environments**
  - **Demonstrated through media transmission of fuze data**
  - **Demonstrated selectable fuze sensor in tactical configuration**
  - **Demonstrated independent control of multiple initiation points**