US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

Malcolm Baldrige National Quality Award 2007 Award Recipient

XM1158 40mm PROXIMITY FUZE

EXPLOSIVE TRAIN DESIGN

XM 1112 ANLM (Airburst Non-Lethal Munition)

ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER ★ PICATINNY ARSENAL, NJ ★

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

40mm Proximity Fuze Design Team

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NDIA 53rd Fuze Conference - Orlando

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OUTLINE

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ANLM Project Overview

- The XM1112 Airburst Non-Lethal Munitions provides selective non-lethal area denial, crowd dispersion or individual/crowd behavior control capability. The system will provide consistent non-lethal effects & significantly increase range capabilities. Proximity fuze enables airburst delivery of NL payloads throughout operational ranges. It has user settable proximity delay mode for room clearing.

- The Joint Non-Lethal Weapons Directorate (JNLWD) is the executive agent for all NL capabilities within DOD and are the program sponsor. The ANLM is a joint program between the US Army, the lead service, and US Air Force. The US Navy and US Marine Corps have expressed program support.

- The XM1112 ANLM is the Tactical Non-Lethal Munition Increment I Capabilities Development Document material solution that was JROC approved on 14Jul08.

- The XM1112 is presently under PM Soldier Weapons management and executed by US Army, ARDEC. Upon approval of Milestone C the program will be transitioned to PM Close Combat Systems for production.

ANLM Project Overview (cont.)

- **Airburst Non-Lethal Munition (ANLM)**
  - **Type Designation XM1112**
    - **Fuze Type Designation XM1158**
  - **Schedule**
    - **Concept Demo July 2006**
    - **Milestone B March 2009**
    - **Fuze Sub-assembly Testing 2008-09**

    - **Integration Testing 2009-2010**
    - **Qualification Testing 2010-2011**
    - **Joint Fuze Safety Board Cert. 2011**
    - **Milestone C September 2011**

Participating Organizations

JNLWD – Joint Non-Lethal Weapons Directorate
Sponsor

US Army Infantry Center/DCD – Firepower Division
Requirements Generation and User Proponent

Air Force Security Forces Center (AFSFC)
User Proponent

PM-Soldier Weapons
RDT&E Management

PM-Close Combat Systems
Production Management

US Army, ARDEC
Munition Lead and Fuze & Projectile Design

NSWC Dahlgren
Payload Technical Lead

ATK Launch Systems
Payload Design Improvements and Integration Support

HECOE
Human Effects Analysis and Support

SAVIT Corp.
Cartridge Design Improvements, Integration, and Development Hardware Support

Aberdeen Test Center – DTC&AEC / NSWC CRANE
Test & Evaluation

Indiana Ordnance Inc.
Developmental Testing

Kansas State University
Environmental Assessment

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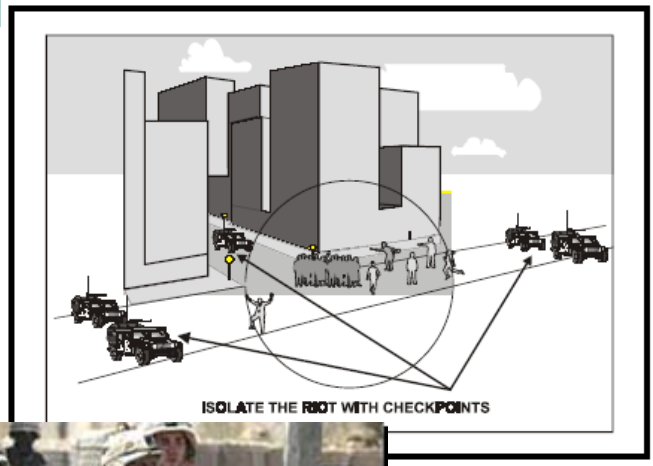
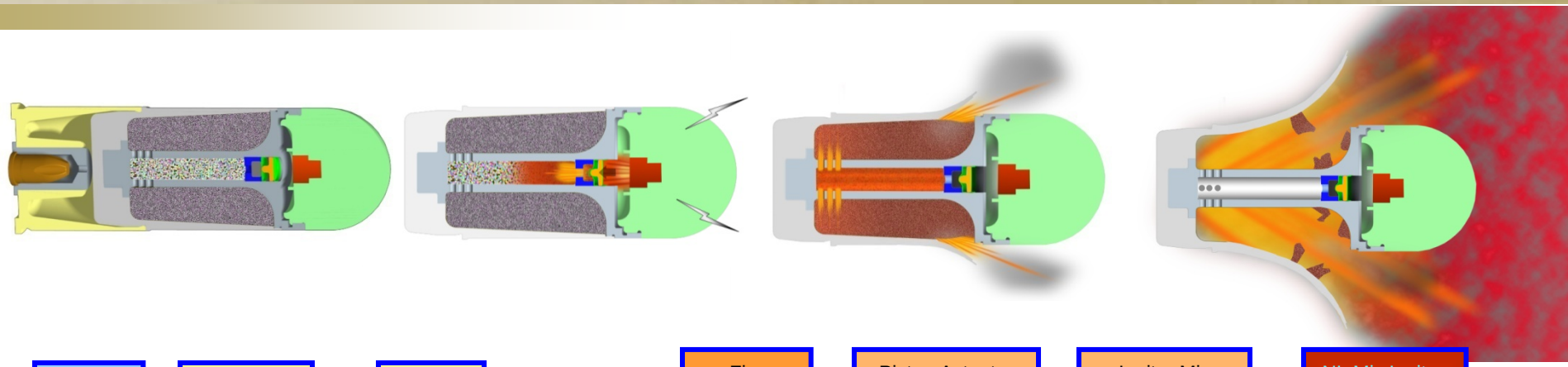
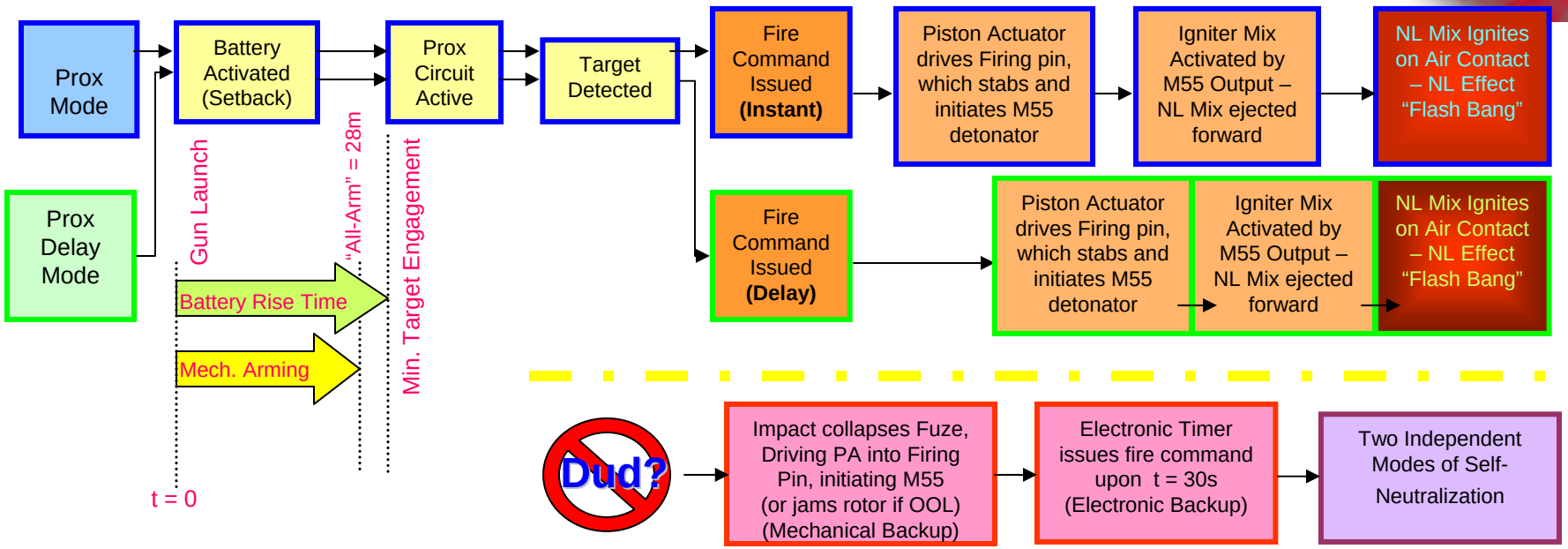
Operational Parameters

- Operational Environment
  - M203 Ballistic environment
    - Compatible with M79, M320
    - 250 ft/s; 63 rps; 15,500 g's
  - Temperature range: -25°F to +140°F
  - Ballistic Equivalent to M433 cartridge
- Operational Requirements
  - Minimum Engagement Range: 35m(T), 15m(O)
  - Shelf Life: 10yr(T), 20yr(O)
  - Engage targets in open terrain & confined spaces
  - Self Destruct/Self Neutralization



ANLM SEQUENCE OF OPERATION





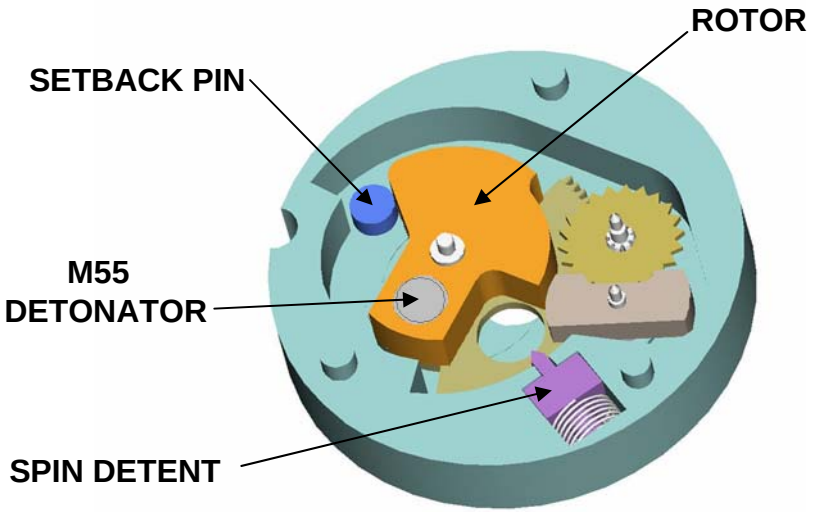
FUZE DESIGN APPROACH

- **Limited Funds Available for Fuze Development**
  - **Emphasis on leveraging existing technologies from other fuzes**
    - **Proximity technology for use in Direct-Fire scenario (EX433 & M734A1)**
    - **Existing mechanical S&A – M550**
    - **Small, fast-activating, reserve-cell battery (EX433)**
- **Utilizes existing mechanical S&A**
  - **Inexpensive & Reliable**
  - **Proven history (>20 million produced)**
- **Piston Actuator Used to Drive Firing Pin**
  - **Initiates M55 Stab Detonator in M550 S&A**
  - **Early design used M100 electric detonator**
- **Transitioned ARDEC Fuze Design to Savit Corp for design refinements**
- **Potential use on other 40mm low velocity cartridges**

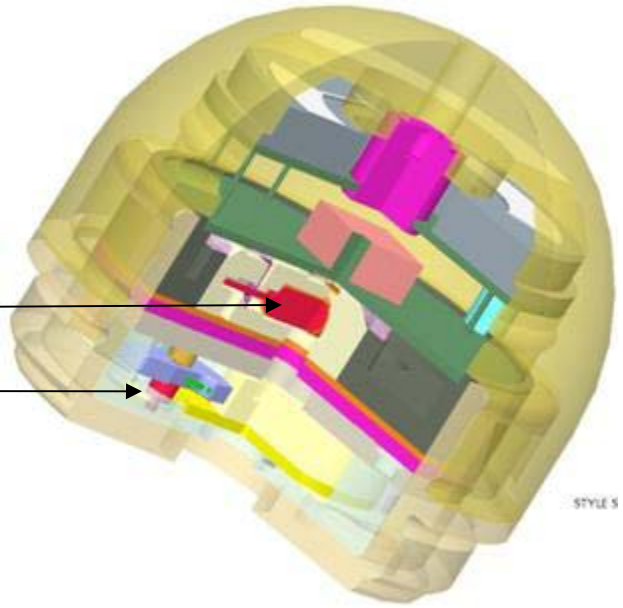
M550 FUZE - Background

History

- The M550 Fuze was Type-Classified in 1971 for the low velocity (250 ft/sec) M433 High Explosive Dual Purpose application
  - Also used in M918 high velocity Target Practice cartridge
- In Production - Over 20 Million fuzes have been produced
- Two independent safety locks (setback pin & one spin detent)
- Excellent safety record



CONCEPT DEMO EXPLOSIVE TRAIN



9 - Month Concept Demo

"Zero-to-Test Hardware"

in Nine - Months

- Initial design used a M100 electric detonator input into the M55 stab detonator
  - M100 positioned 90° "sideways" above M55
    - Used because electric detonators are available, inexpensive, & reliable
    - Utilized MOFA detonator plug & contact clip assembly
  - M100 did not reliably initiated M55
    - Out of line safety barrier plate between M100 & M55 attenuated M100 output

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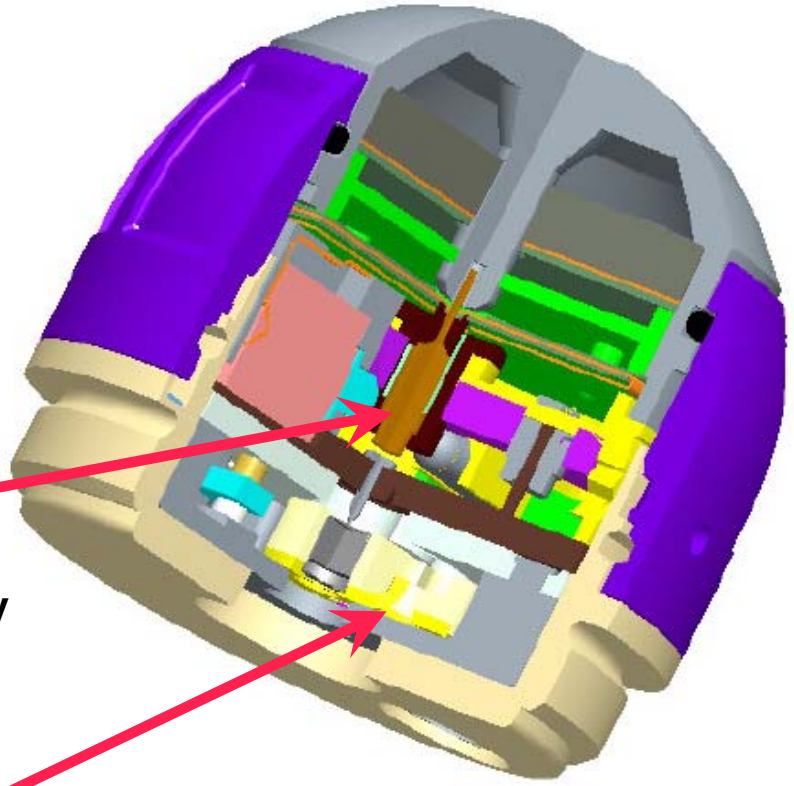
EXPLOSIVE TRAIN

- ARDEC redesigned explosive train to closely duplicate 40mm M550 fuze
  - Duplicated firing pin dimensions
  - Piston actuator pushes firing pin into M55
    - Positioned on centerline
    - Activates on command detonation from proximity circuit



- Design Details
  - Piston Actuator – Action Mfg
    - Directly connects to circuit card assembly using pin and socket connection
    - Piston has attached firing pin
    - Used in PD backup mode
  - M550 Safe & Arm Device - Amtec Corp.
    - Used on current 40mm HE & practice rounds
    - Contains the two independent MIL-STD-1316 compliant safety locks

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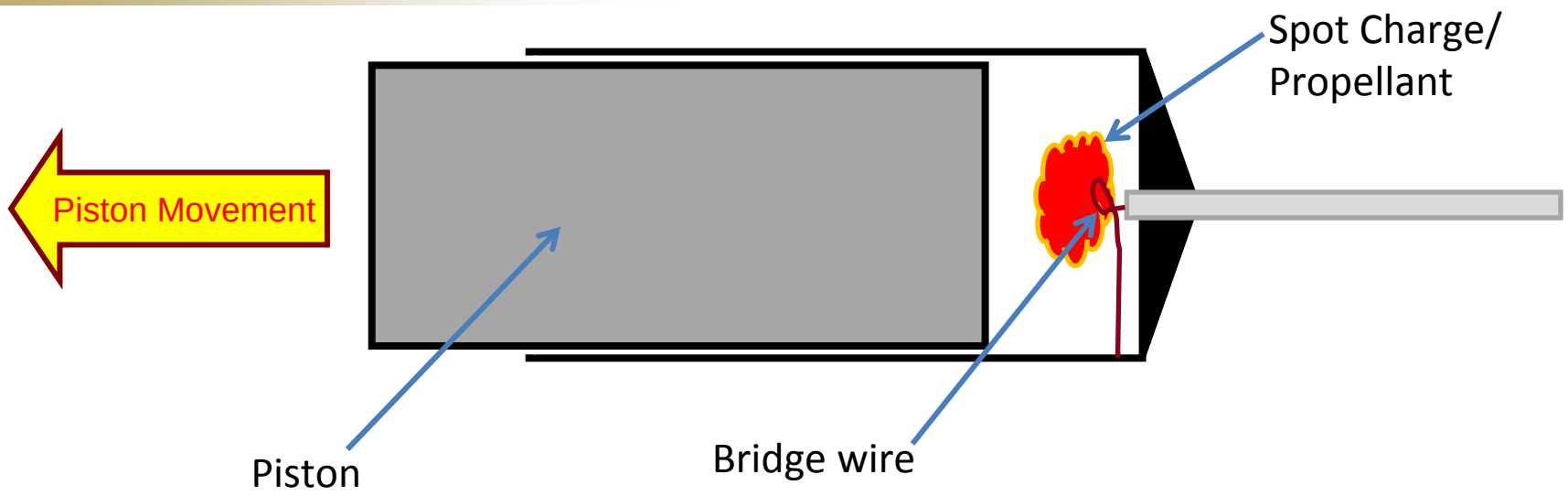
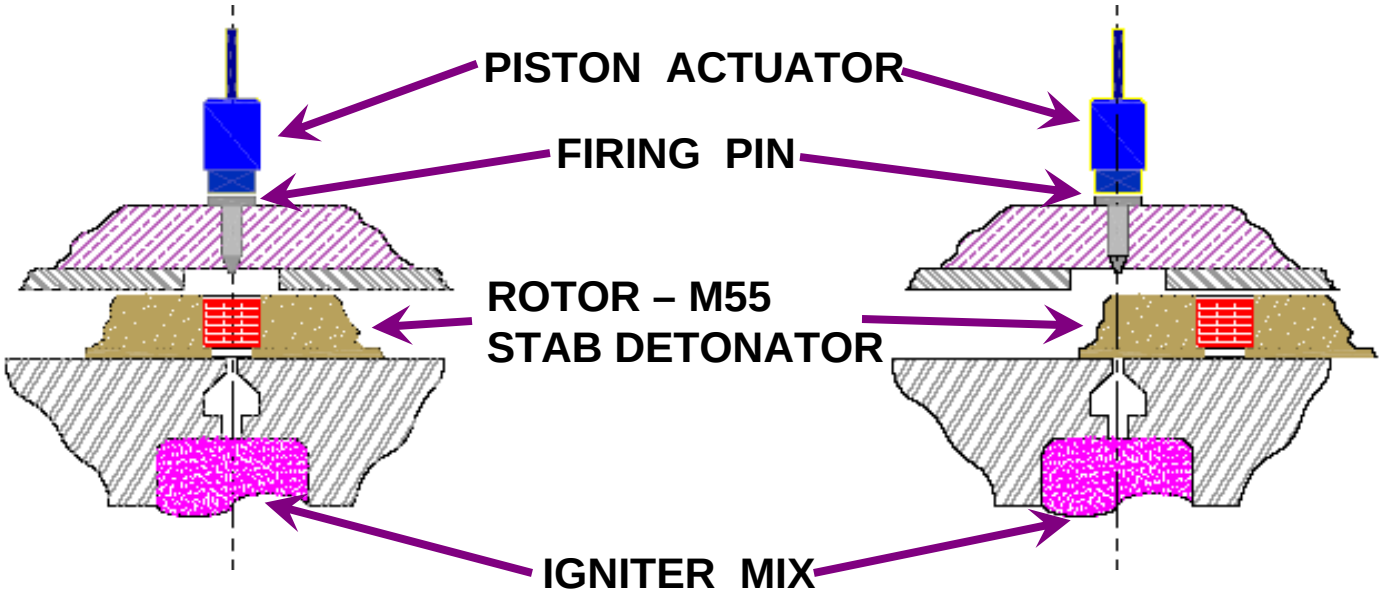
EXPLOSIVE TRAIN



Piston Actuator – Action Mfg

- Approximately 50 lbs force & 0.090” displacement
- ~5mg Spot Charge
- Bridgewire Resistance = 1.5 ± .5 ohms
- All Fire Energy = 22 microfarad capacitor at 2.5 volts
  = 687.5 erg = .06875 joules

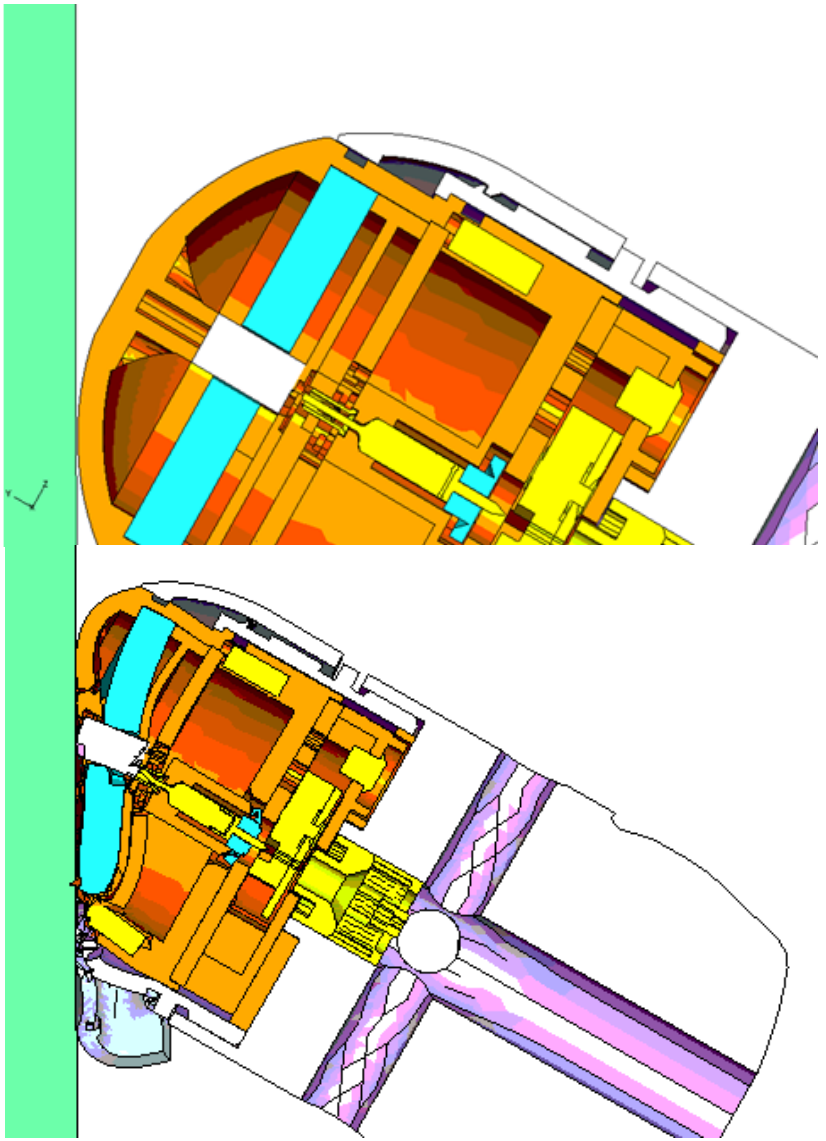
FUZE EXPLOSIVE TRAIN TESTING



- **Explosive Train Subassembly Testing**
  - **Explosive Train Subassembly Tests – Successful Jan-May 2009**
    - **"In-Line" Explosive Component Output – MIL-STD-331, Test D4**
    - **"Out-of-Line" Explosive Component Safety – MIL-STD-331, Test D1**
    - **Progressive Arming Test – planned 3Q FY09 - MIL-STD-331, Test D8**

FUZE EXPLOSIVE TRAIN TESTING

- **Explosive Train Subassembly Testing (cont'd)**
  - **Point Detonation Backup Subassembly Tests**
    - **Head-on Impact Angle Test– Successful March 2009**
    - **Angle of Attack Impact Test– planned June 2009**
      - **Utilizing decision matrix to determine 50% functioning point**
      - **Use samples at operating temperature extremes**



FUZE SUBASSEMBLY TESTS

- **Non Explosive Train Subassembly Testing**
  - **Battery Activation Mechanism Subassembly Test**
    - **Mechanism w/o battery – Successful July 2008**
      - **Drop Test non-activation per MIL-STD-331, Test A4.1**
      - **Ballistic Test activation – M203 Mann Barrel into foam soft catch**
    - **Actual battery – planned June 2009**
      - **Repeat drop and ballistic tests**
  - **Mode Select Subassembly Test/ Electronics Survivability - Planned July 2009**
    - **Ballistic Test – M203 Mann Barrel into foam soft catch**
- **Non-Lethal Warhead Testing**
  - **Fuze explosive train successfully ignited warhead energetic material**

SUMMARY

- SUMMARY
  - Explosive Train Tested Successfully
  - Created Command Initiated Stab Detonator
    - Maintains current explosive train
    - Utilizes proven mechanical S&A

- SHOW VIDEO – ANLM FUNTIONING – Concept Demo July 2006

QUESTIONS?

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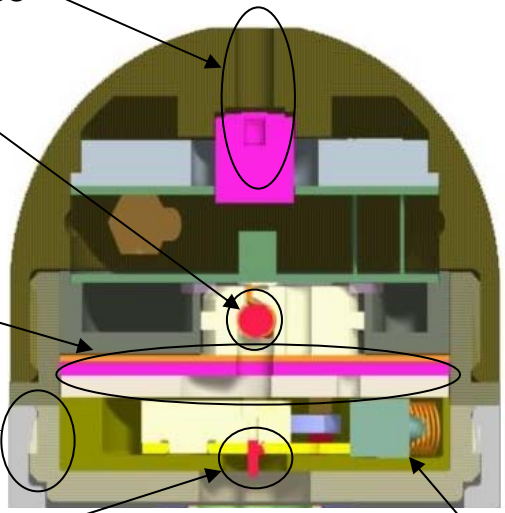
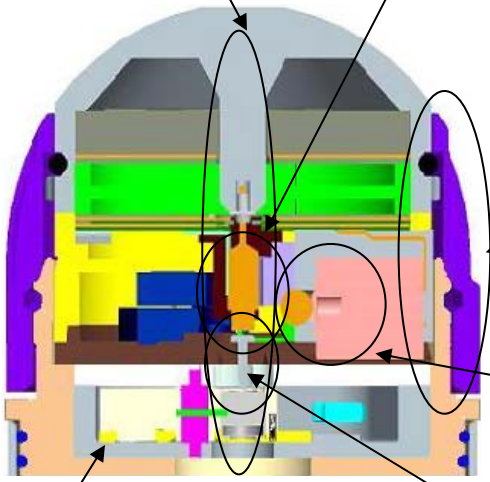
EXPLOSIVE TRAIN – Initial vs. Current

Initial Design



Current Design



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