50th Annual Fuze Conference

"50 Years of Support Freedom"

9 - 11 May 2006

Norfolk, Virginia

Session I & II: *OPENING REMARKS AND KEYNOTE & GENERAL SESSION*
• **Keynote: Mr. Rene Kiebler**, Deputy Project Manager Combat Ammunition Systems, PEO Ammunition
• OSD Perspecctive, **Mr. Peter A. Morrison**, Staff Specialist OUSD/DDR&E(S&T) Weapons Technology
• PEO Ammo Perspective, **Mr. Rene Kiebler**, Deputy Project Manager Combat Ammunition Systems, PEO Ammunition
• US Army RDECOM ARDEC Perspective, **Dr. Joseph Lannon**, US Army RDECOM ARDEC
• Navy Overview, **Mr. Steve Mitchell**, Ordnance Project Area Director, NAVSEA
• Air Force S & T Strategy, **Mr. Timothy Tobik**, Air Force Research Laboratory, Eglin
• Air Force Acquisition Strategy, **Mr. J. Rick Holder**, Sr., Director Fuze Squadron USAF, Eglin
• Fuze IPT Perspective, **Mr. Lawrence Fan**, Fuze and Microsystem Project Manager, NSWC

Session IIIA: *OPEN SESSION*
• PGMM, New Application for an Existing Fuze, **Mr. Al DeSantis**, Picatinny Arsenal, NJ
• Proximity Sensor for the Guided Multiple Launch Rocket System (GMLRS), **Mr. Robert P. Hertlein**, L3 Communications - KDI Precision Products
• Portable Excalibur Fire Control System, **Mr Gregory Schneck**, US Army RDECOM ARDEC
• Enhanced Portable Inductive Artillery Fuze Setter (EPIAFS), **Mr. Tom Walker**, US Army RDECOM ARDEC Adelphi Fuze Division
• The Evolution of the DSU-33 C/B Proximity Sensor, A Success in Customer-Contractor Partnership, **Mr. Michael J. Balk**, ATK Ordnance Systems
• A New Fuze for an Electromagnetic Gun, **Mr, Barry Schwartz**, US Army RDECOM ARDEC
• Introduction of the Multi Option Fuze Artillery (MOFA) DM84 on 120mm Rifled Mortar, **Mr. Jochen Wagner**, JUNGHANS Feinwerktechnik

Session IVA: *OPEN SESSION*
• Challenges Associated with Development of the Affordable Weapon System Fuzing System, **Mr. John Hubert**, L-3/KDI Precision Products, Inc.
• FMU-139C/B. Electronic Bomb Fuze Design Update, **Mr. David Liberatore,** ATK
• Shipboard Submunition Fuze Safety and Realiability Enhancements, **Mr. John Kunstmann**, Indian Head Division, NSWC
• Thermal Battery Development - Reduced Product Variability Through 6-Sigma, Automation and Material, **Mr. Paul F. Schisselbauer** and **Mr. John Bostwick**, ATK
• Performance Testing of Lead-Free Stab Detonators, **Mr. Neha Mehta**, US Army RDECOM ARDEC
• TNO Research on EFI's in Relation to Insensitive Munitions, **Mr. Wim Prinse**, TNO Defence, Security and Safety

Session VA: *OPEN SESSION*
• Hight-G Mortar Electronic S&A Development and Flight Test, **Mr. Cuong Nguyen**, US Army RDECOM ARDEC
• Safe Separation Study for MK 437 Mult-Option Fuze for Navy (MOFN), **Mr. Brian Will**, NSWC, Dalhgren
• Navy Proximity Fuze Simulation with Embedded Tactical Software, **Mr. John Langan**, NSWC WD
• Inadequacy of Traditional Test Methods for Detection of Non-Hermetic Energetic Components, **Mr. Karl Rink**, University of Idaho
• Weapons Reliability How Modern Warfare has Changed the Requirement, **CDR Tom Hole**, USN, US Navy PMA-201
• MAFIS a Proven Hard Target Fuze, **Mr. Laurie Turner**, Thales Missile Electronics
• Aurora a Proven Hard Target Fuze, **Mr. Richard Clutterbuck**, Thales Missile Electronics

50th Annual Fuze Conference

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

Norfolk Waterside Marriott

May 9-11, 2006

50th Annual Fuze Conference

Administrative Remarks

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

- Number for phone messages at registration desk
  - 757-625-6467
- Restrooms
  - Turn left out of ballroom and go to the end
- 50th Anniversary Commemoration is followed by 1st Harry Diamond Fuze Excellence Award
  - Presented before lunch today
- Tonight's reception at Nauticus / USS Wisconsin
  - Three blocks south of hotel
- 2007 Fuze Conference
  - May 22-24, Gaylord Opryland in Nashville, TN
  - Turn off cell phones
  - Speakers give presentation to computer operators asap

50th Annual Fuze Conference

Wednesday, May 10

NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
STRENGTH THROUGH INDUSTRY & TECHNOLOGY

- **Session I**
  - 8:00 Admin Remarks
  - 8:10 Keynote Address
- **Session II**
  - 8:40 OSD Perspective
  - 9:00 PEO Ammo Perspective
  - 9:20 US Army RDECOM ARDEC Perspective
  - 9:40 Navy Overview
  - 10:10 BREAK
  - 10:30 Air Force S&T Strategy
  - 10:50 Air Force Acquisition Strategy
  - 11:10 Fuze IPT Perspective
  - 11:30 Award Ceremony & 50th Conference Commemoration
  - 12:00 LUNCH

USAF Fuze Acquisition Roadmap Presentation to NDIA 50th Annual Fuze Conference 10 May 2006

J. Rick Holder, Sr.
Eglin AFB, Florida
850-883-0842
james.holder@eglin.af.mil

Why Are We Here?

- **Fuze Acquisition Process**
- **Current Fuze Roadmaps**
- **Fuze Deficiencies**
- **Fuze Requirements**
- **AFRL & Foreign Technology**
  - **“Smart” Hard Target Fuzing**

USAF Fuze Acquisition Process

Three Methods of USAF Fuze Acquisition

1) Total System Approach (Eglin AFB)

- **308th Armament Systems Wing**
  - **308th Armament System Group**
    - JASSM (AGM-158)
  - **408th Armament Systems Group**
    - Wind Corrected Munition Dispenser
    - JSOW (AGM-154)
    - Sensor Fuzed Weapon
  - **918th Armament Systems Group**
    - Small Diameter Bomb I & II (GBU-39)

- **328th Armament Systems Wing**
  - **328th Armament Systems Group**
    - AMRAAM

Three Methods of USAF Fuze Acquisition (Cont)

2) Legacy System Approach (Eglin AFB)

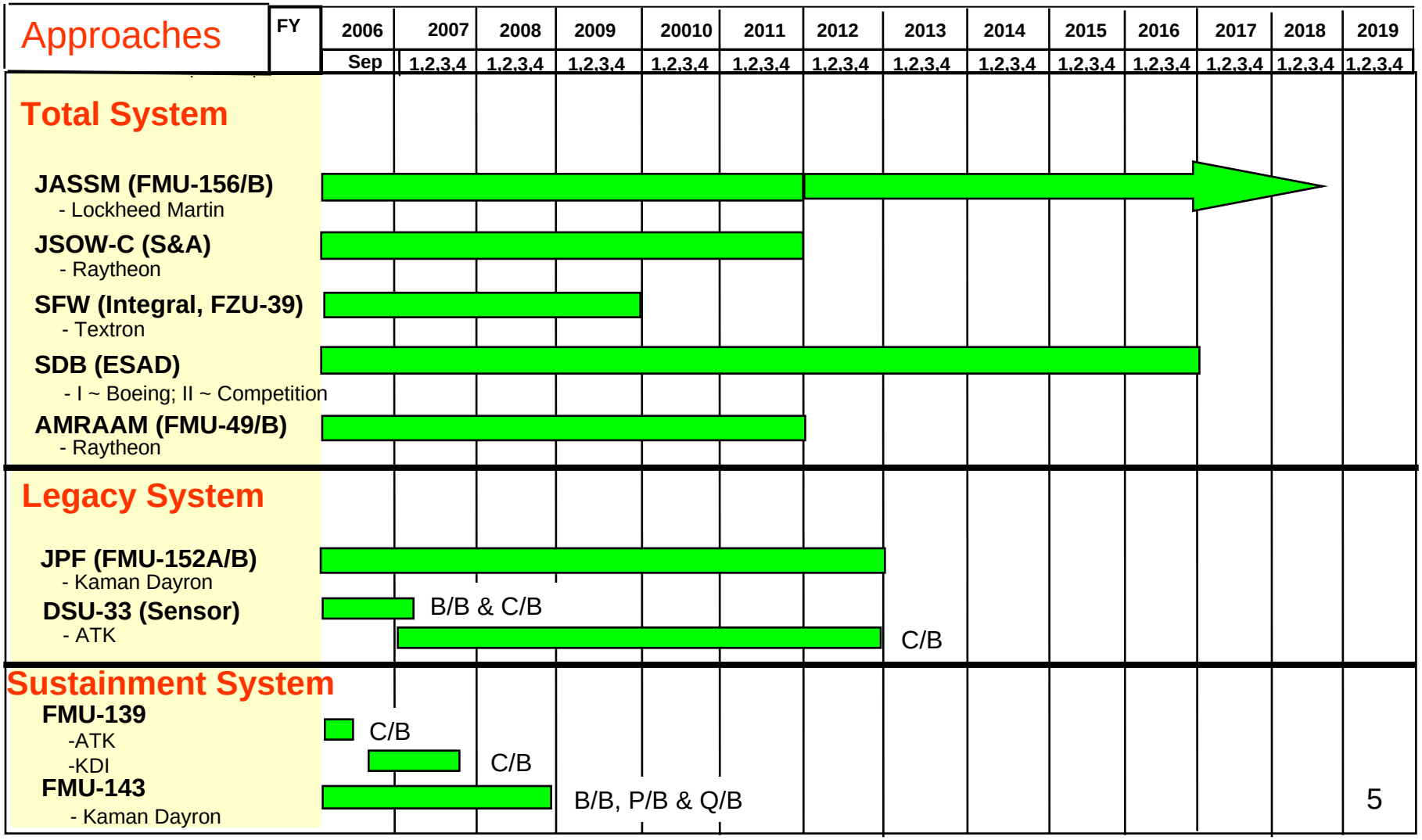
- **308th Armament Systems Wing**
  - **708th Armament Systems Group**
    - FMU-152 (Joint Programmable Fuze)
    - DSU-33 (Proximity Sensor)

3) Sustainment Approach (Hill AFB)

- **784th Combat Sustainment Group**
  - **506th Combat Sustainment Squadron**
    - FMU-139 (Electronic Bomb Fuze)
    - FMU-143 (Electronic Bomb Fuze)

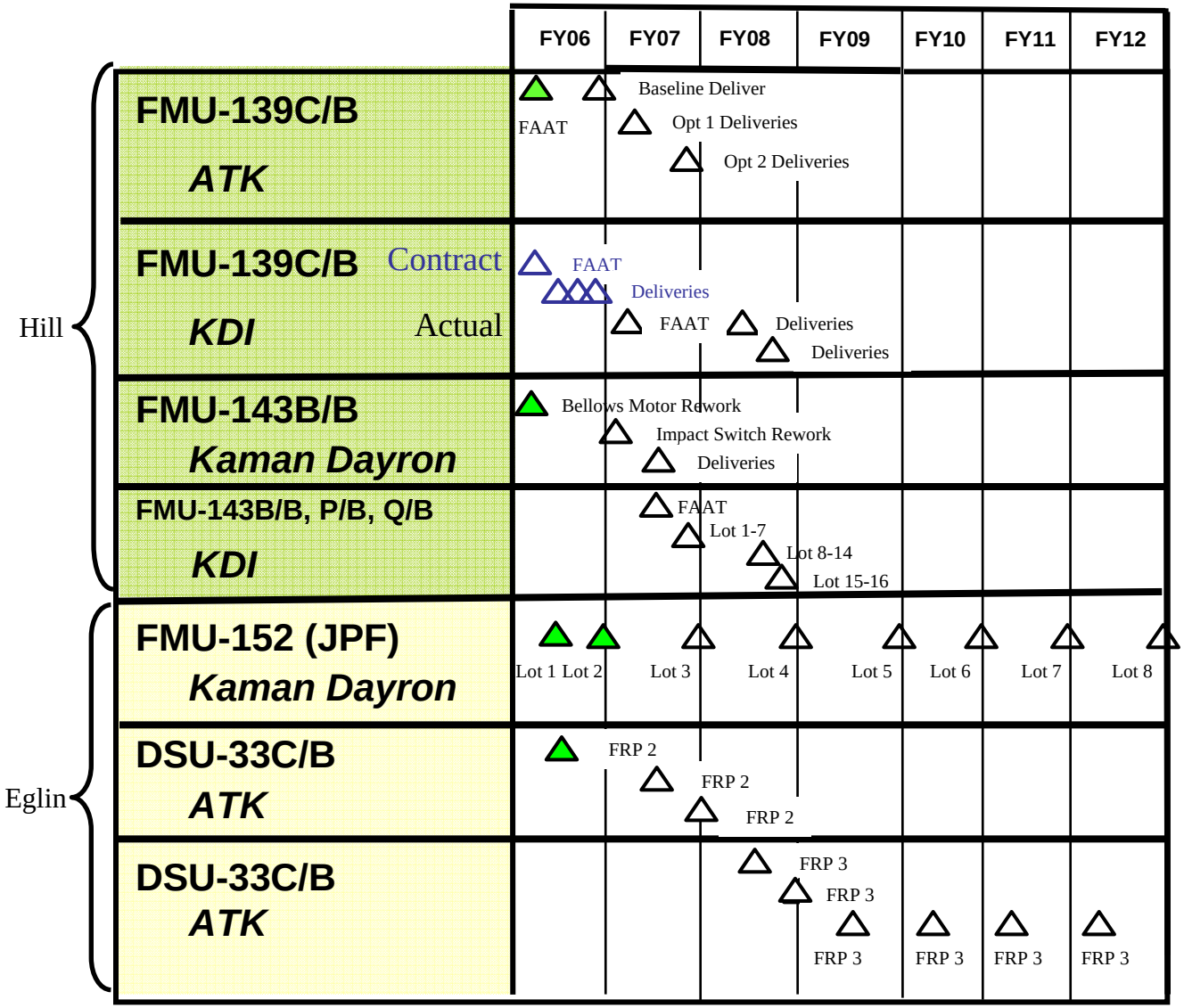
USAF FUZE ROADMAP

308th Armament System Wing



Component Fuze Roadmap

308th Armament System Wing



USAF Fuze Deficiencies

- **Requirement:** A fuze for Hard Target Munitions in support of existing Mission Need Statements (MNS)
  - CAF 314-90, Advanced Fuze Family MNS
  - CAF 317-92, The Hard and Deeply Buried Target Defeat Capability MNS
  - CAF 328-92, The Agent Defeat Weapon MNS

- **Shortcomings of Existing USAF Systems:**
  - No current fuze
    - **Can survive impact loading above 10K g's**
    - **Has a void-sensing or layer-counting capability**
    - **Can arm & power-up at 60,000 feet**
    - **Can power-up at slow release speeds**

Fuze Requirements

- **A "Intelligent" Hard Target Fuze**
  - Survive impact up to 50K g's
  - Sense changes in the target overburden and structure as the warhead penetrates the target
  - Provides a void-sensing or layer-counting capability
  - Initiate the warhead at a predetermined location within the target to maximize warhead effects
  - Power system must be self contained while meeting safety requirements
  - Operate at supersonic and very slow air speeds

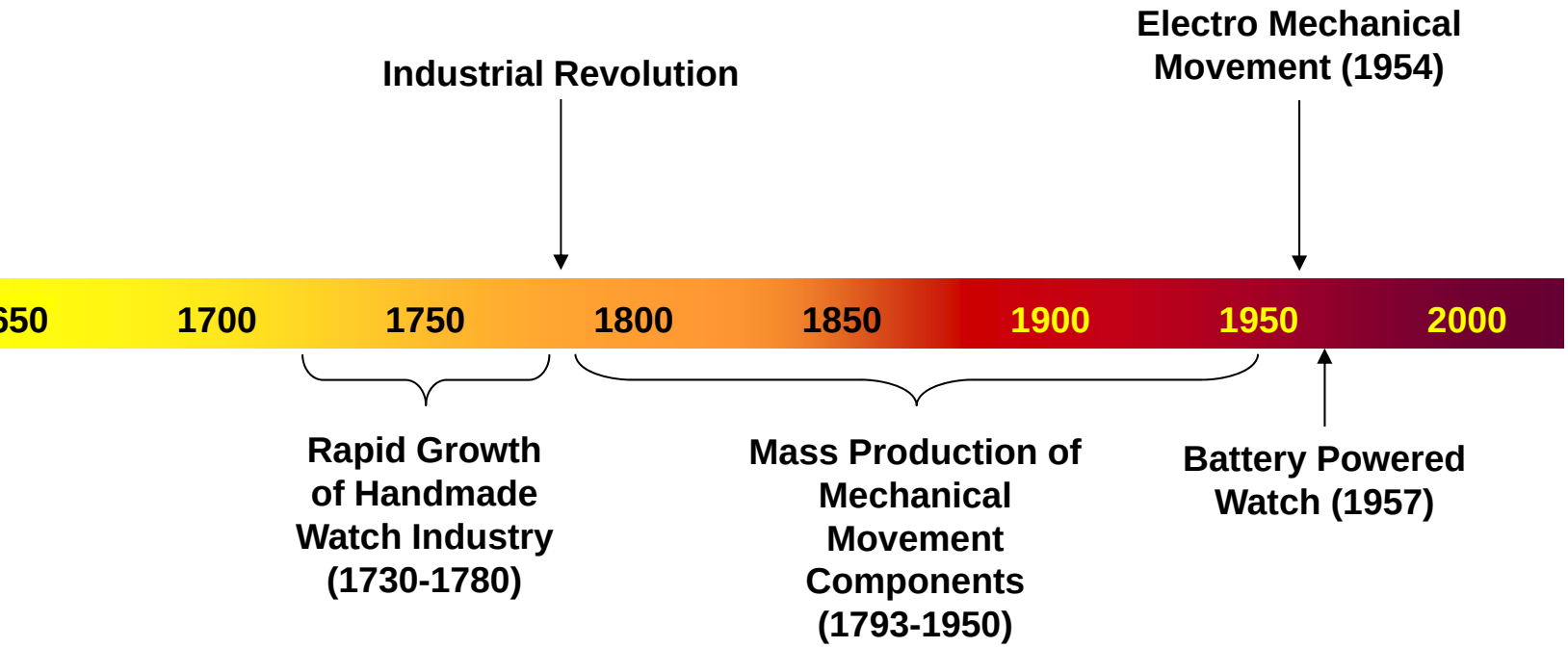
Questions

50th Annual Fuze Conference

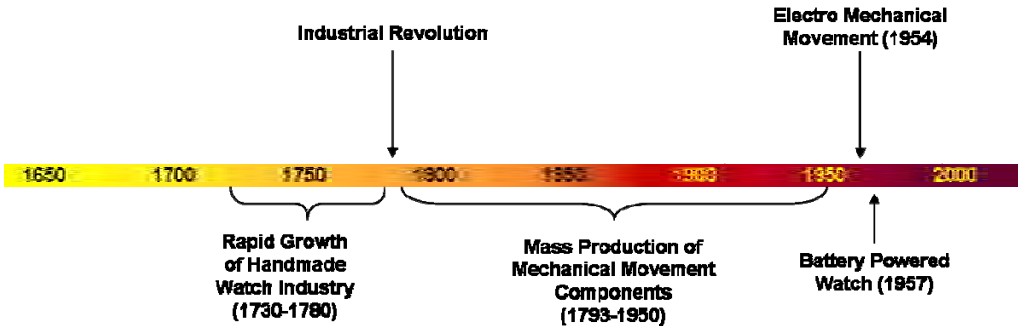
10 May 2006

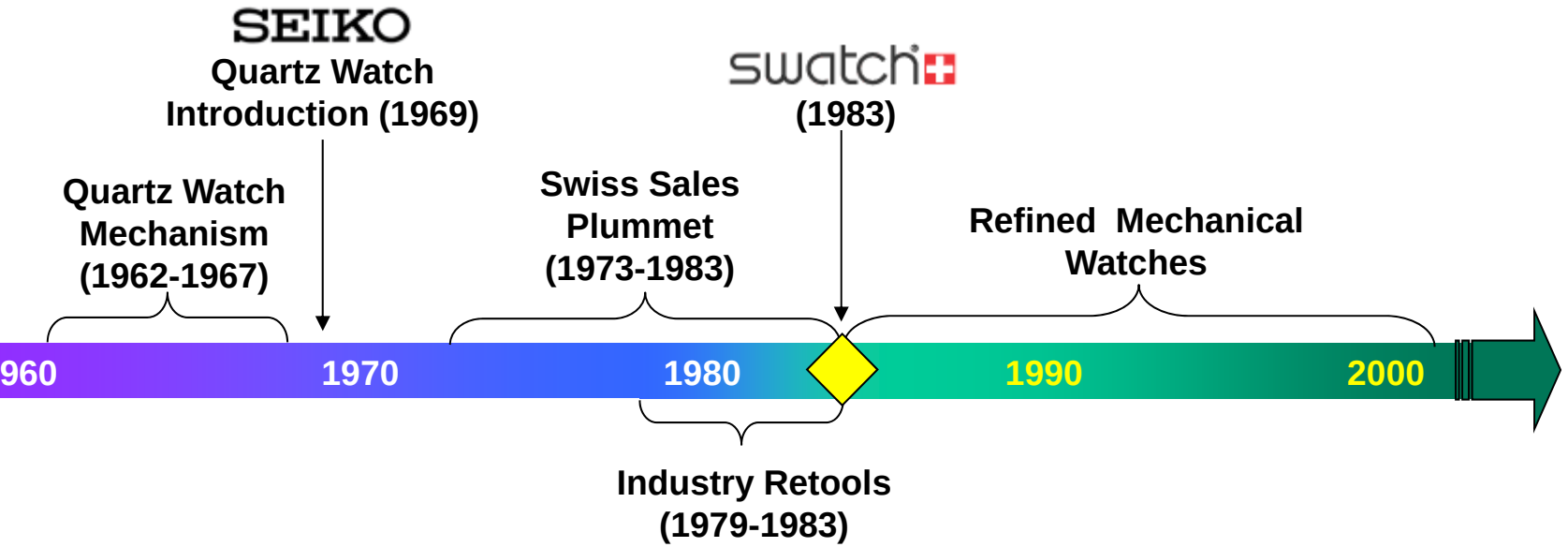
Presented by: Mr. Rene C. Kiebler
Deputy Project Manager for Combat Ammunition Systems
973 724-2110, kiebler@pica.army.mil

History of the Swiss Watch Industry



History of the Swiss Watch Industry





History of the Swiss Watch Industry

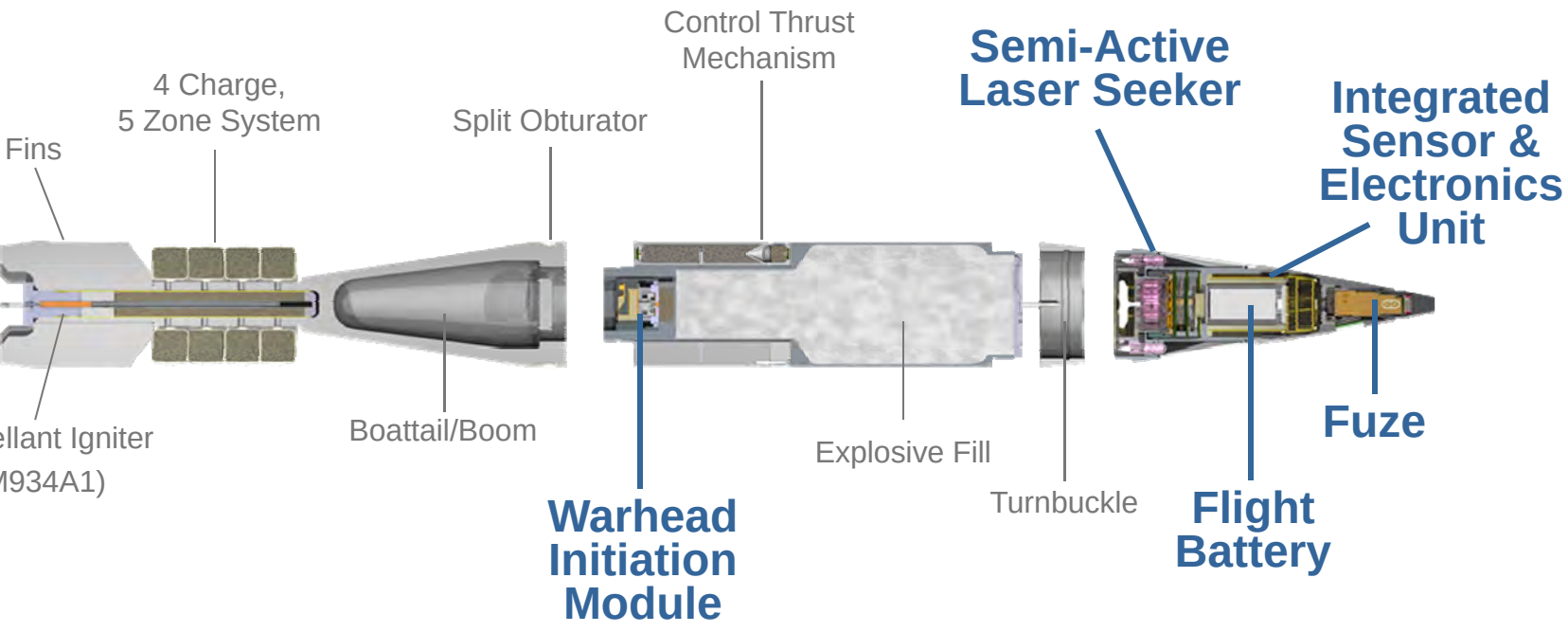
Mechanical Era

Electronic Era

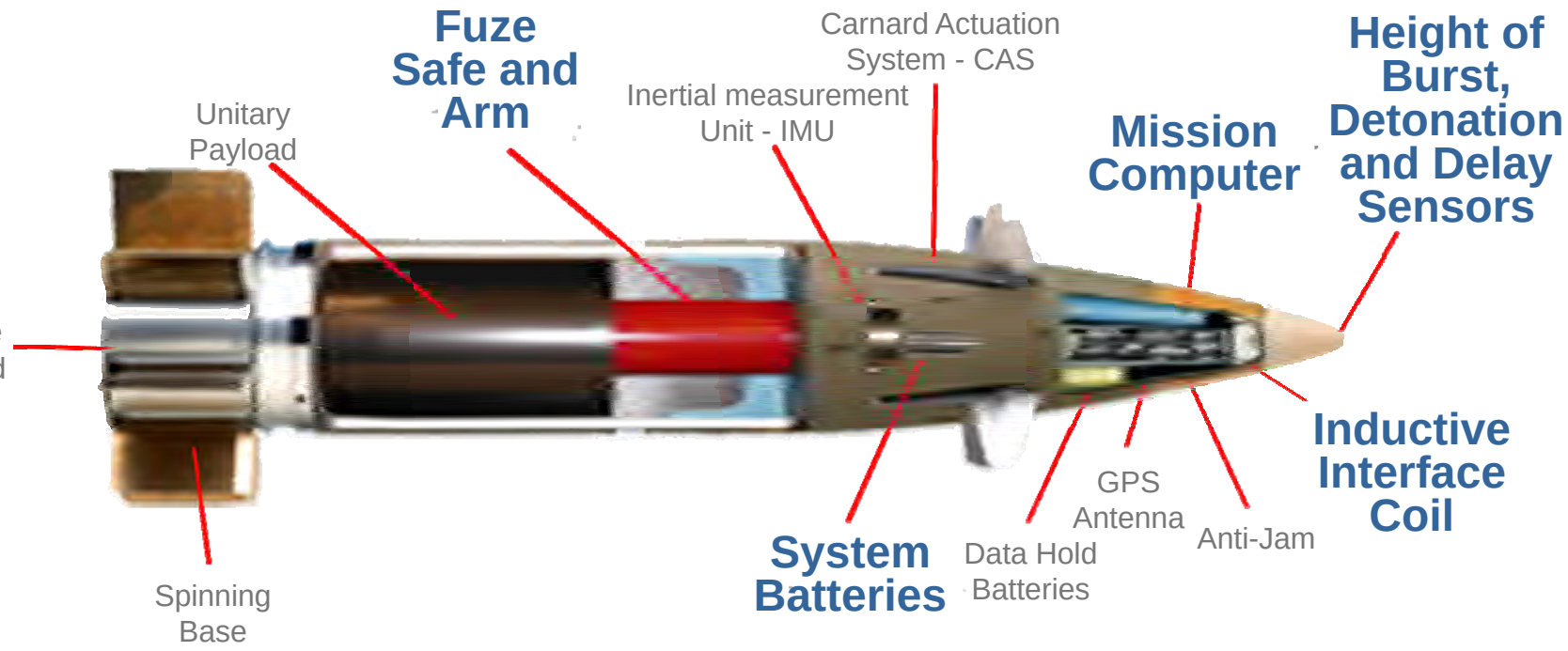
Integrated Era

50 1800 1850 1900 1950 2000

PGMM Integrated Fuze

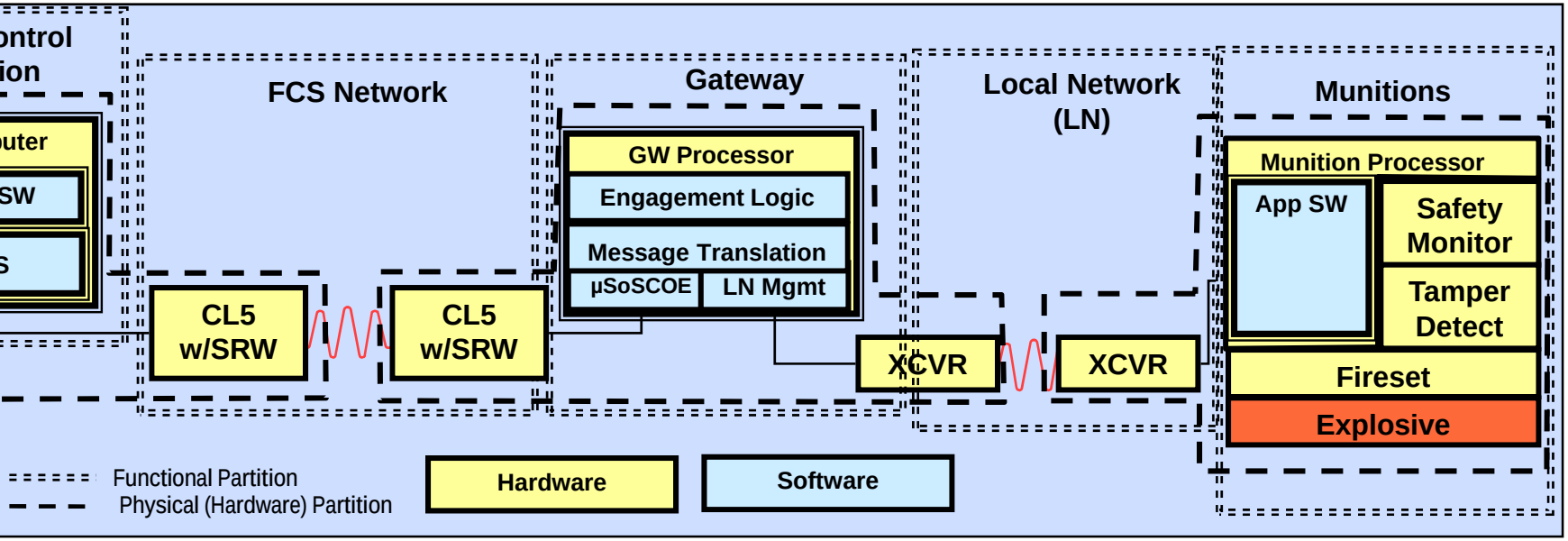


Excalibur Integrated Fuzing



Intelligent Munitions System (IMS)
Distributed Initiation & Fuzing

ator



r a networked munition system, the **initiation and fuze chain** begins at the **operator** & includes y **Hardware & Software** that plays a part in creating, processing, sending & receiving a message at will either cause or enable the munition to fire.

addition, any Hardware or Software the plays a part in creating, processing, sending, receiving, oring, & displaying a status back from the munition that includes its armed/disarmed state is also **fety critical**.

Existing Production Base

Do not over React/Abandon Mechanical Technology

Develop Retooling Strategy for Mechanical Technology

- ✓ Focused on Flexible Modern Processes
- ✓ Lower Unit Prices
- ✓ Maintaining Quality Levels

Adapt to Technology Advancement

- ✓ System Contractor Teaming
- ✓ Embrace Emerging Technology Innovations
- ✓ Aggressively Pursue Next Generation Markets
- ✓ Leverage Production Experience
- ✓ Develop Retooling Strategy

Aggressively Pursue Niche Markets

- ✓ FMS
- ✓ Legacy Buys

Adapt or Perish

Government Agencies

Don’t Abandon Mechanical/Electronic Technologies

Aggressively Pursue Technology Advancement

- ✓ Technology Development Contracts
- ✓ Foreign Technology
- ✓ Establishment of Fuze Technology Funding

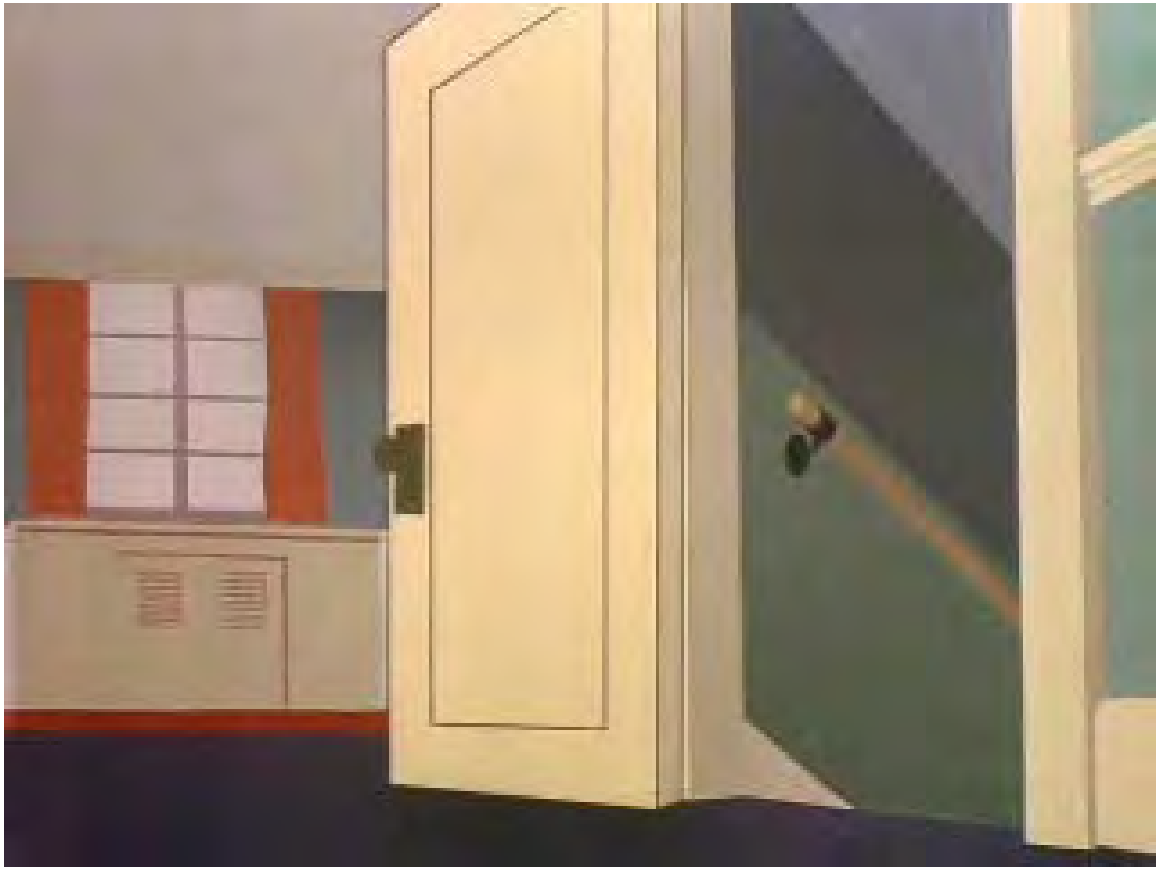
Safety is Job #1

Clarify/Rethink Requirements

- ✓ Service Safety Review Board
- ✓ Technology Independent/Flexible
- ✓ Responsive to Change
- ✓ Analytics and Data

Anticipate and Reduce Barriers to Foreign Markets

- ✓ Direct Sales
- ✓ Technology Alternatives
- ✓ Develop Upfront Constraints Workarounds
- ✓ Establish Process for Inventory Technology Upgrades



Systems Contractors

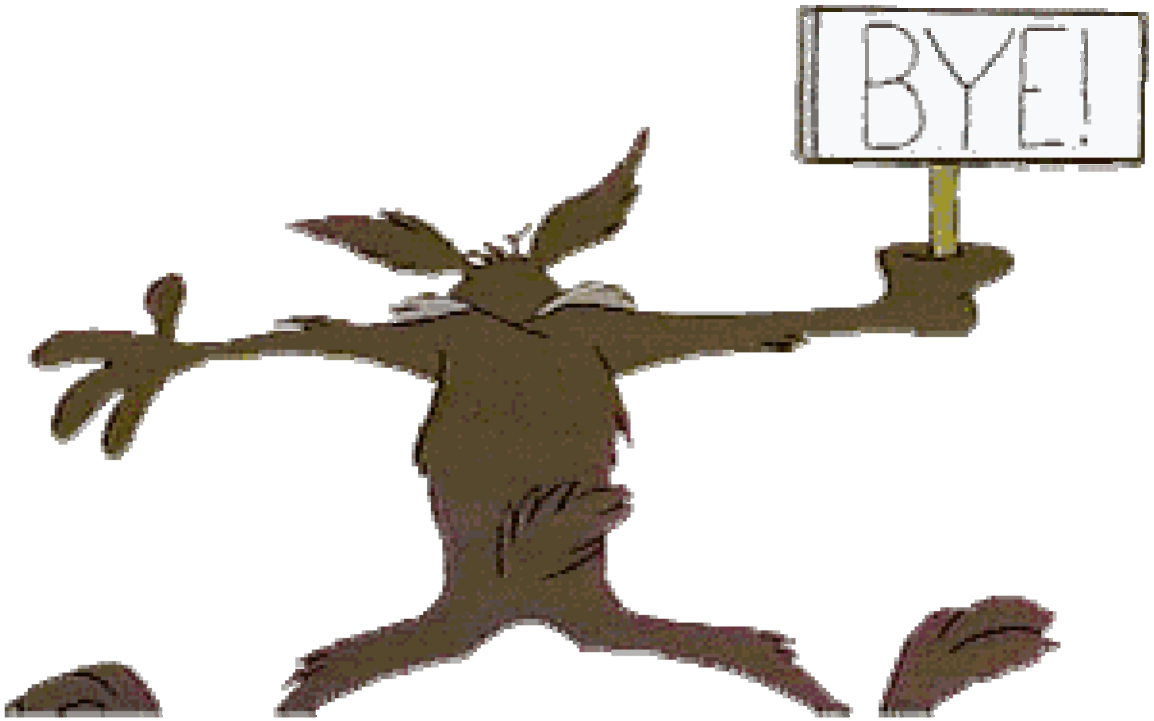
Understand Requirements/Process

Early Service Safety Review Board Review

Leverage Fuze Industrial Base Expertise

Respect Fuze Development Process

Questions??



Fuze Conference

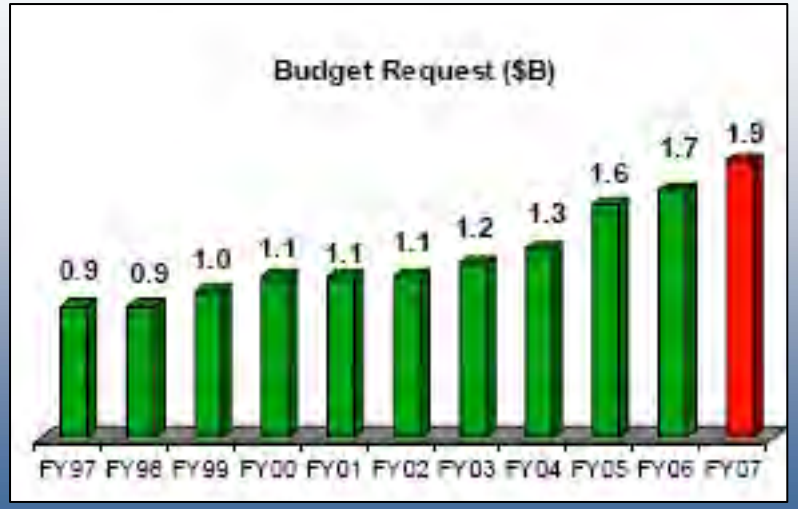
May 2006

Rene C. Kiebler

Ammunition

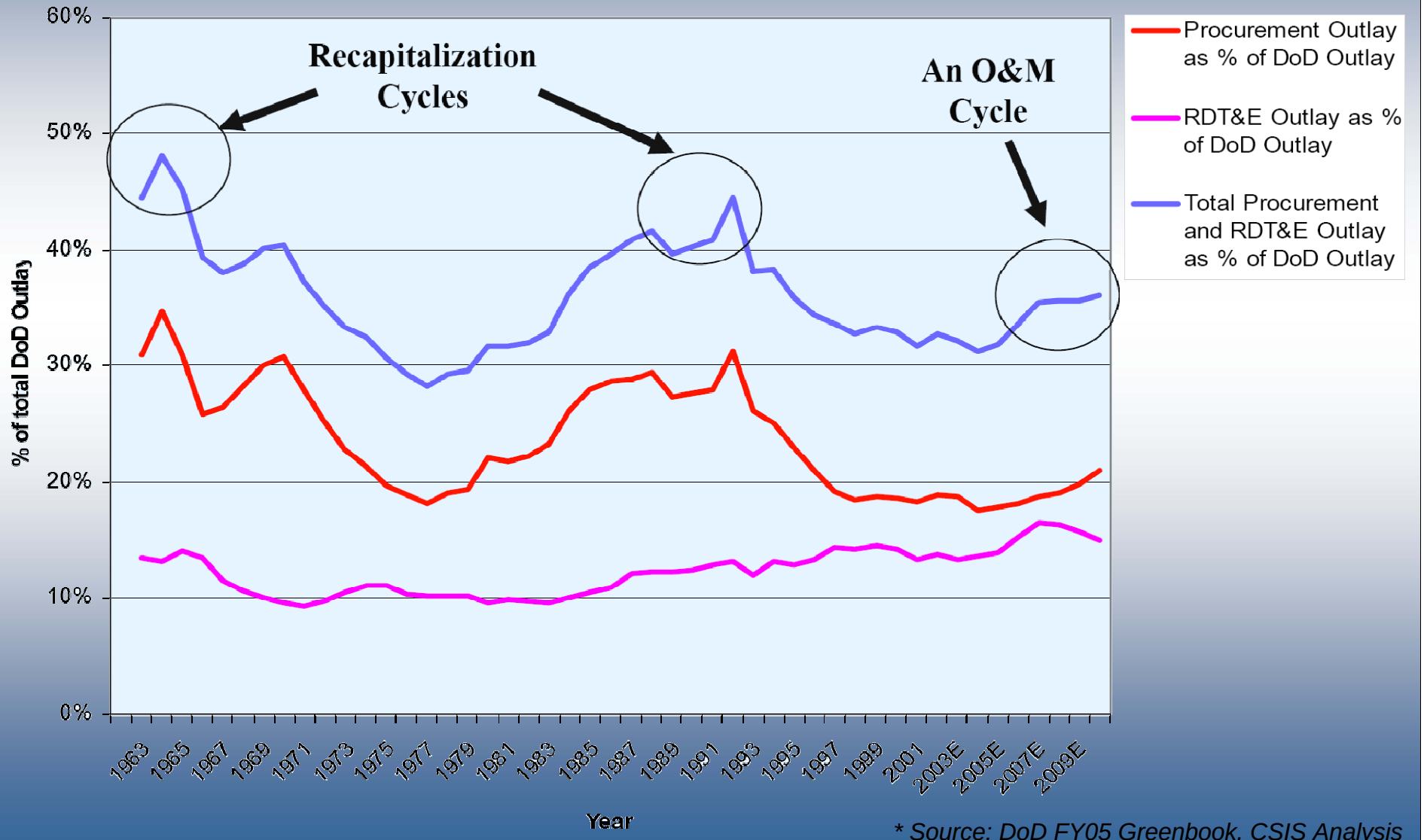
Program Highlights	FY07
❖ Funds Overall Training Ammunition to 77% (Small Arms at 100%)	$1,353M
❖ Procures Modest War Reserves	$304M
❖ Funds Production Base	$221M
❖ Transportation, Testing	$25M

105mm M900 Anti-Tank



** Source: Army Budget Office*

Cycle Continues



** Source: DoD FY05 Greenbook. CSIS Analysis*

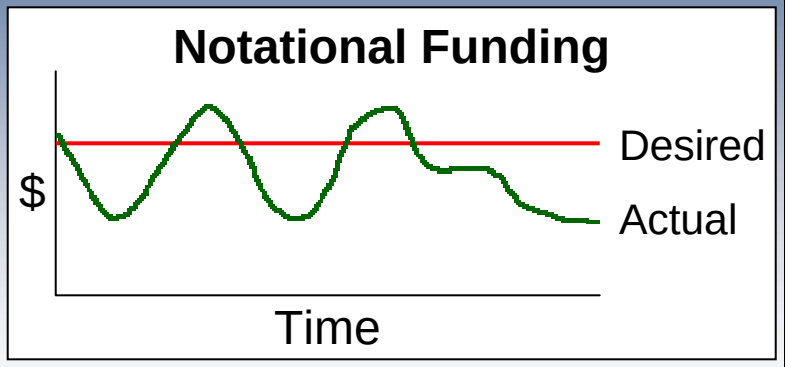
Approach to 08 POM

- Use FY07 Pres. Budget as a start point
- Consider G3 / G8 Guidance
  - ✓ War Reserve: Procure War Reserve Quantity
  - ✓ Training Unique: 150 day training pipeline only
  - ✓ Training Standard: Fill War Reserve Quantity or increase the Mob Training requirement if WR is below annual training
- Assess Industrial Base impacts based on guidance
  - ✓ Is funding sufficient and allocated correctly

Assessment of Pres Bud to DA Guidance

Family	Meet Guidance	Does Not meet Guidance
Artillery Fuzes	✔	
40MM All Types		✔
155MM All Types	✔	
M228 Fuze		✔
Counter Measure Flair		✔
Smoke Grenades		✔
MACS	✔	
Small Caliber Ammo	✔	

Considerations to Preserve Current Industrial Base and Readiness



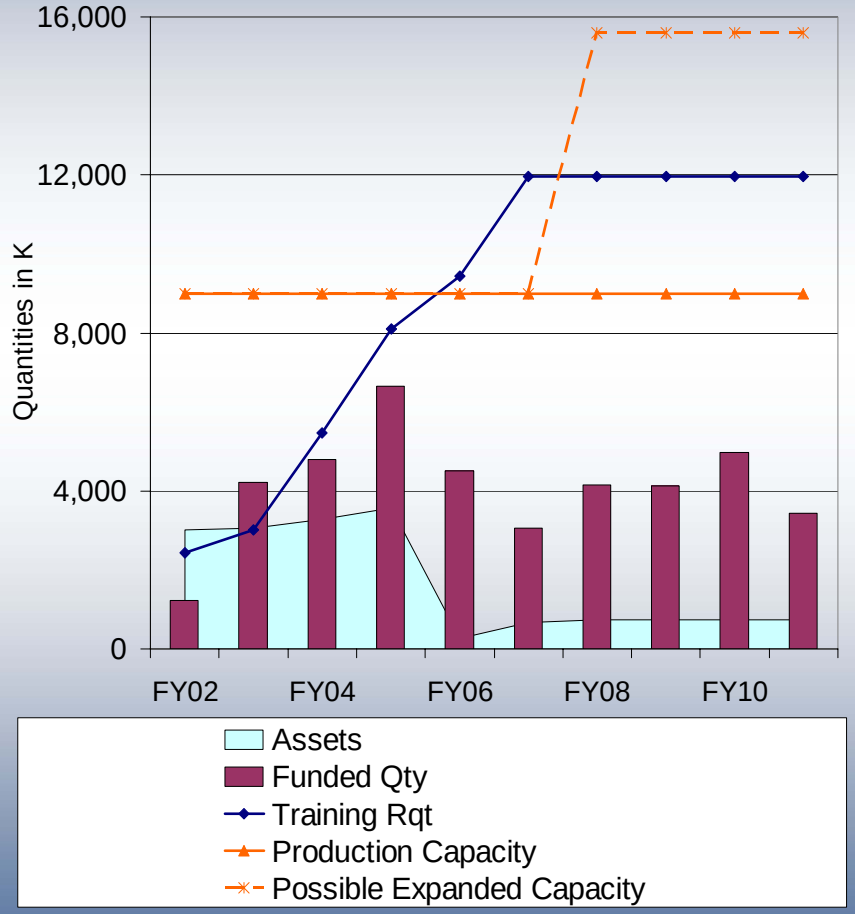
- **Small Caliber Ammo**
  - ✓ Minimum buy of 1 billion rounds per year
    - Required for economic dual source strategy and future surge capability
    - Hedge against current requirements “uncertainties”
- **Medium Cannon 25mm/30mm**
  - ✓ Minimum buy of 2 million rounds per year, 300K M789 HEDP for war reserve
    - Required for dual source strategy, reduce single point failures, mitigate increased cost
    - Maintain fuze production capability
- **Aircraft Countermeasure Flares**
  - ✓ Minimum buy of 635K per year (M211/M212 combined)
    - Support training and fill war reserve. Maintain wartime industrial base capacity (recently increased facility capacity)
    - Assumes AF continues to support the M206 base
- **Tank Training**
  - ✓ Minimum buy of 80K M865A3 and 40K M1002
    - Required for dual source strategy, reduce single point failures, mitigate increased cost
    - Keep Tank Ammunition Production Base alive (Industrial Base as well as Engineering/Design) for future War Reserve production in support of FCS
- **M228 Fuze, Training Hand Grenade**
  - ✓ Minimum buy of 6M per year
    - Minimally supports fuze production base

Bottom Line to Preserve Current Industrial Base

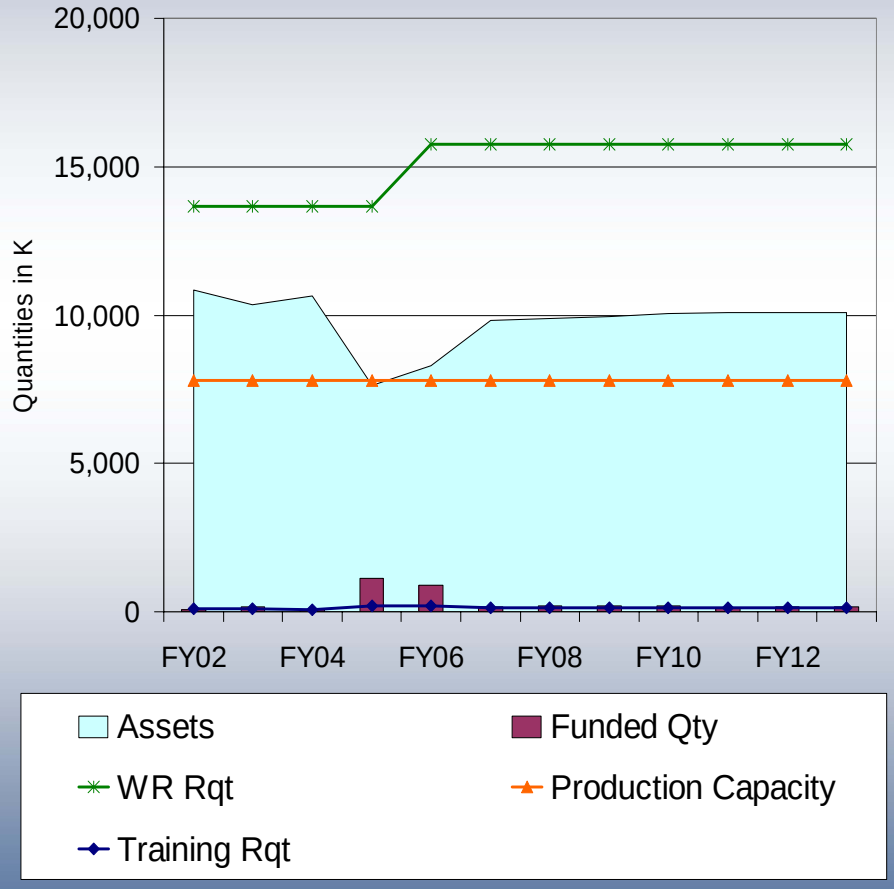
- **Maintain dual source strategy**
  - ✓ Mitigate cost increases
  - ✓ Reduce Single Point Failures
- **Maintain existing base to minimum sustaining levels**
- **Sustain expanded base capacity**
  - ✓ Small Cal
  - ✓ Flares

High Velocity Dilemma

Training Requirements



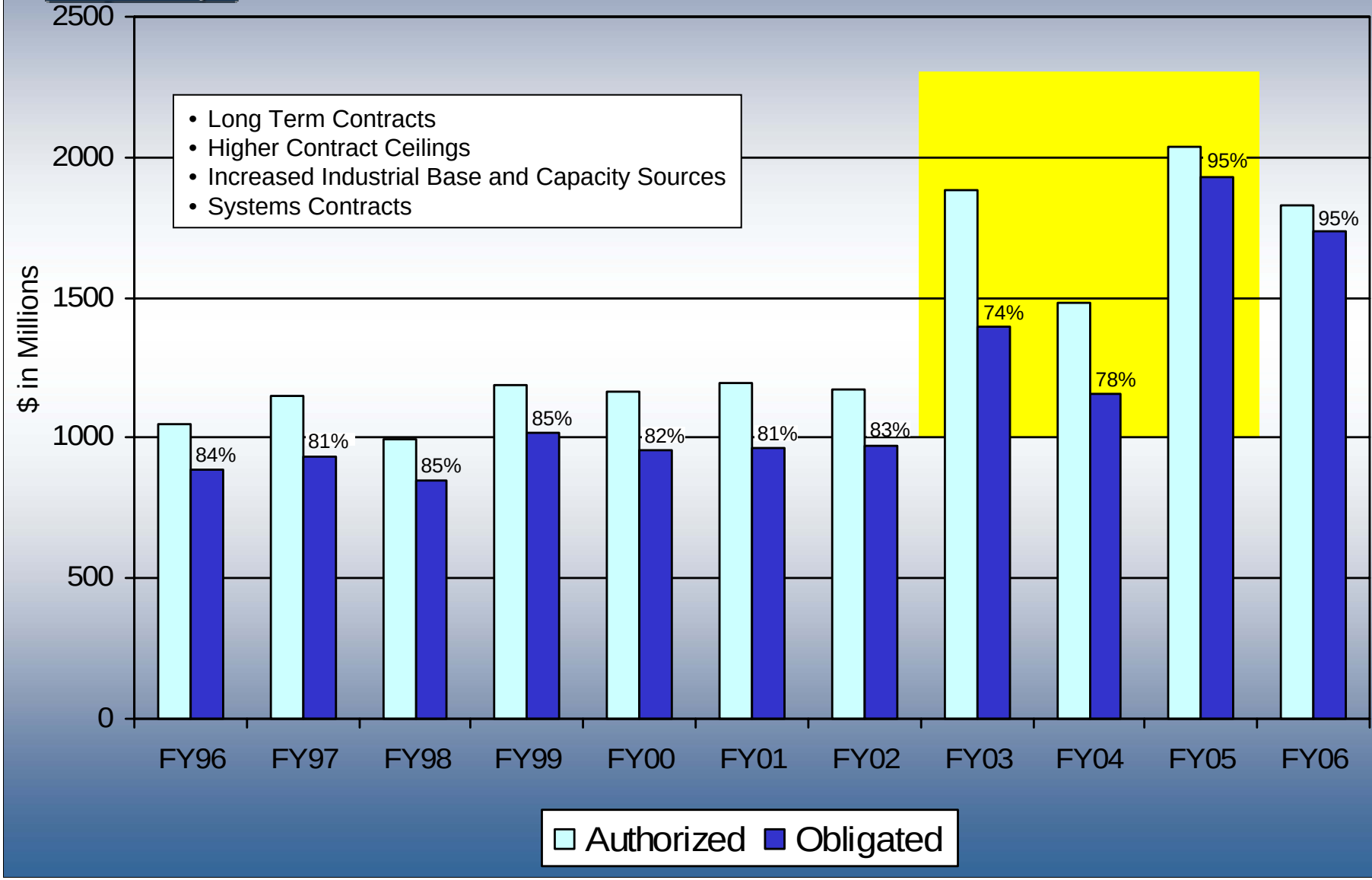
War Reserve Requirements



Training and Tactical: Underfunded

Ammo Executes its Funds First Year Obligation Rate

(Including Supplementals)



50th Annual NDIA Fuze Conference
ARDEC Fuzing Overview

Presented by:
Dr Joseph Lannon
ARDEC Director
10 May 2006

Vision:

Innovative Armaments Solutions for Today and Tomorrow

Mission:

Execute and manage totally integrated life-cycle engineering processes required for the research, development, production, field support and demilitarization of ammunition, weapons, fire control, and associated items.

ARDEC Video

Click to start video.

ARDEC Organization Chart

OFFICE OF THE DIRECTOR
DIRECTOR
AMSRD-AAR-D
Dr. J. Lannon
X-6000
Deputy Director
AMSRD-AAR-DD
COL J. Merkwan
X-7000

SPECIAL STAFF

IG: AMSRD-AAR-IG, J. Szatkiewicz, X6426
IRAC: AMSRD-AAR-IR, D. Murawski, X6360
Legal: AMSRD-AAR-GC, D. Scott (A), X3410
SB: AMSRD-AAR-SB, R. Burdett, X4106
OA: AMSRD-AAR-AO, P. Rowland, X7243
EEO: AMSRD-AAR-EEO, R. Brown, X6368

ASSOC TECH DIR FOR SYS CONCEPTS & TECHNOLOGY
B. Machak (A)
x7019

FINANCIAL MANAGEMENT OFFICE
AMSRD-AAR-FM
M. Manser
X-8625

ARMAMENTS ENGINEERING TECHNOLOGY CENTER (AETC)
AMSRD-AAR-AE
T. Sebasto/M. Ford (A)
X6196/6197

ENTERPRISE MANAGEMENT (EM)
AMSRD-AAR-EM
J. Hedderich III
X-7016

ARMAMENT SYSTEMS INTEGRATION CENTER (ASIC)
AMSRD-AAR-AI
COL S Crizer/P. Serao
X6006/6154

QUALITY ENGINEERING & SYSTEM ASSURANCE DIR
AMSRD-AAR-QE
P. Chiodo
X3918

WEAPON SYSTEMS & TECHNOLOGY DIR
AMSRD-AAR-AEW
R. Fiscella
DSN 374-5500

MUNITIONS SYSTEMS & TECHNOLOGY DIR
AMSRD-AAR-AEM
S. Musalli
X6446

STRATEGIC MGT OFFICE
AMSRD-AAR-EMS
D. Denery
X6081

PORTFOLIO MGT OFFICE
AMSRD-AAR-EMP
R. Benjamin
X7854

PROJ INTEGRATION OFFICE
AMSRD-AAR-AIP
G. Berg
X6906

LOGISTICS RESEARCH & ENGINEERING DIR
AMSRD-AAR-AIL
R. Rossi
X2168

BUSINESS INTERFACE OFFICE
AMSRD-AAR-EMB
J. Brescia
X5010

KNOWLEDGE MANAGEMENT OFFICE
AMSRD-AAR-EMK
G. Albinson
X7376

JOINT SERVICE SMALL ARMS PROGRAM OFFICE
AMSRD-AAR-AIJ
J. Goldman
X6060

SYSTEMS ENGINEERING, ANALYSIS & CONFIGURATION MGT DIR
AMSRD-AAR-AIS
J. Dyer
x4707
AMSRD-AAR-AIS-R
A. Heyderman (RIA)
DSN 793-6339

FIRE CONTROL SYSTEMS & TECHNOLOGY DIR
AMSRD-AAR-AEF
A. D'Agosto
X3439

EXPLOSIVE ORDNANCE DISPOSAL TECHNOLOGY DIR
AMSRD-AAR-AEX
J. Wu
X7643

OPS CENTER
AMSRD-AAR-EMO
Marie Felix
X8552

WARFIGHTER CENTRAL
AMSRD-AAR-EMW
Kurt McNeely
X3904

ENERGETIC WARHEADS & ENVIRONMENTAL TECHNOLOGY DIR
AMSRD-AAR-AEE
C. Anderson
X4287

FUZE & PRECISION ARMAMENTS TECHNOLOGY DIR
AMSRD-AAR-AEP
Phil Gorman (A)
X7307

ARMY FUZE MANAGEMENT OFFICE
AMSRD-AAR-AIF
L. Springer
X6842

U.S. ARMY FUZE MANAGEMENT OFFICE
Summary of Responsibilities

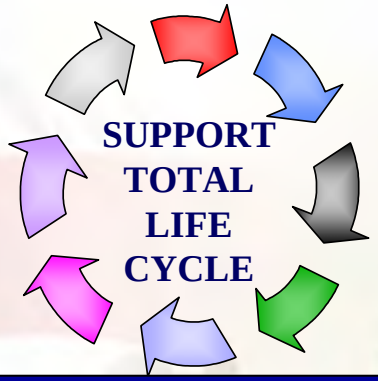
- **Centralized Life Cycle Oversight Management of All Non-Nuclear Army Fuzes**
  - Focal Point for PEO Ammo on Fuzing Issues
- **Ensure proper execution of fuze RDA programs**
  - **Appropriate designs**
  - **User needs**
  - **Applicable standards**
- **Intensive management of designated programs**
- **Guidance and Input To PEO/PM Community on Fuzing Issues**
- **Coordinate Fuze Tech Base Programs**
- **Propose, Recommend and Support Actions Directed Towards Ensuring the Fuze Industrial Base Is Properly Maintained**
- **Army's focal point for multi-service and international fuzing interaction**
  - **NATO AC310 SGII**
  - **DoD FESWG**
  - **JOCG Fuze Subgroup**
  - **DoD Fuze IPT**
  - **Munition Control case disposition**
- **Chair and Manage The Army Fuze Safety Review Board**

ARDEC Fuze Division

- Total Life Cycle Fuzing Responsibility
- Fuze Products
  - Proximity, Time, Point Detonating & Delay Fuzes
    - Artillery, Mortars, Tank, Med / Sm Cal,
    - Missiles & Rockets, Networked Munitions,
    - Mines & Demo, Non-Lethal
  - Safe and Arming (S&A) Devices
    - Mechanical / Electro-Mechanical
    - Electronic S&A (ESA)
  - Fuze Setters
  - Advanced Sensors

Customers/Interfaces

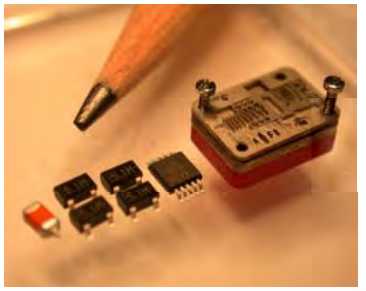
- User Communities
  - Ft. Benning
  - Ft. Sill
- PEO Ammunition
  - PM CAS
  - PM MAS
  - PM CCS
- PEO Soldier
- PEO GCS
- Army Fuze Management Office (AFMO)
- PEO Missile & Space
  - PM CCWS
  - PM JAMS
- AMRDEC
- National & International Fuze Related Committees
- AFSRB
- DoD Fuze Committees

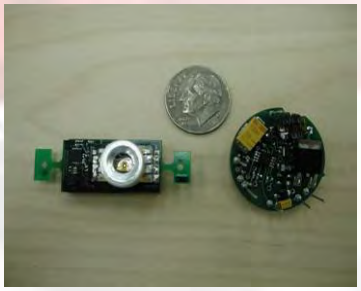


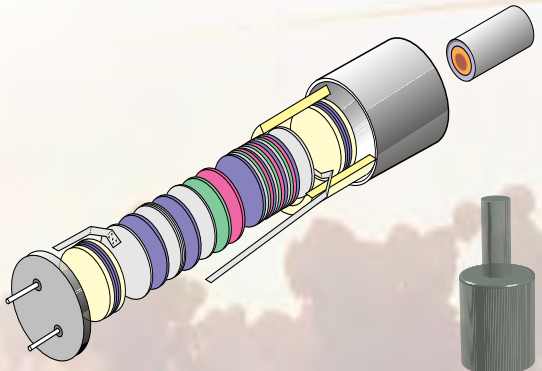
Fuze Competency Resides In The ARDEC Fuze Division

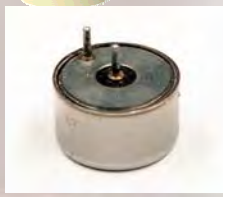
Army Technology Objective
Fuze and Power for Advanced Munitions

- User Payoff:
  - **Fuze Components**
    - Multipurpose & Multimode Capability
    - Customizable Lethality
    - Increased Safety
    - Affordability
  - **Power Sources** (Advanced On-Board Munitions Power Systems)
    - Increased Energy and Power Densities
    - Enables Longer Range Performance
    - Improved Producibility
    - Decreased Emphasis on Single Battery Solutions









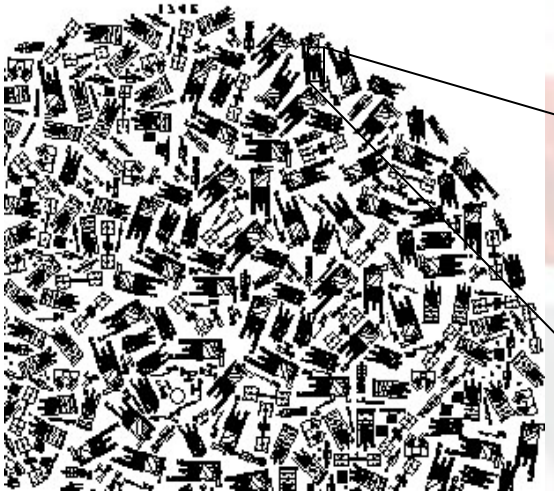
Army Technology Objective
Fuze and Power for Advanced Munitions

- **Fuze Technology Thrusts:**
  - **Multi-point Electronic Safe & Arming Devices (ESAD)**
  - **Micro Electro-Mechanical Systems (MEMS) Safe & Arming (S&A)**
    - **Large Caliber Applications**
  - **Advanced Sensors**
    - **Proximity Sensors For Direct Fire Applications**
    - **Environmental Sensors / Impact Sensors**
- **Power Source Technology Thrusts:**
  - **Thermal Battery Prototypes**
    - **Higher Energy Densities In A Smaller Volume**
  - **Novel Liquid Reserve Battery Prototypes**
    - **More Producible and Cost Effective**
  - **Hybrid Power System Prototypes**
    - **RF Energy Harvester**
    - **Piezo Electric Harvester**
    - **Thermophotovoltaic**
    - **Super Conductors**

Army Manufacturing Technology Objective - MEMS Safe and Arming

- Technology Thrusts:
  - MEMS-Based S&A Device Producibility
  - Scaleable Micro-Scale Explosive Loading Technologies
  - Common Device Form Factor for Medium and Large Caliber Applications

- Payoff:
  - High Volume Manufacturing Capability
  - Technology Affordability



XM307
ACSW

XM25
AWS

ARDEC Fuze Division Developmental Programs

- **XM784/785 ET Mortar Fuze**

- **XM395 PGMM Fuzing**

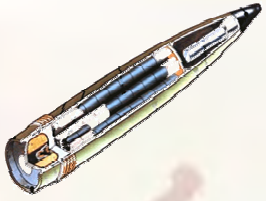
- **Precision Guidance Kit (PGK)**

- **EPIAFS**
- **XM 982 EXCALIBUR (integral Fuze)**

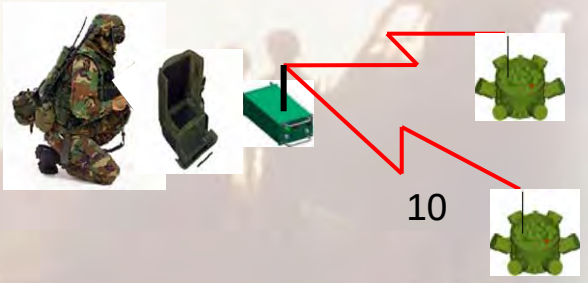
- **Medium Caliber Bursting Munitions**
  - XM25 – Shoulder Fired Weapon

  - XM307 Advanced Crew Served Weapon (ACSW)

- **40 mm Proximity Fuzing**
  - Lethal & Non- Lethal
- **Line Of Sight – Multi-Purpose (LOS – MP) – ARDEC ATO**
- **Self Destruct Fuze for M864 RECAP**
  - M223E1 (BTFP) & XM242 (ATK / IMI)



- **Network Munitions**
  - Spider
  - Intelligent Munition System (IMS)



ARDEC Fuze Division Production Programs

Artillery Fuzes
- M782 Multi-Option Fuze for Artillery (MOFA)
- M762A1/767A1 Artillery Electronic Time (ET) Fuze
- M234 Self-destruct Fuze
- M1155 PIAFS

Mortar Fuzes
- M734A1 Multi-Option Fuze for Mortars
- M783 Point Detonating Fuze for Mortars
- M772/M776 Mechanical Time Fuzes
- Mortar Practice Fuzes
- M935 Point Detonating/Delay

Grenade Fuzing
- M213 for M67 Grenade
- M228 Practice for M69
- M201A1 for M18 Smoke
- M201A1 MOD 2 for Stun Grenade

Countermines/Demolitions/AT Munitions
- APOBS Fuzing
- M1134A3 for MICLIC
- M147 TDFD
- M87A1 Volcano

Rocket/Missile Fuzing
- M423, M439, M442 – 2.75 in. rocket
- MK 420-BD

Medium Caliber Fuzes
- M549/M549A1
- M759 (30mm)
- M550 Escapement (S&A)


M1155


MOFA


M734A1


M228


M789 w/M759 Fuze

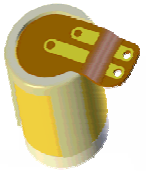

M762A1/767A1


APOBS Fuzing

Tank Fuzes
- M774 Point Initiating Base Detonating (M830A1)
- M74 Proximity Switch (M830A1)
- M578E1 Base Detonating (M393 Cartridge)

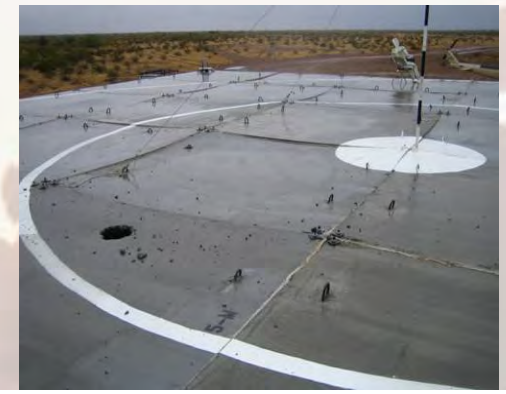
Fuze Technology Integration

- Technology Insertion To Current Munition Items
- Addresses Industrial Base Single Point Failure Issues
  - Risk Mitigation:
    - Battery Aging / Battery Airgun Test Facility
    - Signal Processor / MMIC Transceiver 2nd Source
    - M74 Proximity Switch
  - Block Upgrades:
    - Improved Bunker Defeat Munition Sensor
    - Update M734A1 Signal Processor
    - 2nd Env Safety Sensor Using Optics
- PEO Ammunition / User Payoff:
  - Insert Current Technology Into Today's Munitions
  - Preclude Obsolescence By Incorporating Component Technology
  - Provide Safer, More Reliable and More Lethal Munitions


Fuze Division Success Stories

- XM784 / XM785 Mortar Electronic Time (ET) Fuze
  - Successful Ballistic Testing: Feb 06
- M782 Multi-Option Fuze for Artillery (MOFA)
  - Materiel Release: Nov 05
- Self Destruct Fuze for M864 Recapitalization (RECAP)
  - M223E1 (BTFP) Successful Engineering Test
  - XM242 (ATK / IMI) Successful Engineering Test
- Line-Of-Sight Multi-Purpose (LOS-MP)
  - Latest Tests Look Promising In PD & Air-Burst Mode
- M762A1 / M767A1 Electronic Time (ET) Artillery Fuze
  - 53 Consecutive Successful Lots (Since Production Started 2001)
    - » 99.7% Overall Reliability
- Excalibur S&A and HOB Sensor
- Enhanced Portable Inductive Artillery Fuze Setter (EPIAFS)
  - In Support of Excalibur (Integration Into PEFCS)
- M734A1 Multi-Option Fuze for Mortars
  - 99.46 % Overall Reliability (70 Consecutive Successful Lots)
- Advances In MEMS S&A Devices
- 40 mm Lethal and Non-Lethal Proximity Demonstrations



Excalibur

Fuze Development Center

- Provides Rapid Response to User and Customers
  - Fabricate and Test Under One Roof
  - Acquisition of Material / Parts Blanket Purchase Agreements
  - Continuous Investment in Facilities Maintains Relevance to New Technologies
- Facilitates Government/Contractor joint efforts.
  - Structured Data, Document, and Process Development Allows for Rapid Handoff To Production Vendor
- Programs Already Benefiting From The Facility:
  - 40mm Lethal and Non-Lethal Proximity Fuze
  - Excalibur Sub-Assembly Testing
  - Marine Corp PIAFS Training Kit
- Future Programs:
  - Mortar Mission Setter.
  - Enhanced Active Protection System (EAPS)
  - FTI Efforts

ARDEC In-House Fuzing Capabilities

- Engineering Modeling and Simulation
- Electromagnetic Environmental Effects (E^3)
- Armament Technology Facility
- Centrifuge Capabilities
- Air Gun / Rail Gun
- Environmental Conditioning
- ARDEC Soft Recovery System (SRS) Facility
  - 155 mm Soft Catch (Scat) Gun
    - » 39 – 62 Cal Capability
- Fuze Development Center

Armament Technology Facility

Soft Recovery System Facility

Defense Ordnance Technology Consortium (DOTC)

Mission: Provide rapid transition of new lethality and protection technology

DoD Ordnance Laboratory Center

- DoD, DoE, Other Agencies and Departments

National Warheads and Energetics Consortium

- Contractors, Academia, Not-for-profit/Non-profit Organizations
- 67 Consortium Member Agreements (CMA) with industry and academia
- Members partner in submitting project proposals
- Members May Offer cost sharing in their project proposals

...Partnering to leverage investment and capability

- Utilizing Other Transaction Agreements (OTA) – Section 485
- Leading to: Task Order Sub-Agreements (TOSA), CRADAs, DEAs

FY06 Funded Projects (Fuze Area)

- Micro Fabrication R&D
- Foundry Services
- Proximity Fuze R&D
- Fuze Integration
- Fuze Prototyping
- Sensor Development
- Battery/Energy Development

ARDEC Overview Summary

- **Fuze Division Mission Spans Total Fuze Life Cycle**
- **Full Breadth of Munition Product Lines:**
  - **Artillery, Mortars, Tank, Medium / Small Cal,**
  - **Missiles & Rockets, Networked Munitions,**
  - **Mines & Demo, Non-Lethal**
- **Recent Technology Investments:**
  - **Advances Battlefield Capabilities**
  - **Puts ARDEC In Best Position To Support Warfighter**

Fuzing Is At The Forefront Of Safety & Lethality

NDIA 50th Annual Fuze Conference UNITED STATES NAVY OVERVIEW

Stephen Mitchell

Co-Chair, Naval Energetics Enterprise

NAVSEA WARFARE CENTERS

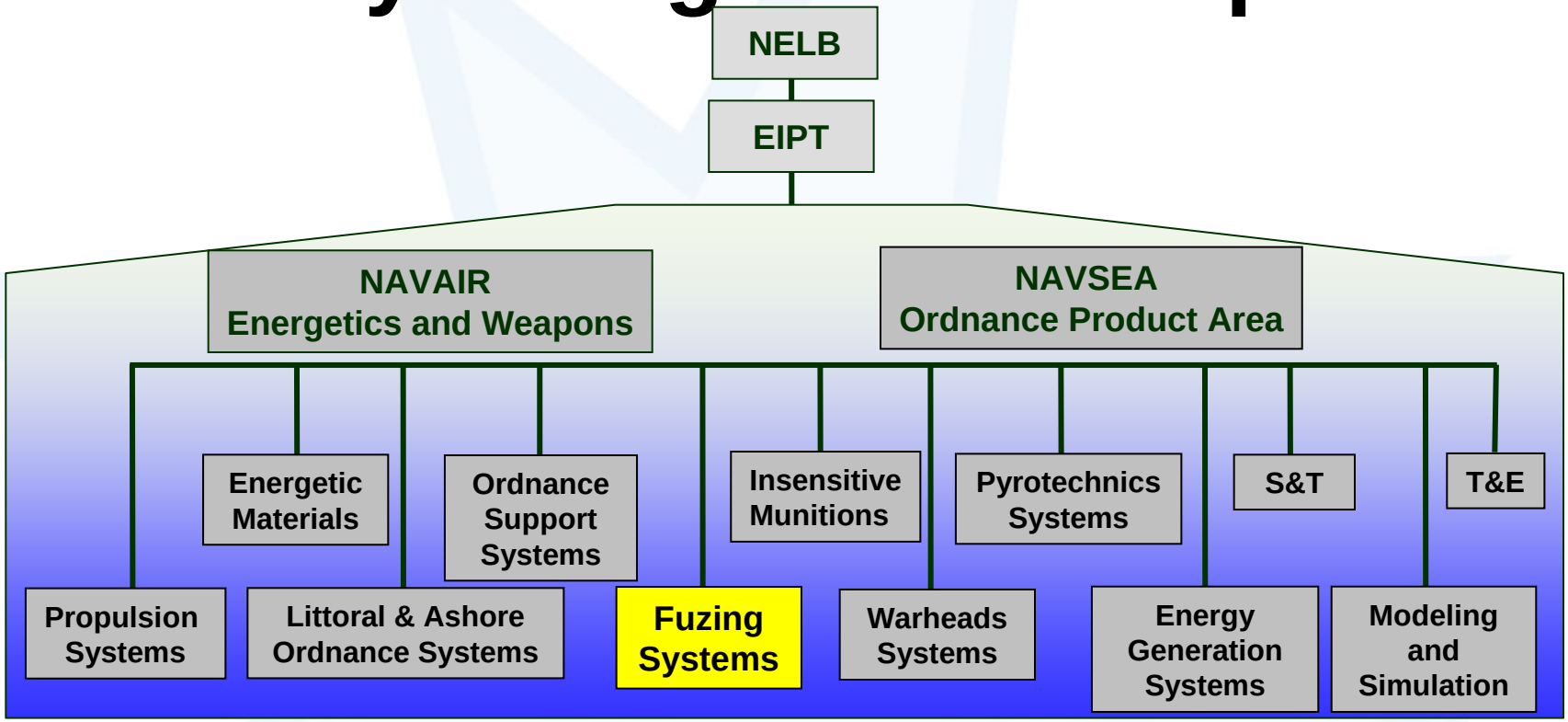
NAVY Energetics Collaborating for the Warfighter

NAVAIR

OUTLINE

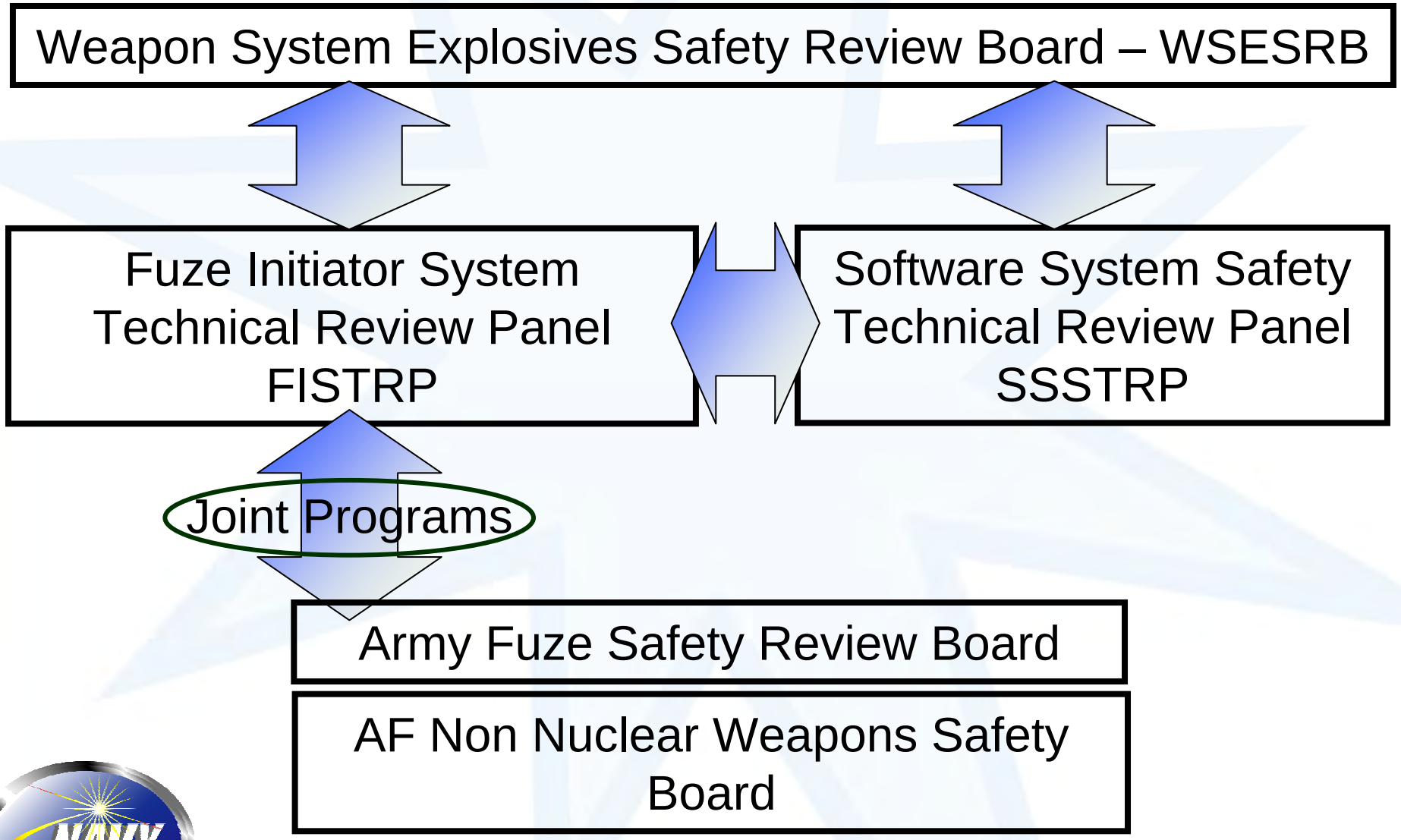
- Navy Energetics Enterprise – NEE
- Navy Safety Board Structure
- Air, Surface, Undersea Navy Programs
- Emerging Technology
- Summary

Navy Energetics Enterprise



- Collaboration to provide best technical solutions for Warfighter needs
- Achieve long-term cost avoidance resulting from shared people and facilities

Navy Fuze Safety Review Process



Fuze Initiator System Technical Review Panel

FISTRP

Panel Chair – Jack Waller

Panel Members –

Ralph Balestieri	Tinya Coles-Cieply
Randy Cope	Brad Hanna
John Hendershot	George Hennings
Dave Libbon	Scott Pomeroy
Dave Riggs	Gabe Soto
Brian Will	John Kandell
Ray Ash	Gene Marquis

Current Topics of Interest/Challenge

- Evolving Requirements Definition (within FESWG)
- Move to STANAGS
- 1901A/23659B – In-Line Ignition Safety Device (ISD)
- Programmable Logic Devices (PLD) Implementation
- Built In Test (BIT)

FMU-139 Family
Electronic Bomb Fuze

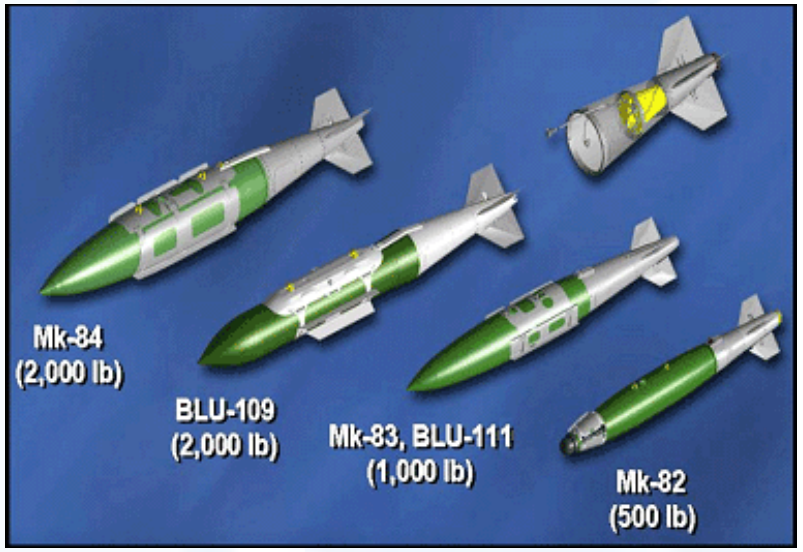
- **FMU-139C/B Currently Being Procured From KDI and ATK**
  - **Replenish Current Aging Inventory**
  - **Extended Operational Life With FFCS**

FMU-139 PIP Efforts

- Currently Being Conducted at KDI and ATK
  - Enhanced Capabilities Demonstration
    - Serial Data Interface
    - Increased Penetration
    - In-Line Explosive Train
    - Increased Reliability

FMU-139D/B

- Next Version of FMU-139
  - ✓ Enhanced Capability
  - ✓ Enhanced Reliability



Planned Full & Open Competition
RFP Release Late FY-06

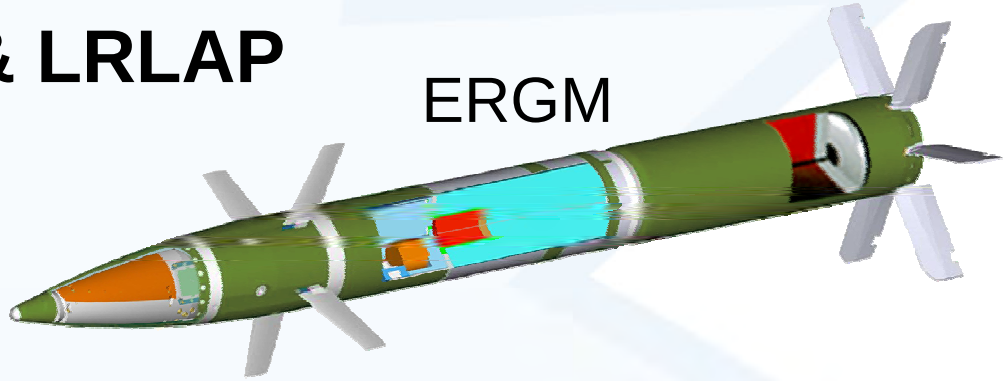
HI-REL FUZE

- Next Generation Fuze For Precision Guided Munitions
  - Dual Mode LGB, JDAM
- Higher Reliability
  - Eliminate external devices such as Fuze Function Control Set (FFCS), Mk-122 Arming System Switch, M 70 Series Cable, and associated electrical and mechanical connections (i.e. lanyard)
  - Incorporate Pre-Release Checks
- Safety Architecture Integral With MIL-STD-1760 Interface and Weapon Guidance Control Unit
- NAWCWD Conducting Tests to Evaluate Compliance of Approach with MIL-STD-1316

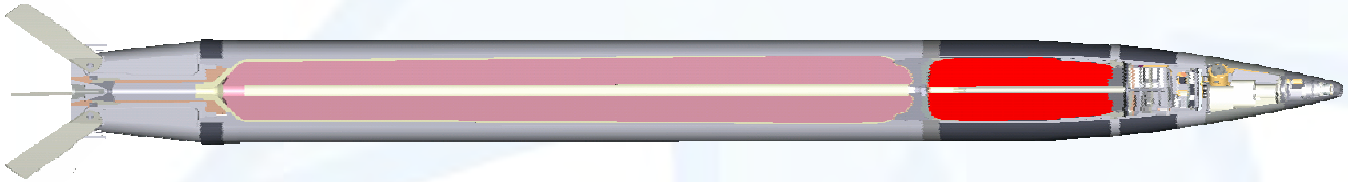
Gunnery Programs

- **Long Range Guided Projectiles in Development:**
  - **ERGM, BTERM, & LRLAP**
    - **41nmi+**

ERGM



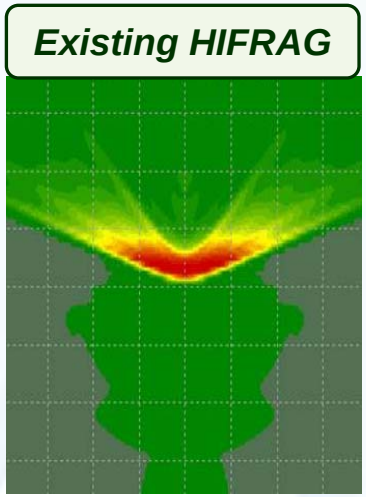
LRLAP



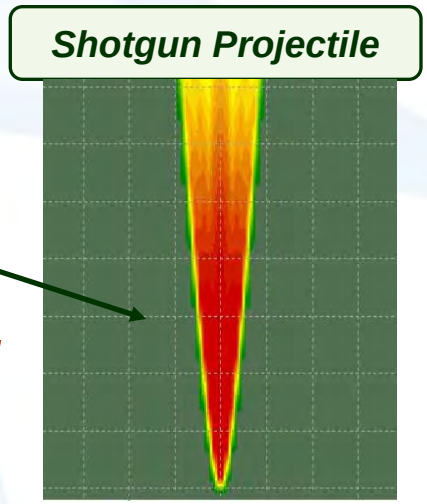
BTERM

Gunnery Programs

- **Short Range Self-Defense Projectiles:**
  - **5” Guns Have 3 New Projectiles: KE-ET, HE-ET, HE-MFF**
  - **Minor/Medium Caliber Guns**
    - **25mm**
    - **30mm**
    - **57mm**
    - **76mm**

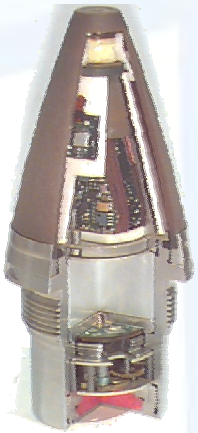


Twice the Lethal Area

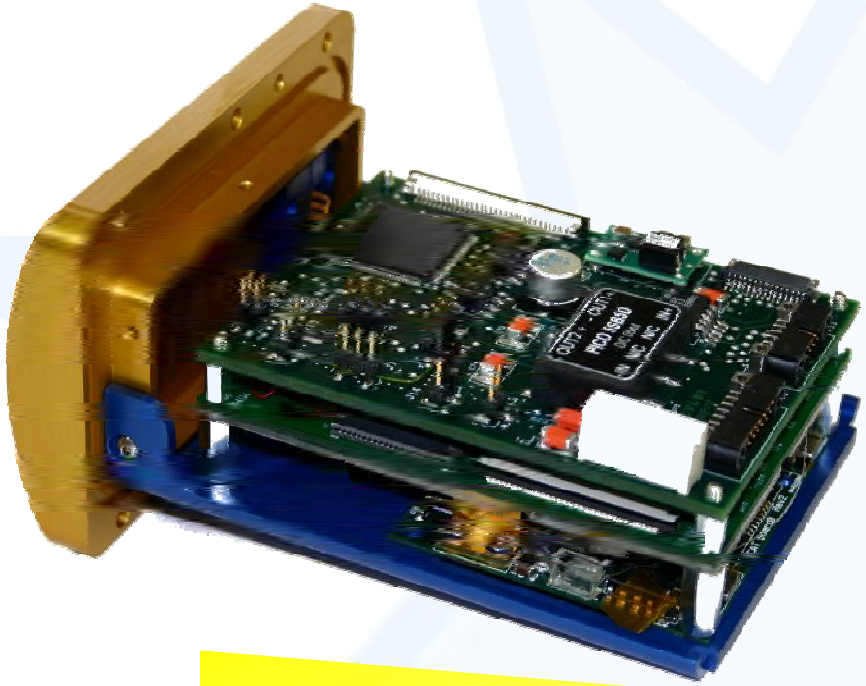


Gunnery Fuze Production Programs

- Low Cost Fuzing
  - MOFN Instead of MFF for Most Threat Scenarios
  - Producible Fuzing:
    - Need Battery for Next Production of MFF
      - Testing Diehl/Eagle Picher Batteries



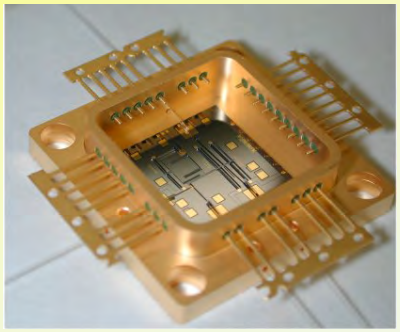
Future Undersea Weapon S&A



- Multi-Mission Capable
  - Single S&A configuration for multiple missions & platforms
  - Multi-point warhead initiation
- Safety Features
  - IMU based Safe Separation System
  - Safe-arm indication, safing switch

MEMS S&A package

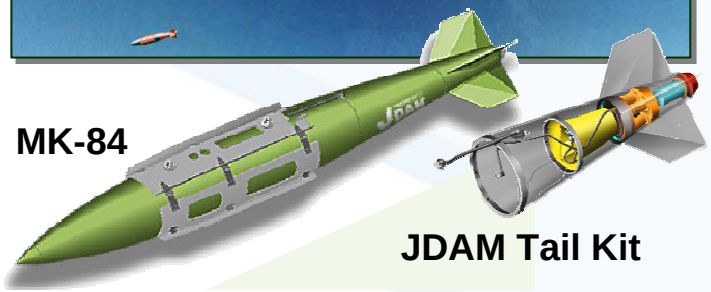
- Miniaturization of safety and arming and initiation components
- Enables common S&A for multiple platform deployment
- Ruggedness demonstrated in harsh environments



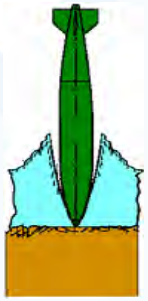
Packaged MEMS S&A Chip

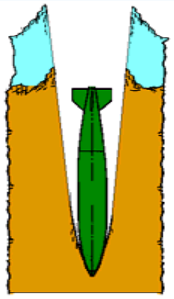
JDAM Assault Breach System JABS

MK-84



JDAM Tail Kit





- **Fuze (FMU139) with pre-selected delay times to increase bomb effectiveness against mines / obstacles in the surf zone**
  - **Bomb detonates at optimum position in range of water depths**
  - **Increase lethality against mines and obstacles**
- **FY07 Evaluate JABS lethality in the Very Shallow Water (VSW)**

FY06 JABS S&T

- **Flight tests with instrumented Fuzes**
- **Record water impact signature**
- **Monitor response of (FMU139) impact switches**

Shock Hardened Recorder Redundancy

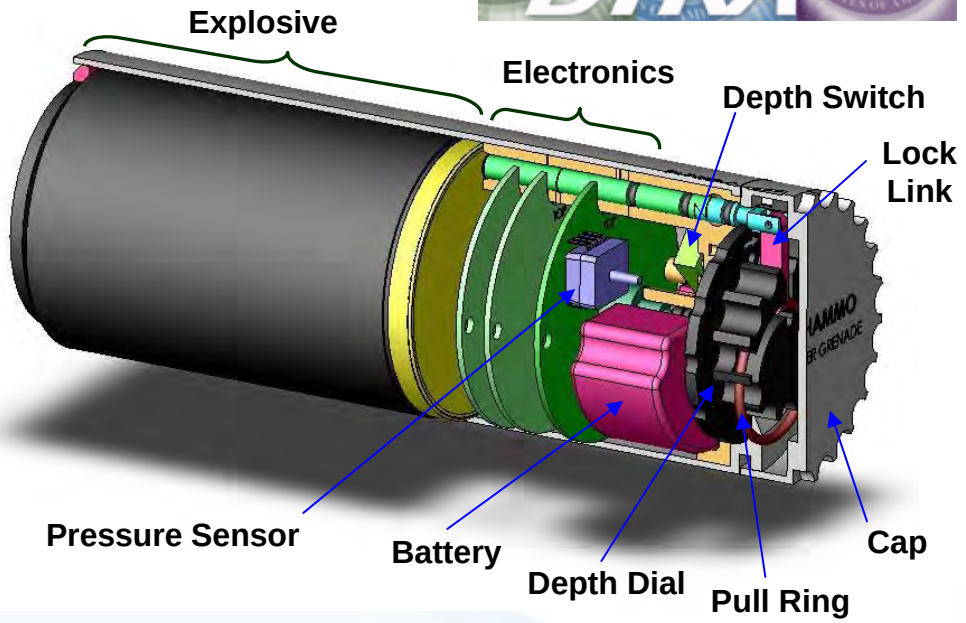
- **Two Recorders per Bomb**
- **Two Accelerometers per Recorder**
- **Non-Volatile Memory**

Data Recorder

ANTI-SWIMMER GRENADE (ASG)

Force Protection

- Designed to protect assets from attack by SCUBA swimmers



Safety

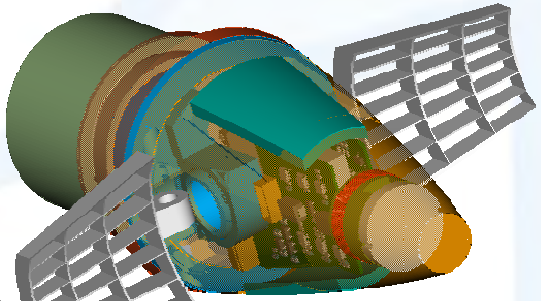
- ASG will detonate only underwater beneath a predefined safety depth
- Will harmlessly render itself safe if it is activated but fails to see the correct arming environments

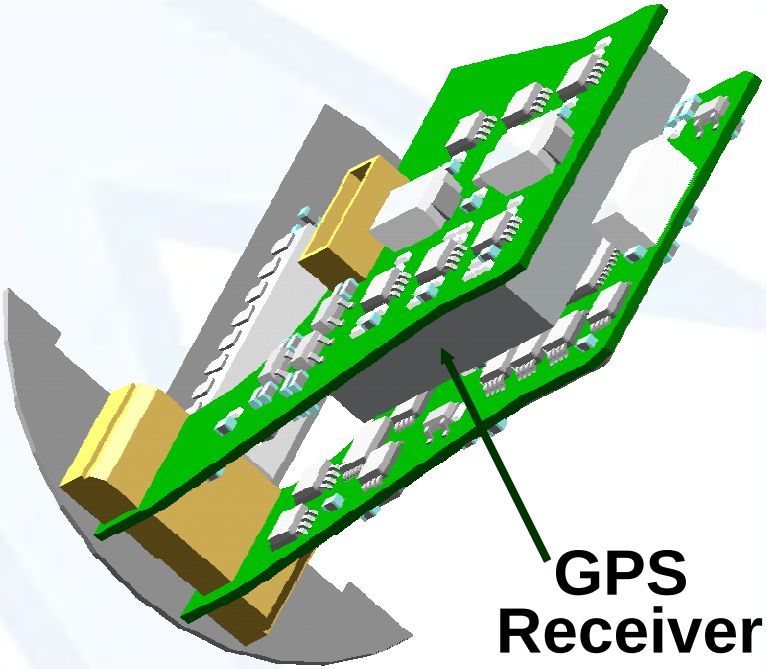
Features

- Electronic In-Line Safe-Arm Device
- Hand-Emplaced Ordnance design meets MIL-STD-1911
- User-selectable function depth (10-ft to 100-ft in 10-ft increments)

Gunnery Technology Fuzing Thrusts

- Low Cost Guidance:
  - GIF & PGK
    - Developing Next Generation GPS Receiver
      - Small Size (<1.5 in2)
      - Low Cost (<$500)
      - Low Power (<1 Watt)





ONR Future Naval Capability (FNC) Program

IMU Based Safe Separation System

- Miniature (MEMS based) Inertial Measurement Unit (IMU) embedded in S&A to measure safe separation distance

- Flexible IMU-based safety algorithm that incorporates:
  - Weapon post-launch position determination independent of guidance system
  - Two independent parallel algorithms for fault tolerance

- COTS IMU sensor integrated into S&A

- FY06: in-water tests of IMU sensors

ONR Discovery & Invention (D&I) S&T Program

MEMS S&A Technology

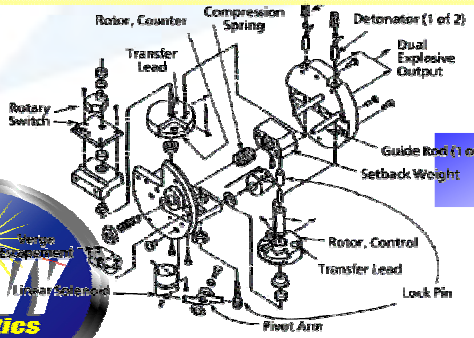
- Capitalizes on commercially available IC large scale batch fabrication techniques
- Enables weapon system integrated fuzing for multi-mission and scaled effect capability
- Reduces fuze cost and size

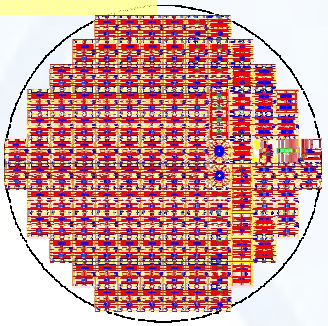
Status;

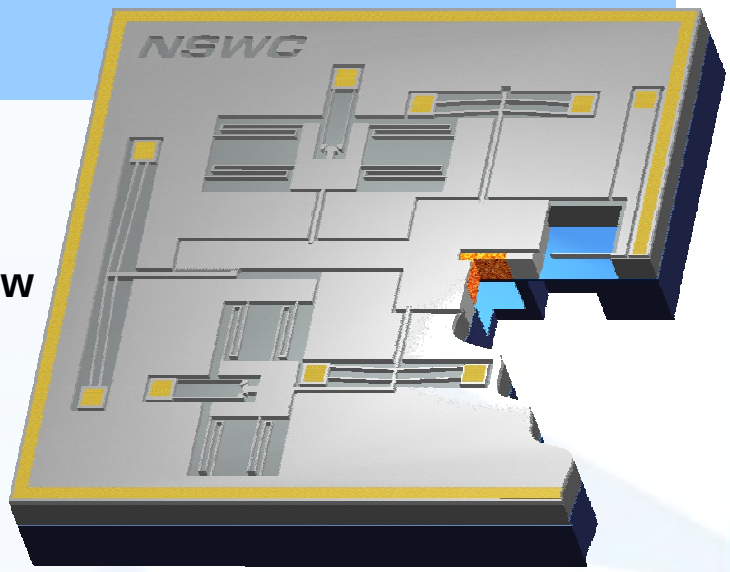
Completed characterization of 1st prototype S&A components and devices in laboratory … long throw actuators, G sense locks & impact sensors

Designed & fabricated hermetic cap chips

MEMS in-situ detonator based S&A device technology currently TRL 4







S&A Chip

From tens of mechanical parts per fuze to 100's of fuze chips per single wafer

ONR Discovery & Invention (D&I) Program

In-Situ Micro Detonator Technology

- Energetics formed in-situ after MEMS fabrication
- No energetic waste material
- No processing equipment exposed to energetics

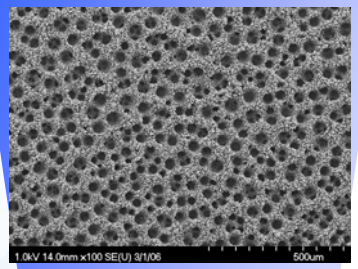
Status;

Developed in-situ (dry) conversion process

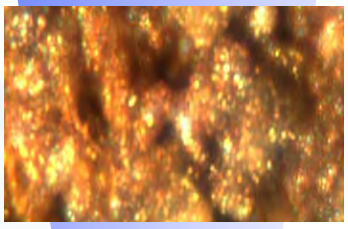
Demonstrated explosive transfer to qualified booster materials; RSI-007, PBX-N5 & Comp A-5

Currently conducting detonation characterization experiments

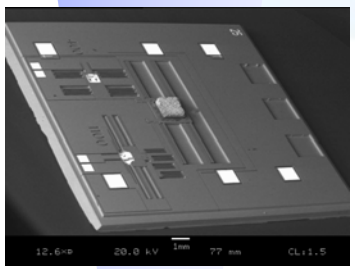
MEMS in-situ micro detonator technology currently TRL 4



Porous Metal



Azide Explosive



S&A Device with Micro Explosive

Summary

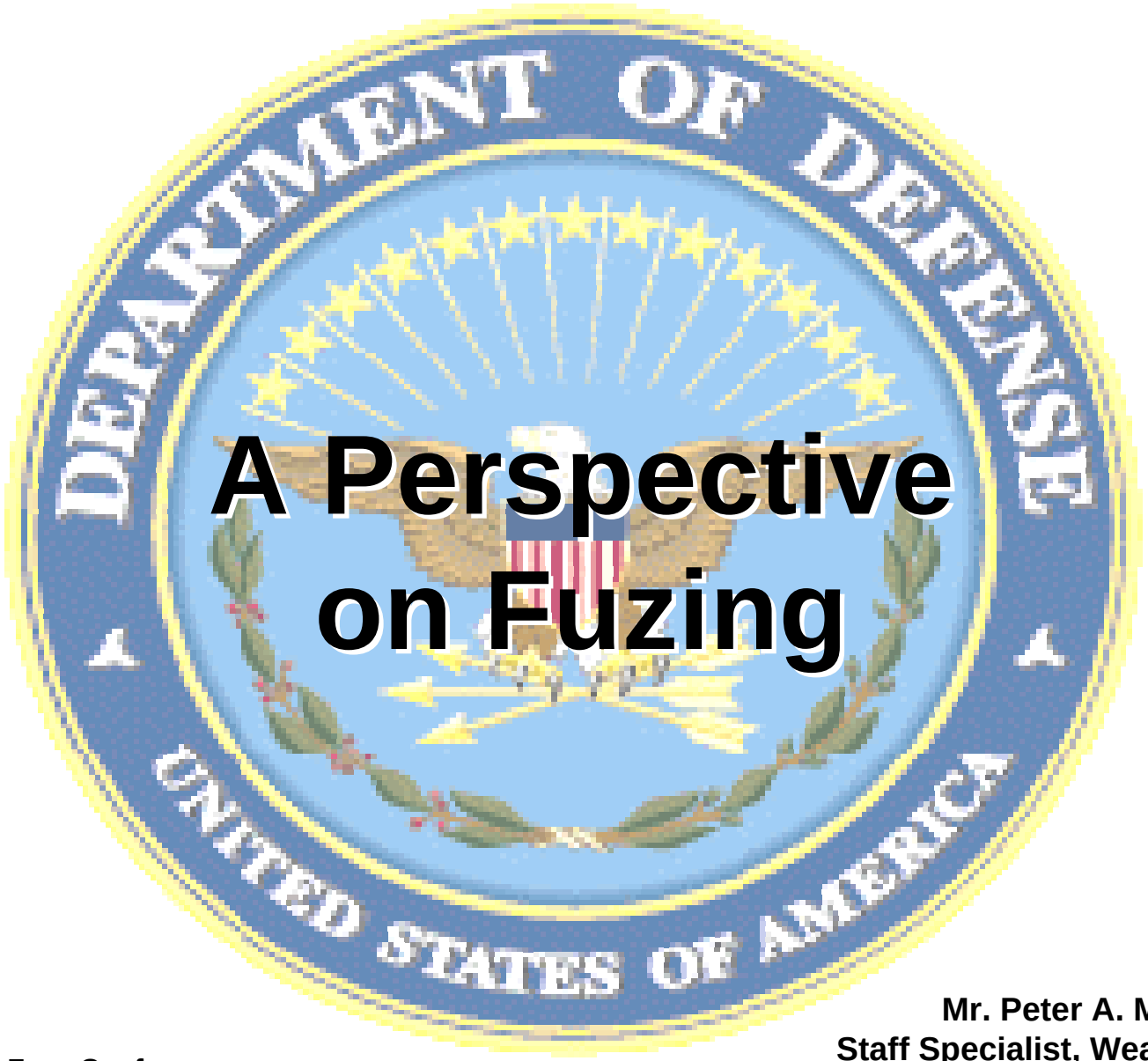
The Path Forward …

Joint Fuze Technology Program

- Navy PM/PEO community validated weapon requirements and needs that fed into the Joint Fuze Technology Program (DoD Fuze IPT)
  - Joint Fuze Technology Program will leverage on Navy S&T efforts and advancements

- Examples of Navy Future Capabilities Needed
  - Hard and Deeply Buried Target Fuzing
  - Increased reliability to reduce UXO
  - Multi-mission selectable fuzing
  - Advanced initiation for controlling lethal effects

Navy Energetic Enterprise



A Perspective on Fuzing

NDIA 50th Annual Fuze Conference
May 9, 2006
Norfolk Waterside Marriott,
Norfolk,VA May 9 - 11, 2006

Mr. Peter A. Morrison
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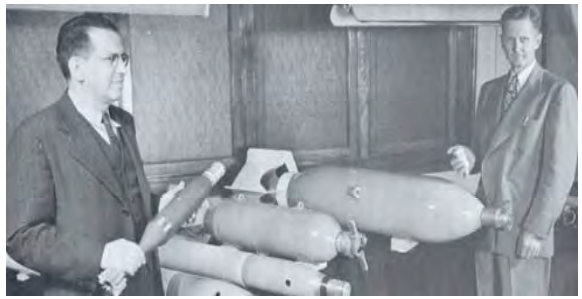
S&T Mission

To <u>ensure</u> that warfighters today and tomorrow have <u>superior</u> and <u>affordable</u> technology to support their missions and to give them revolutionary war-winning capabilities.

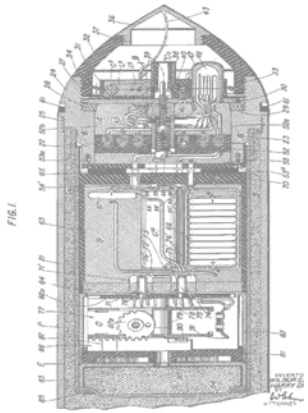
A *Historical Perspective on Adaptation to Needs*
Proximity Fuze Development and Production in WWII



<u>Problem:</u> Early in WWII, Proximity (VT) fuzes were prohibitively expensive, low performance and unreliable to counter air targets or ground targets with optimum effects at height above the ground.

<u>Development:</u>

- Development of proximity fuzes started in the summer of 1940
- The development effort involved an estimated number of at least 2,236 individuals
  - Efforts began at the National Defense Research Committee (NDRC) and Office of Scientific Research and Development (OSRD)
  - Two different developmental teams were made up of individuals from the Department of Terrestrial Magnetism, National Bureau of Standards, Johns Hopkins Applied Physics Laboratory, Military, academia
  - Initially, Civilian Scientists from the National Bureau of Standards (NBS) under the leadership of Harry Diamond were recruited and this work later transitioned to the US Army for various weapons systems

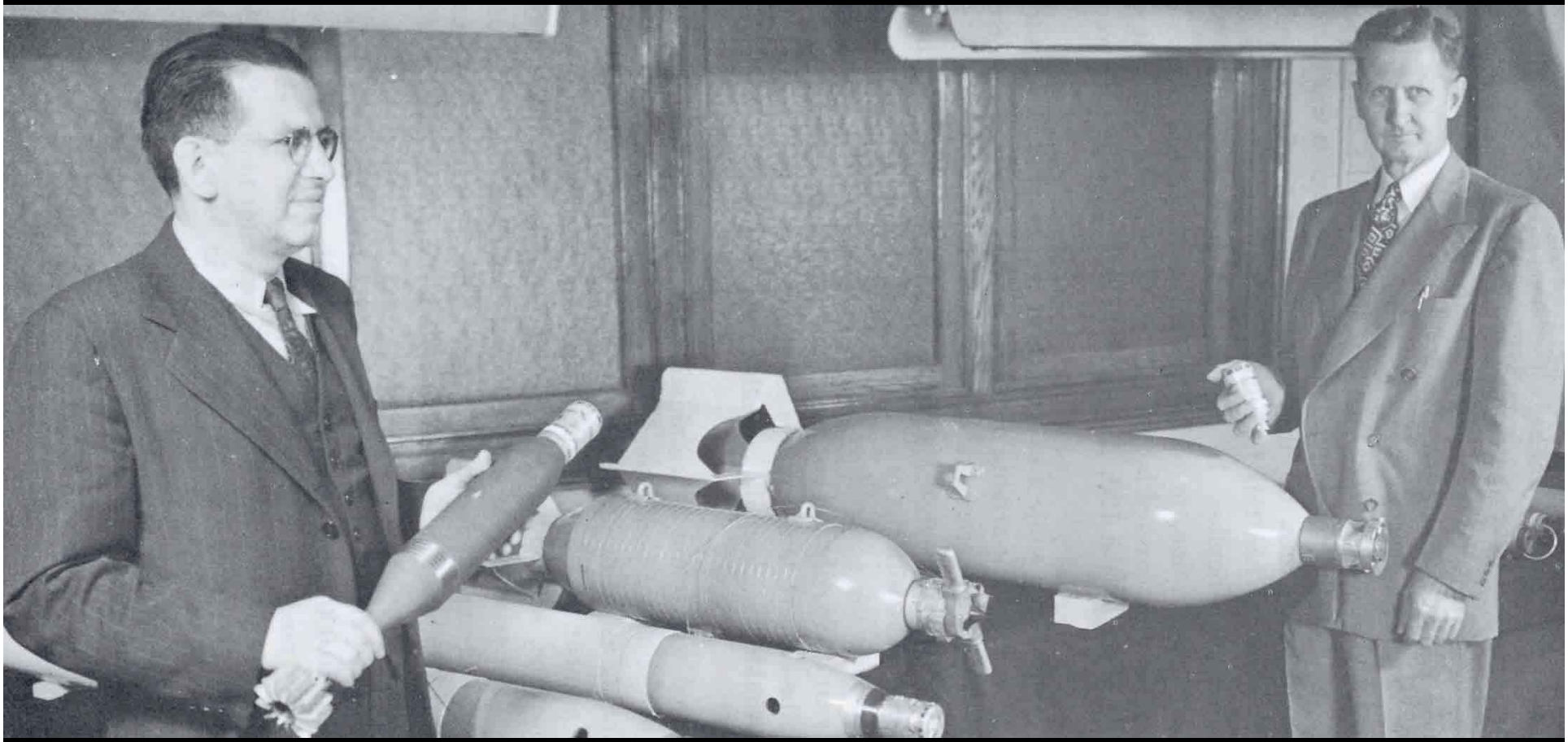


- Labor costs, from records, were estimated at approximately **$837,000,000** (2002 dollars)
- The War Department later described inventor Harry Diamond's proximity fuze as "one of the outstanding scientific developments of World War II ... second only to the atomic bomb" in military importance

<u>Production:</u>

- Actual costs per fuze was **reduced <u>from $732</u> in 1942 <u>to $18</u> in 1945**, permitting over **twenty-two million fuzes** to be purchased for about **$8.5 billion (in 2002 dollars.)** In March of 1945 alone, there were approximately 110 companies engaged in the production of VT fuzes for spinning rounds, bombs, rockets and mortars

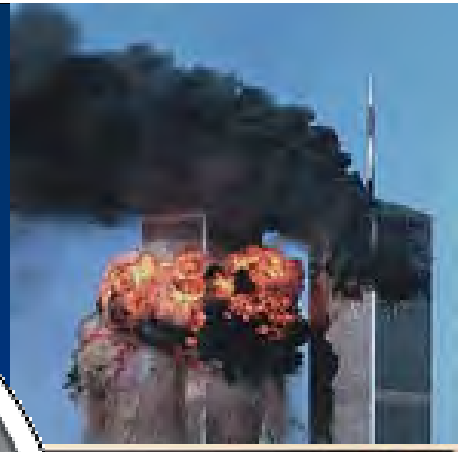
We know where we've been…



Where are we going?

9/11 Changed Everything

From working to provide overmatching capability against any nation-state on the sea, in the air and on the land … to a global war on terrorism against an enemy who fights in the shadows…



"The concept of a virtual organization is essential to understanding how 21st Century business will work. Al Qaeda represents a new and dangerous kind of virtual organization and the rise of the virtual state. We are entering into an era in which a small number of people, operating without state sponsorship, but using the enormous power of modern computers, biogenetic pathogens, air transport, suitcase bombs, and even small nuclear weapons will be able to penetrate the tremendous vulnerabilities of contemporary open societies." - *Time,* 9 Sept. 2002

Changing Security Environment
- Four Challenges -

Irregular

- Unconventional methods adopted by non-state and state actors to counter stronger state opponents.
- (e.g., terrorism, insurgency, civil war, and emerging concepts)

Catastrophic

- Acquisition, possession, and use of WMD or methods producing WMD-like effects against vulnerable, high-profile targets by terrorists and rogue states.
- (e.g., homeland missile attack, proliferation from a state to a non-state actor, devastating WMD attack on ally)

Traditional

- Military capabilities and military forces in long-established, well-known forms of military competition and conflict.
- (e.g., conventional air, sea, land forces, and nuclear forces of established nuclear powers)

Disruptive

- International competitors developing and possessing breakthrough technological capabilities intended to supplant U.S. advantages in particular operational domains.
- (e.g., sensors, information, bio or cyber war, ultra miniaturization, space, directed-energy, etc)

VULNERABILITY

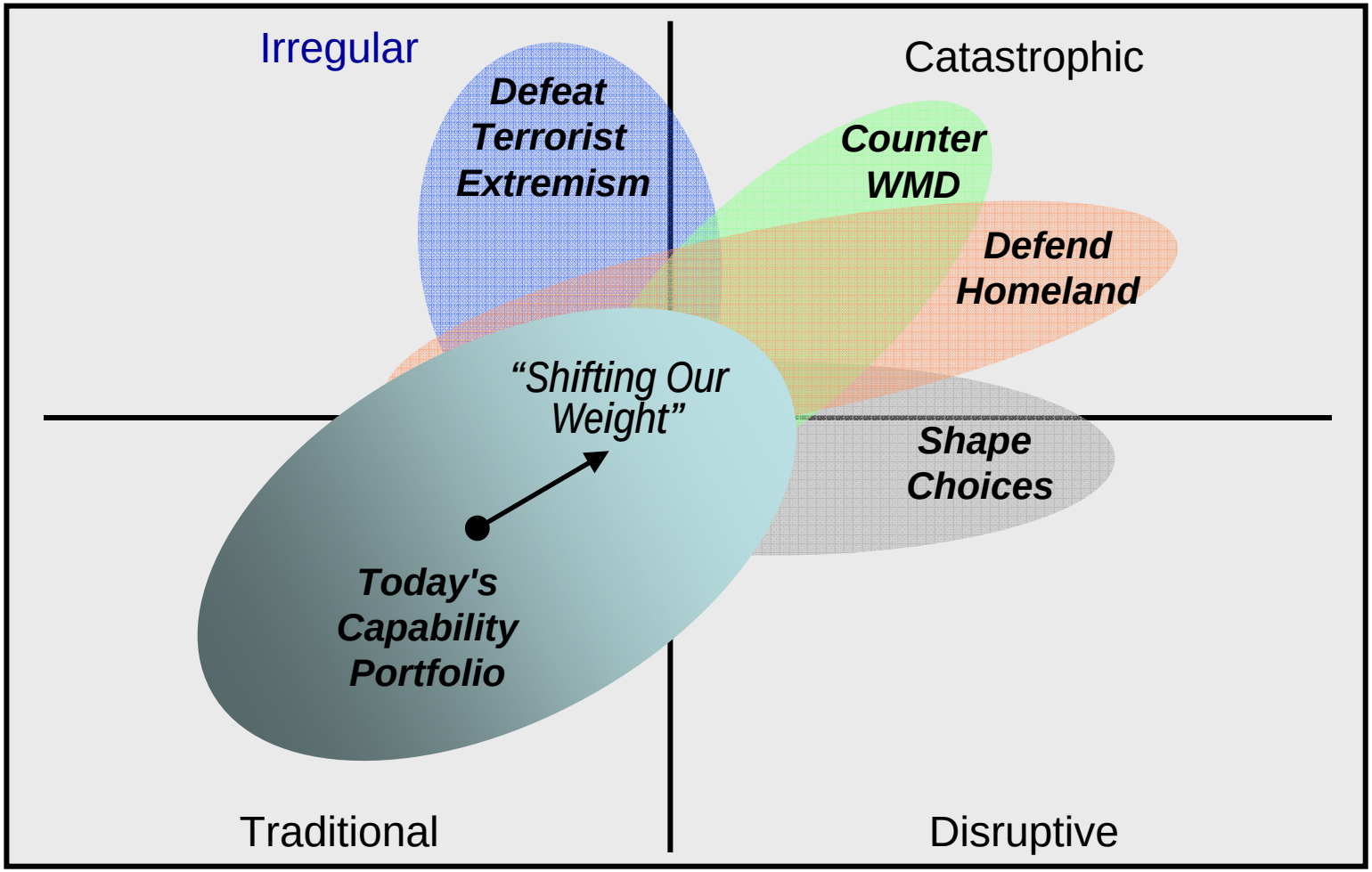
Lower *Higher*

Higher *Lower*

LIKELIHOOD

Uncertainty is the defining characteristic of today's strategic environment

QDR Re-balancing Future Force Capabilities

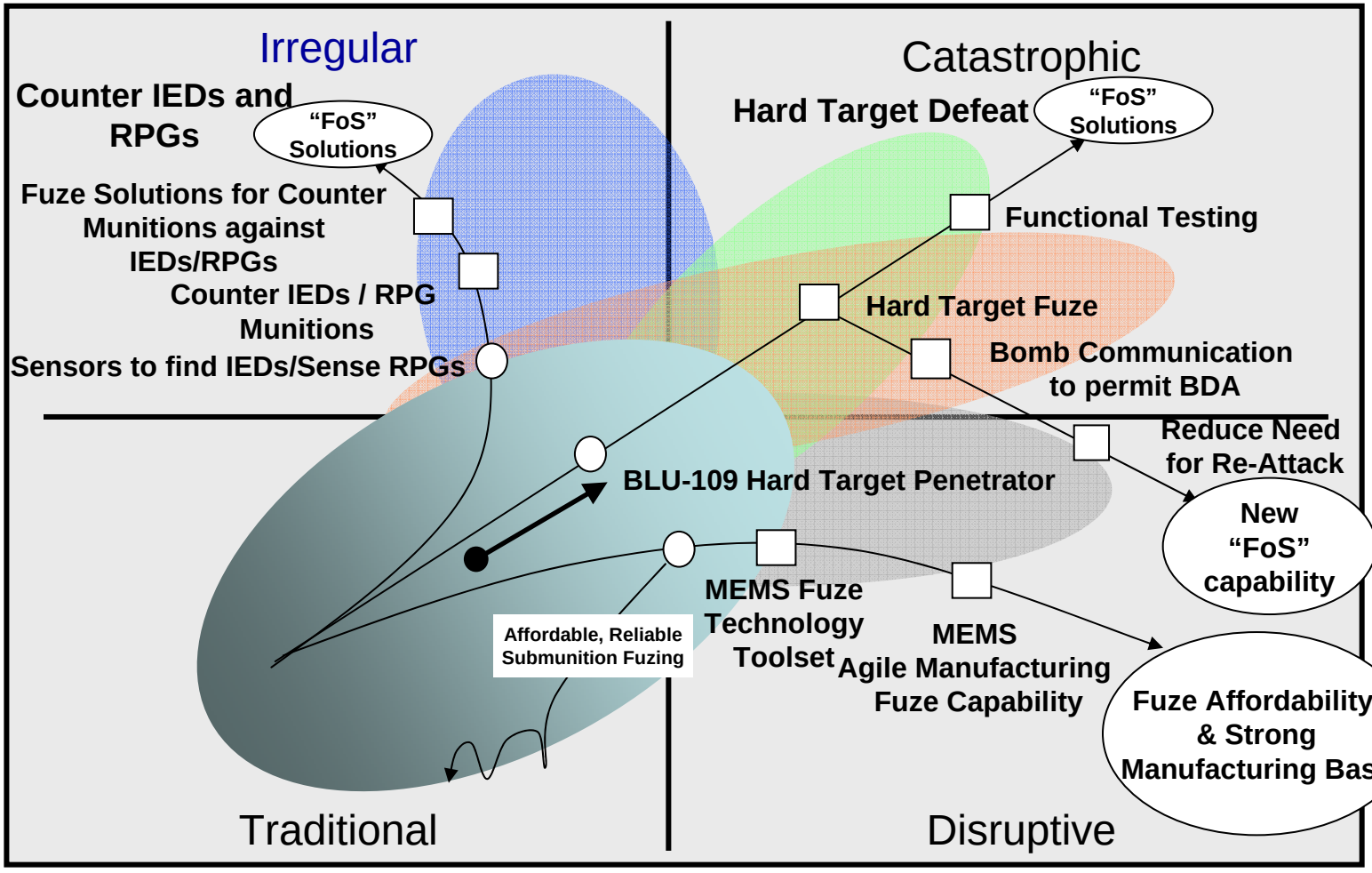


Continuing the reorientation of military capabilities and implementing enterprise-wide reforms to ensure structures and process support the President and the warfighter

QDR Re-balancing Future Force Capabilities:

A Suggested Path to Rebalance Fuzing Thrusts to Meet Future Capabilities

"Shifting Our Weight"



Munitions Procurement Trends

- **Affordability can not be ignored!**
- **Heavier emphasis being placed on Precision Munitions, Weapons for Autonomous Systems and Multi-Mission Weapons**
  - **Guidance systems increase munitions cost & Systems complexity**
  - **Can not afford to miss the hidden costs! (DOTMILPF*)**
- **Traditional munition inventories counts will be smaller and replenishment on use will be a "just in time" production issue**
- **Industrial Base will be affected:**
  - **Surge and Agility vs. Mass Produced Quantity Systems Approach**
  - **Requirements (such as IM) are driving AUR costs up**
    - **Will we be forced to buy Less?**
    - **Can we afford "Service requirements creep?" vs. Joint, Multi-Mission Roles**
  - **If fewer munitions are being bought, so mass production value is lowered: Cost goes up for start up, qualification.**
- **DoD perspective:**
  - **These issues will drive the acquisition cost of munitions systems**

The Department cannot buy what it bought before, and not at the same cost…

**** DOTMILPF**, Doctrine, Organization, Training, Material, Leadership and Education, Personnel, and Facilities*

DoD Fuze Ongoing Status/Update

- **OSD AT&L LW&M, DDR&E S&T, and DUSD/IP in active participation**
- **Services – PEO's/PM's, Laboratories involved and active**
- **DOE – Weapons Laboratories, DOE-DoD Technical Coordination Groups (TCG)**
  - **Active and Sharing Information Openly, Transparently**
- **Teams:**
  - **Fuze Technology – Joint Service Fuze Technical Panel***
  - **Acquisition data collection survey and update***
  - **Industrial Base Survey* (DUSD/IP, DCMA Study concluding 2006)**
  - **Policy**

** Details contained in Brief "Fuze IPT Perspective," by **Mr. Lawrence Fan**, Fuze and Microsystem Project Manager, NSWC*

Conclusions

- The Business Case has changed:
  - Lower munitions procurement budget trends
  - Fewer fuzes are expected to be bought
  - Precision munitions are driving costs up and quantities down
  - New requirements will need to be met
  - Can not ignore other Cost Drivers (DOTMILPF)

- The “shift” to Irregular, Disruptive and Catastrophic warfare is liable to change the focus or perspective of need for traditional munitions

- The proximity fuze was once heralded as one of the most significant technological accomplishments of WWII because it provided the “shift” that was needed at the time

- We need to be innovative, agile and adaptive to address changing threats and to meet requirements for modern munitions

AIR FORCE
FUZE TECHNOLOGY

10 May 2006

Timothy Tobik

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"

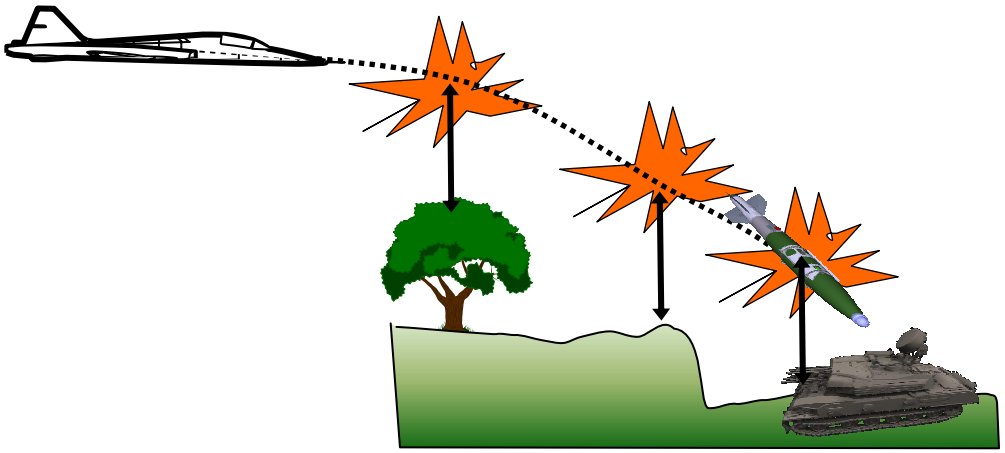
Asked where there are "holes" in the munitions pipeline, Chedister (Maj. Gen. Robert W. Chedister, Air Force program executive officer for weapons and commander of USAF's Air Armament Center at Eglin AFB, Fla.) said more money is needed in the research end.

"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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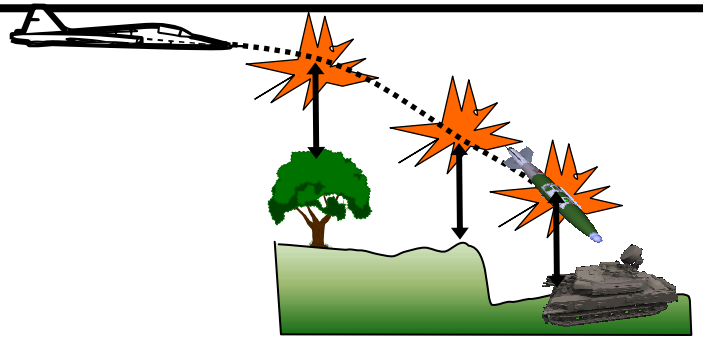
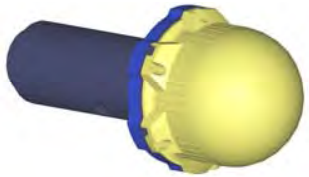
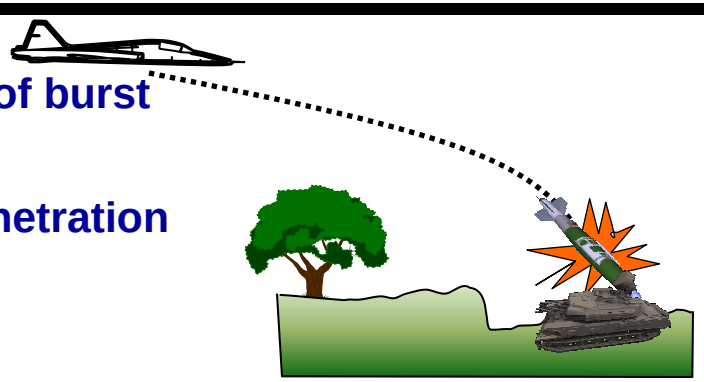
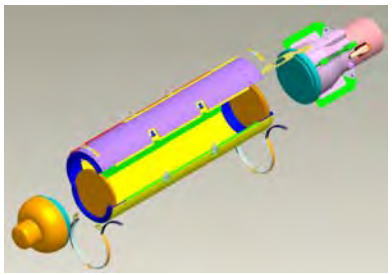


Fuze Air to Surface Technology (FAST)

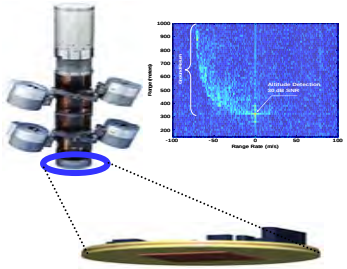


- Electrically selectable height of burst
- 0 – 20 m @ 0.5 m increments
- Ground profiling & foliage penetration
- Extended range 20 – 3000 m
- Low cost digital components
- Expandable capability for receive





High Altitude Sensor



•Low Cost Altimeter for BLU-108

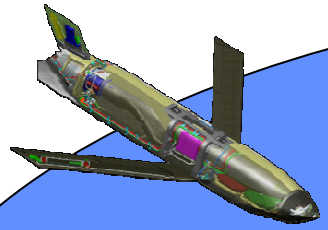
Link 16 Receive

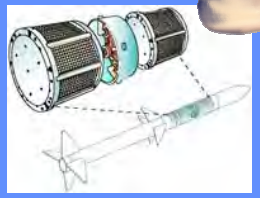
Technology Focus

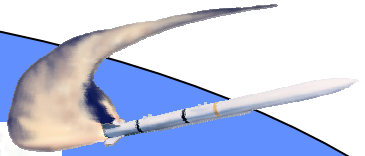
Battlespace Access

Area Dominance

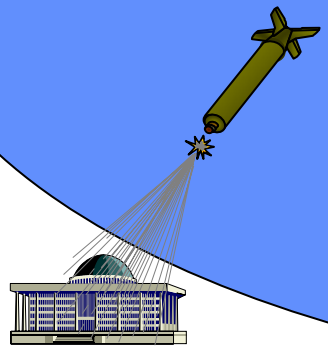
Air Supremacy

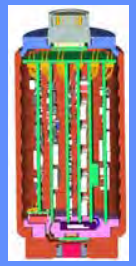


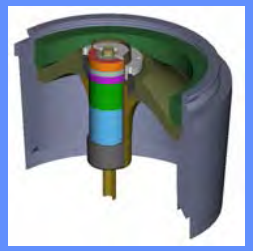


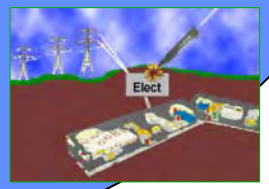


FUZING TECHNOLOGY









Irregular/Catastrophic Threat Neutralization

Revolutionary Technology

Facility Neutralization

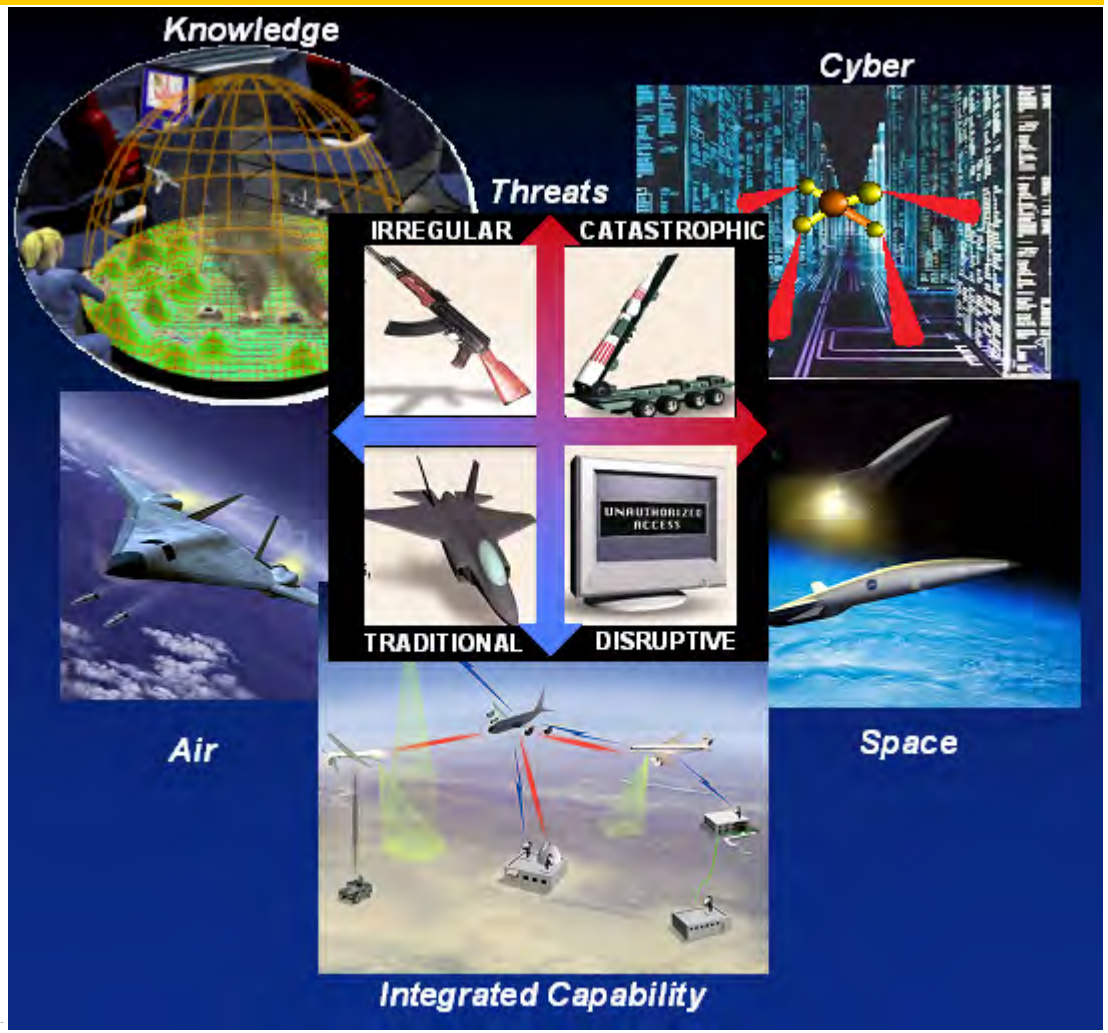
Fuzing is crucial to every Integrating Concept

Focused Long Term Challenges

Focused Long Term Challenges

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

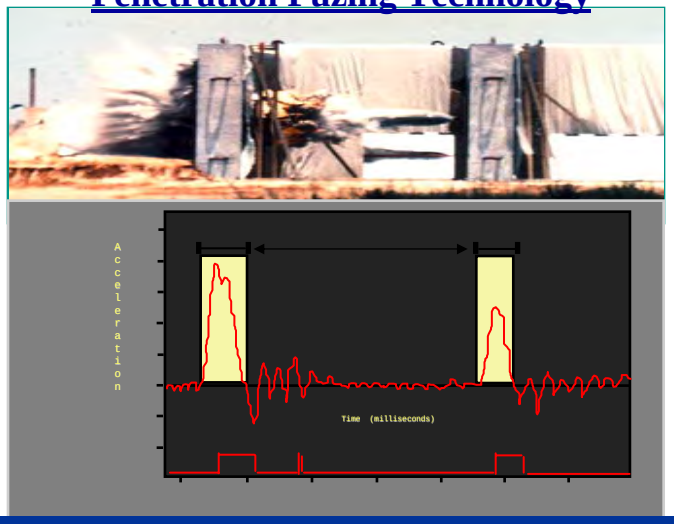
- **Anticipatory Command, Control & Intelligence (C2I)**
- **Unprecedented Proactive Surveillance & Reconnaissance (S&R)**
- **Dominant Difficult Surface Target Engagement/Defeat**
- **Persistent & Responsive Precision Engagement**
- **Assured Operations in High Threat Environments**
- **Dominant Offensive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



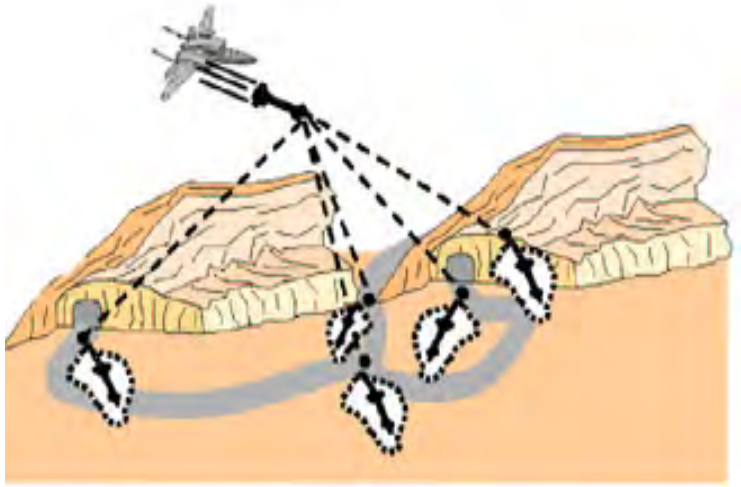
Fuze Challenges

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

Penetration Fuzing Technology



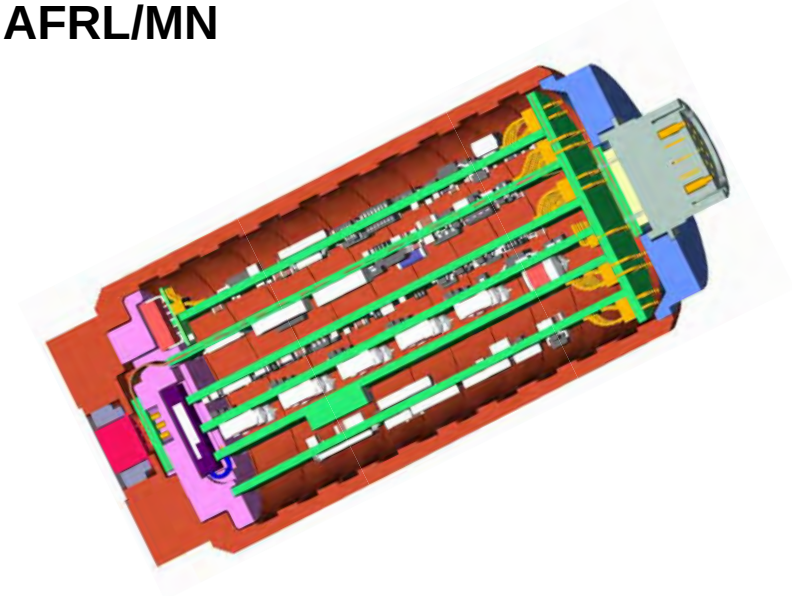
Penetration Fuzing Technology



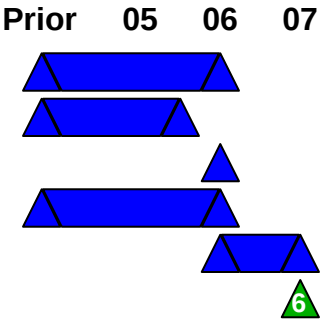
Survivable Thermostable Robust Intelligent Fuze (STRIFE)

Munitions Directorate

AFRL/MN



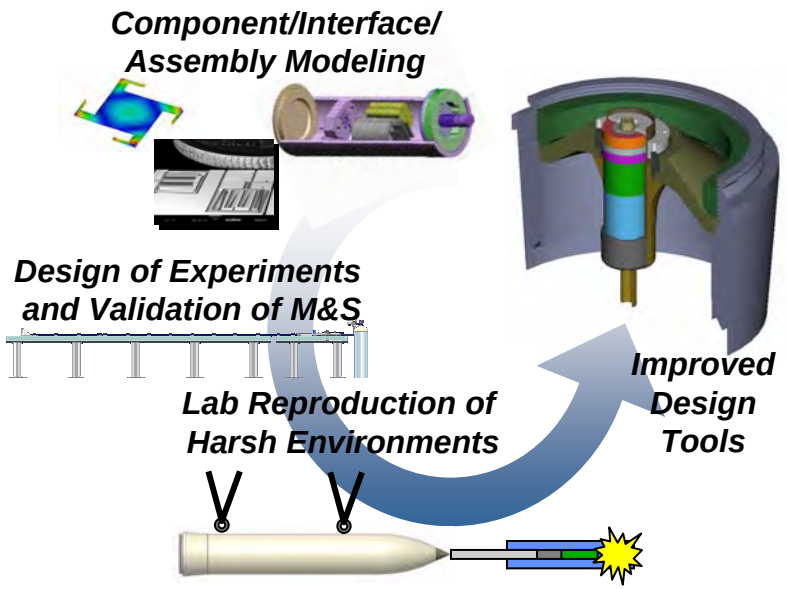
Technology Investment Schedule (FY)



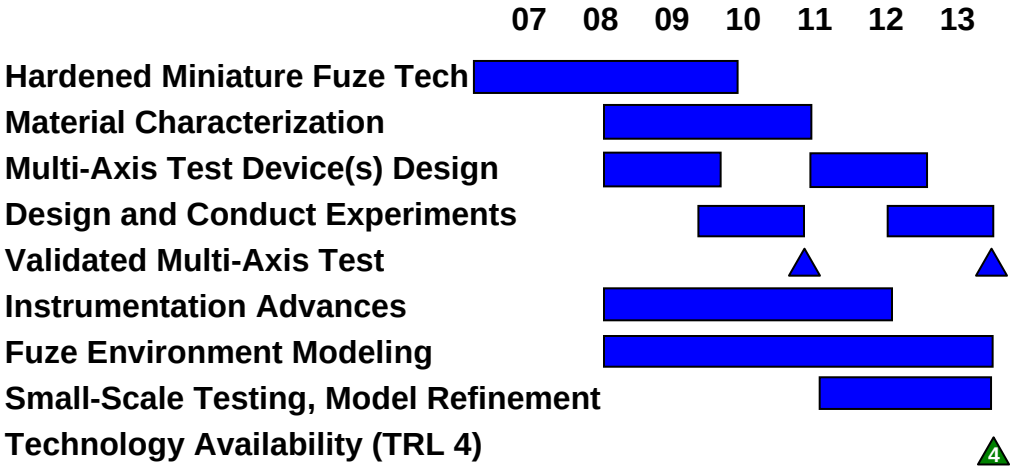
Description	Benefits to the Warfighter
• Provide interoperability between a smart fuze and the CAV flight vehicle. • Provide inert/live fuzes for the inert HSP 1000 sled test and MTD-3B/CAV flight test.	• Ability to reach hardened and deeply buried targets which cannot currently be reached. • Fuze capable 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)



Technology Investment Schedule (FY)



Description

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

Technology

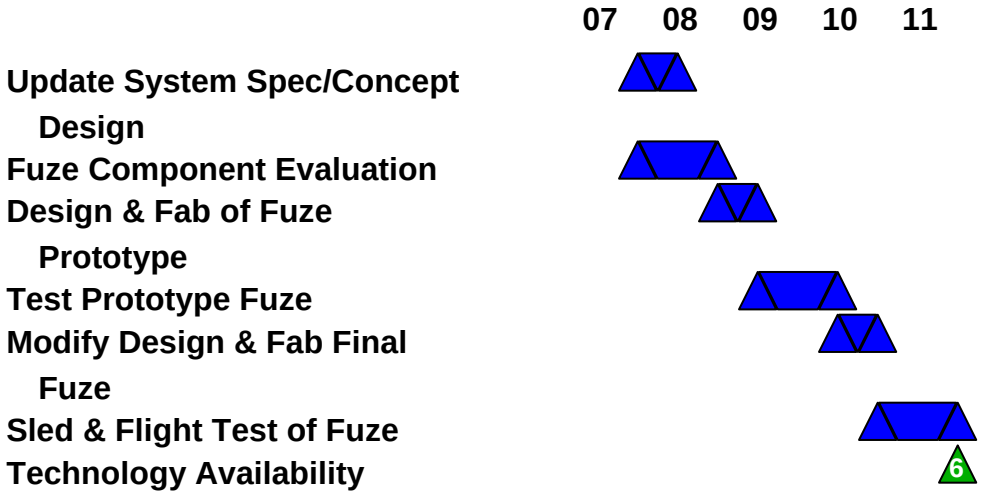
- Survivable fuze technology
- Microelectronics for harsh environments
- Validated M&S of fuzewell environment
- Model-based design of experiments
- Scaling of models for harsh environment prediction
- Dynamic test apparatus and methodology

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

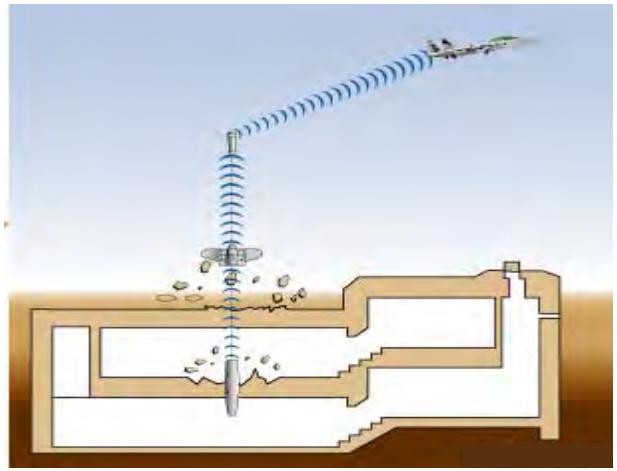
- Shock hardened, cooperative seismic, acoustic and/or magnetic vehicle sensors
- Shock hardened, extended-life power source
- Target discrimination algorithm
- Shock hardened safe & arm and fuze electronics

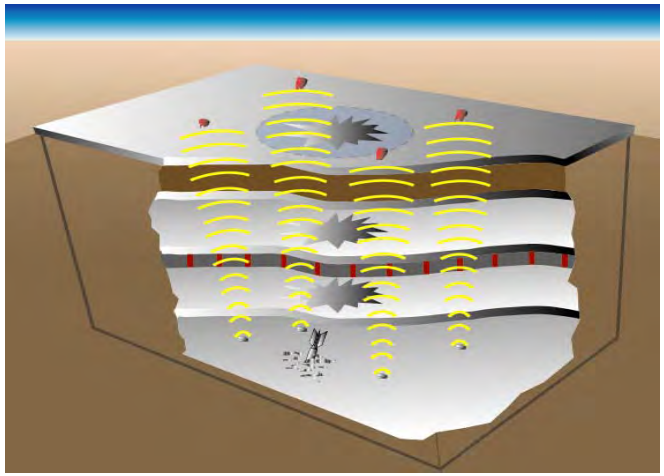
Benefits to the Warfighter

- 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

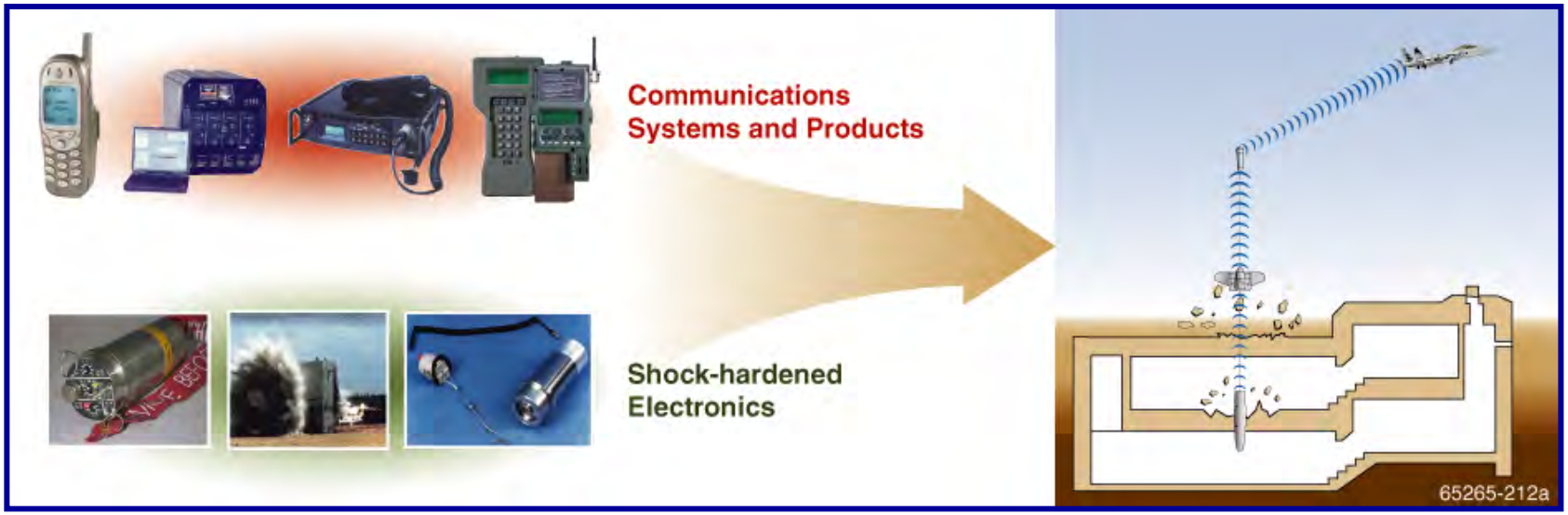
- Penetration Fuzing
  - Target Defeat
  - Target Denial
- **Bomb Damage Sensing**
  - **Real-time bomb damage information from hard target weapon to airborne platform**
  - **Two way, shock hard, through earth communications**



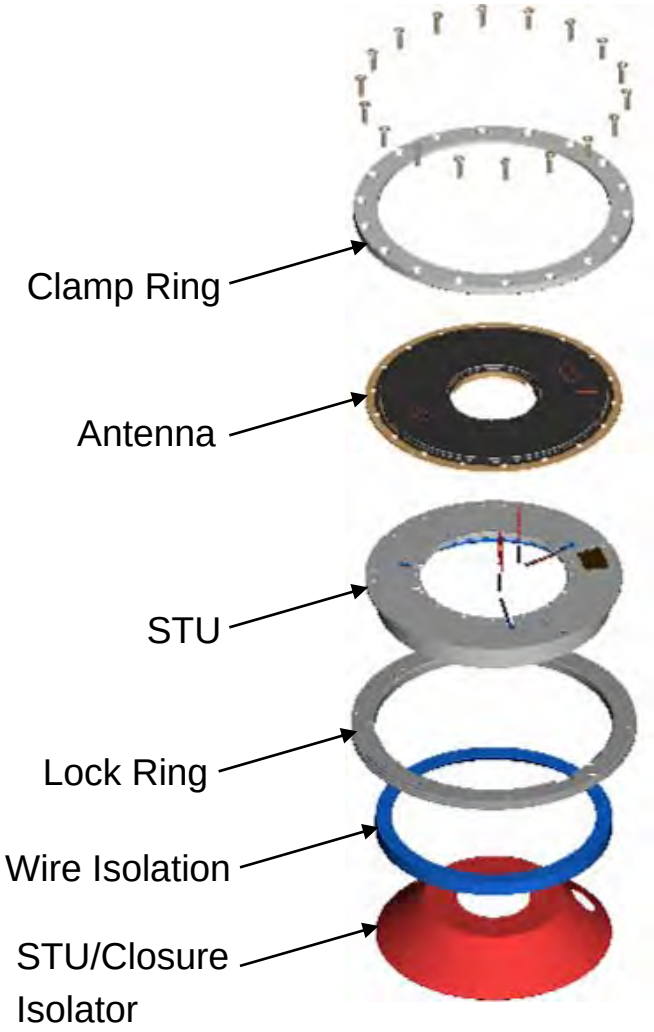


Fuze Integrated Bomb Damage Information Demonstration (FIBDID)

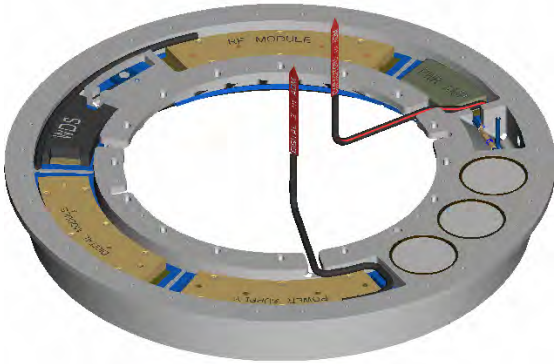
- **Radio system that overcomes severe signal attenuation and distortion**
- **Hardware that operates as the weapon penetrates through hard target**

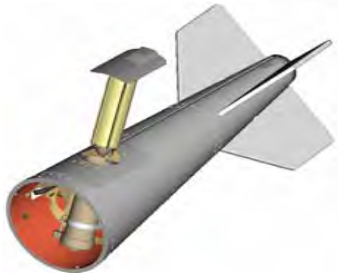


Key FIBDID Technologies



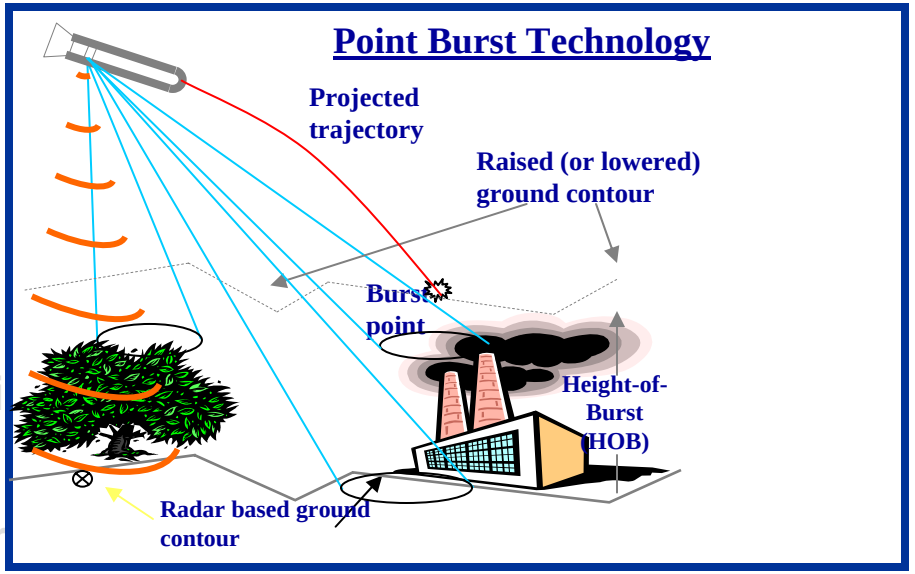
- **Shock Hardened BDI Electronics**
  - **Shock hardening of hand-held radio transmitter**
  - **High losses in transmission through soil/concrete**
  - **Hardened accelerometer sensor module**
- **Antenna Designs To Efficiently Couple RF to Soil**
  - **Design limited by weapon size and space constraints**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

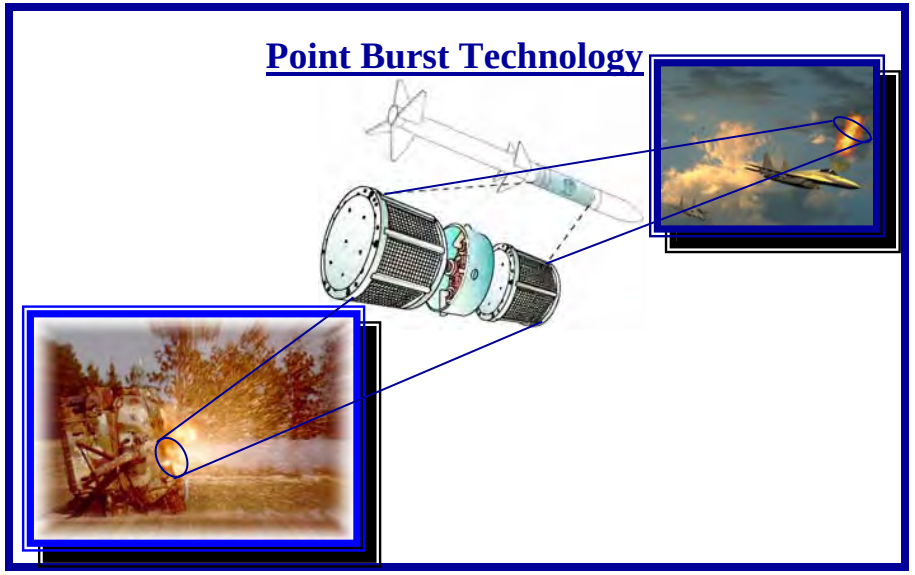




Fuze Challenges

- 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)

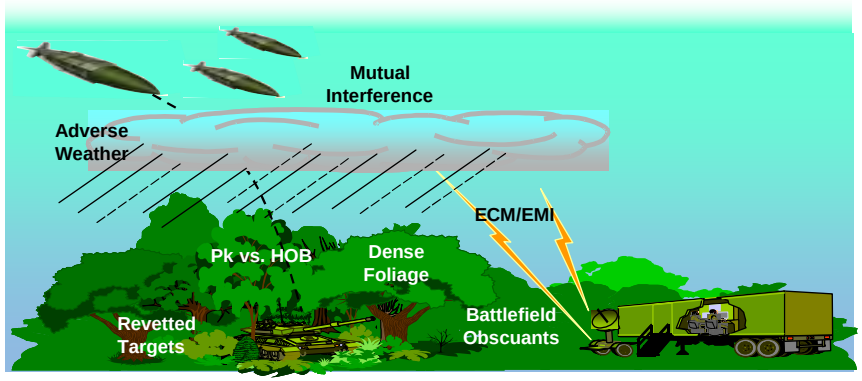
A Precision HOB, Low Cost Ground Profiling Radar

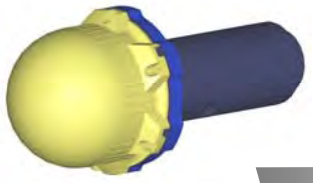
Common Fuze Sensor for a Broad Spectrum of Weapons

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



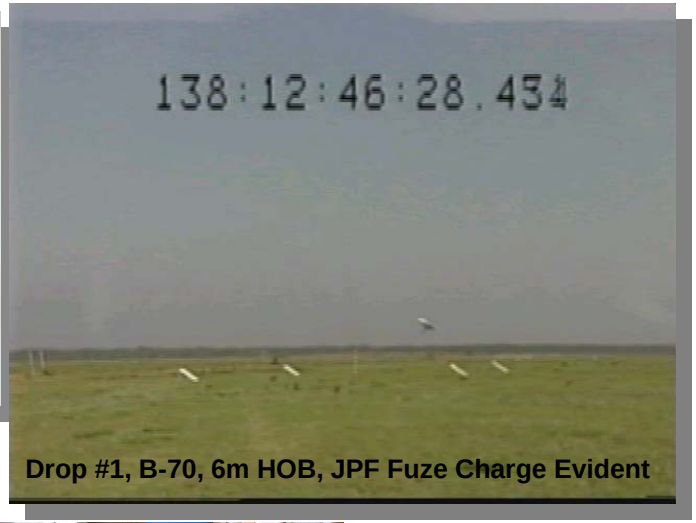


Nose-Mounted Configuration (DSU-33 Form Factor)

Tail-Mounted Configuration (MK-82 Demo)

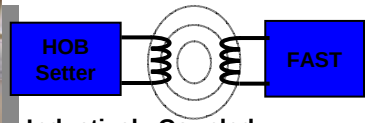
100% Common Low Cost Electronics and Operational Software

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

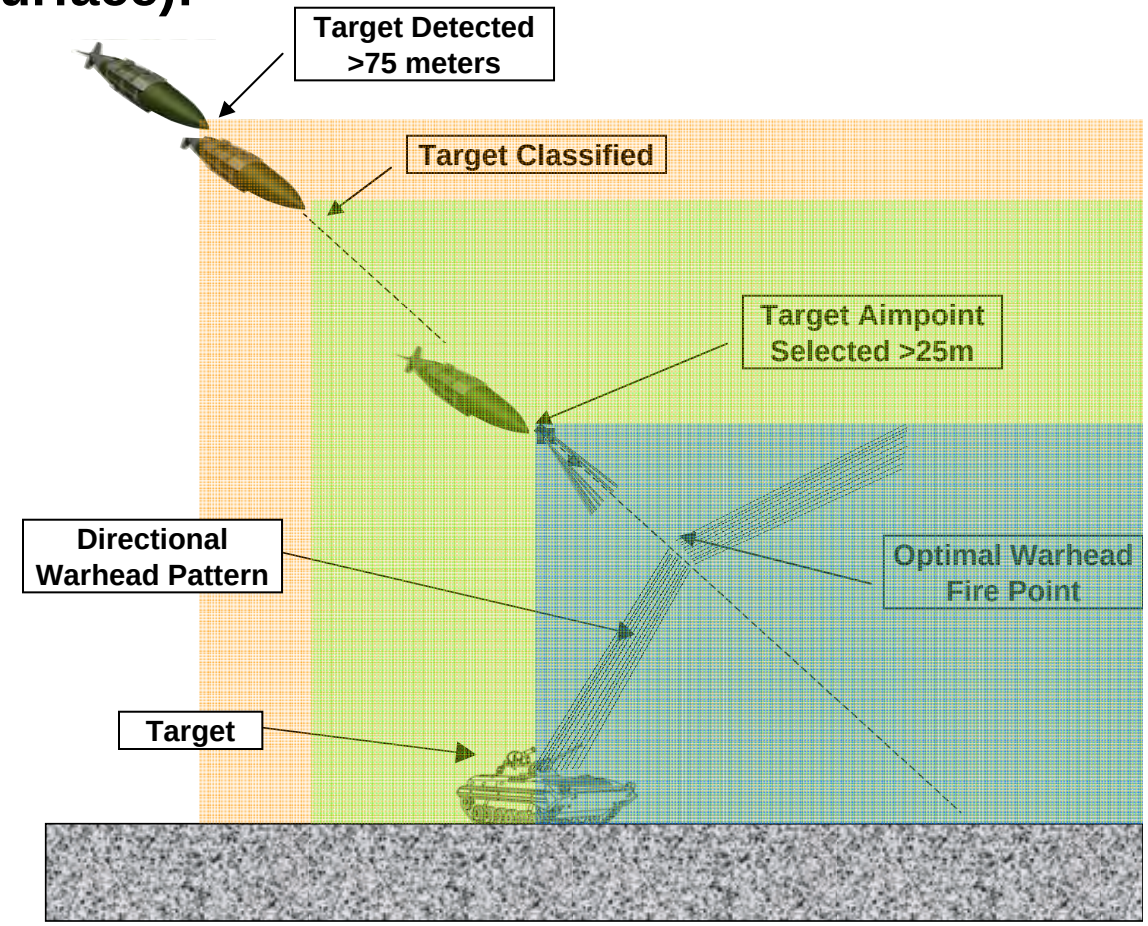
TM Setup, B-70

FOCAS Concept

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

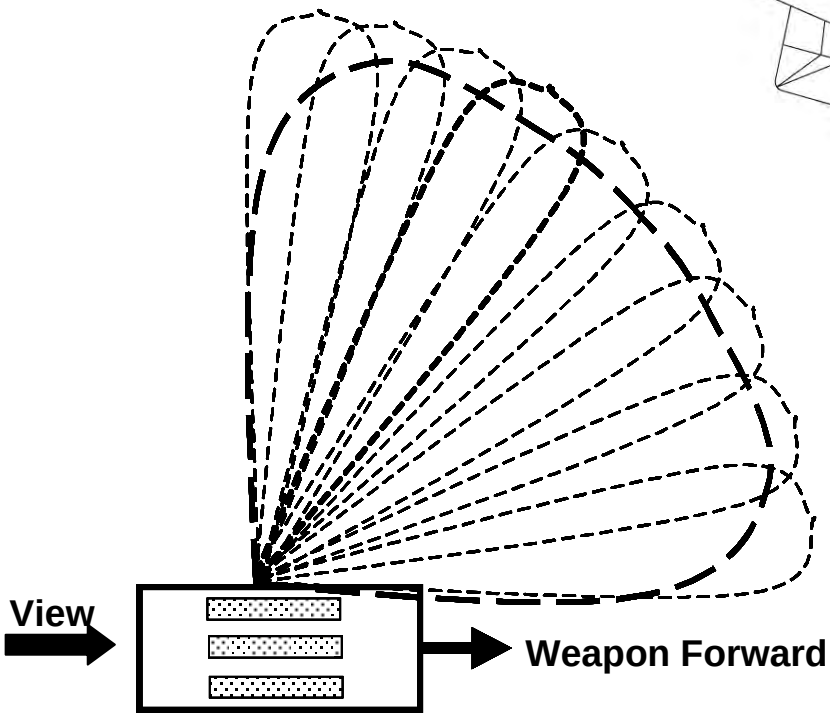
A Proximity Fuze Sensor That:

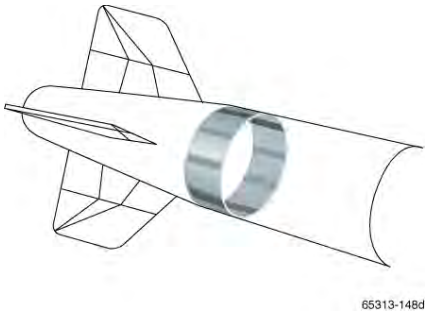
- **Separates The Target From Background Clutter**
- **Calculates And Tracks The Target's Aimpoint**
- **Selects The Correct Warhead Mode For The Given Encounter**
- **Communicates The Warhead Mode And Firing Time To The Warhead Initiation System**
- **Updates Solution Until Burst Time Is Reached**

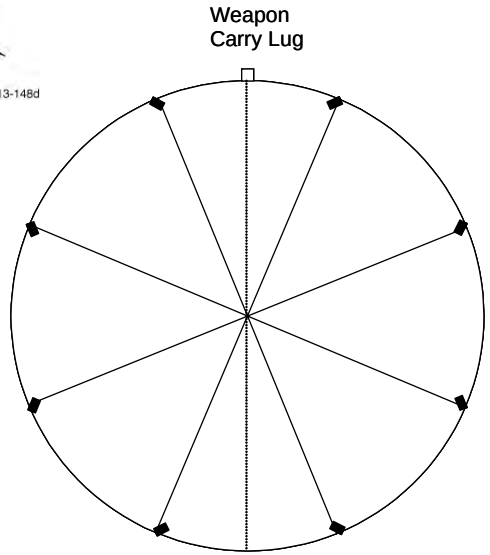


Imaging Millimeter Wave Antennas

Digitally Formed Beams





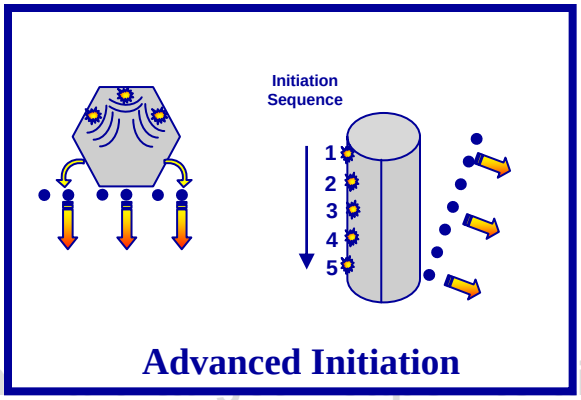


Viewed from Behind

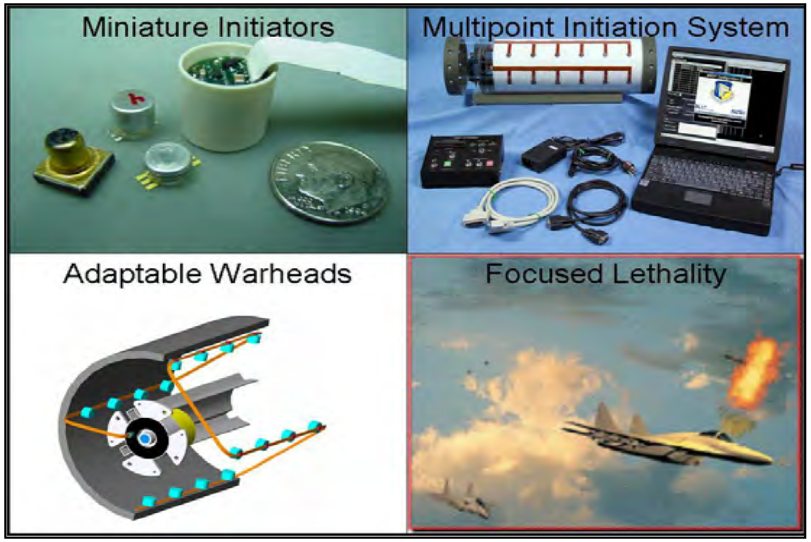
Simultaneously Receive on all Elements, Form Beams with Software

Fuze Challenges

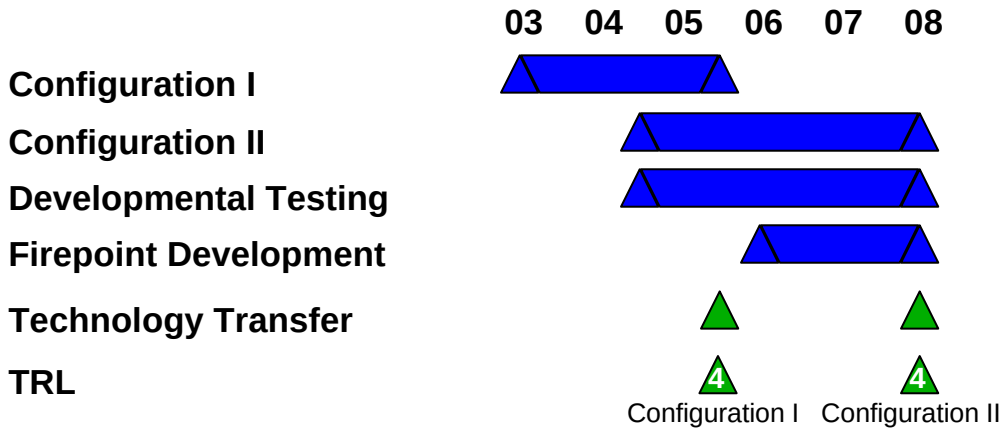
- Penetration Fuzing
  - Target Defeat
  - Target Denial
- Bomb Damage Sensing
  - Real-time bomb damage information from [illegible] airborne platform
  - Two way, shock hard, through eart[illegible]
- Point Burst
  - Ground profiling radar
  - Active imaging fuze sensor
- **Advanced Initiation**
 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