Fuzes for Air Force Unguided and Precision Guided Weapons

17 April 01

Air Armament Center
AAC/WMG
Eglin AFB, Florida

Mr. Frank Robbins
Director
Precision Strike SPO
<table>
<thead>
<tr>
<th><strong>Report Date</strong></th>
<th><strong>Report Type</strong></th>
<th><strong>Dates Covered (from... to)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>17Apr2001</td>
<td>N/A</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Title and Subtitle</strong></th>
<th><strong>Contract Number</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuzes for Air Force Unguided and Precision Guided Weapons</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Author(s)</strong></th>
<th><strong>Grant Number</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Robbins, Frank</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Performing Organization Name(s) and Address(es)</strong></th>
<th><strong>Performing Organization Report Number</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Armament Center AAC/WMG Eglin AFB, Florida</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sponsoring/Monitoring Agency Name(s) and Address(es)</strong></th>
<th><strong>Sponsor/Monitor’s Acronym(s)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NDIA (National Defense Industrial Association) 211 Wilson BLvd., Ste. 400 Arlington, VA 22201-3061</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Distribution/Availability Statement</strong></th>
<th><strong>Sponsor/Monitor’s Report Number(s)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for public release, distribution unlimited</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Supplementary Notes</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Abstract</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Subject Terms</strong></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Report Classification</strong></th>
<th><strong>Classification of this page</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>unclassified</td>
<td>unclassified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Classification of Abstract</strong></th>
<th><strong>Limitation of Abstract</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>unclassified</td>
<td>UU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Number of Pages</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
</tr>
</tbody>
</table>
• Current Weapon Systems
• Fuzes: Inventory, Production
• Challenges For Today’s and Tomorrow’s Fuze Programs
CURRENT WEAPON SYSTEMS

- AGM-130
- AGM-142
- GBU/EGBU-15
- GBU/EGBU-24/27
- GBU/EGBU-28
- JDAM
- JASSM
AGM-130 MISSILE SYSTEM
DESCRIPTION

• Rocket Powered Standoff Precision Guided Missile
  – Man-in-the-Loop (MITL) Terminal Control
  – Interchangeable TV or IR Seekers
  – Interchangeable MK 84 or BLU-109 Penetrator Warhead
  – Fully Autonomous INS/GPS Adverse Weather Capability
• Only U. S. Fighter Launched Air Force Standoff Weapon With 2,000 Pound Warhead
• Integrated on the F-15E Strike Eagle
• Over 100 Used During Operations NORTHERN WATCH SOUTHERN WATCH and ALLIED FORCE
AGM-130 EXPANDED EFFECTIVENESS

• Weapon Improvements
  – Television Guidance Seeker (CCD)
    • Charge Coupled Device
    • Rate Stabilized Platform
    • Correlation Tracker
  – Improved Modular IIR Seeker
    • Focal Plane Array
    • Correlation Tracker
  – Digital Autopilot With GPS/INS
  – Switchable Data Link
  – Performance Enhancements
    • Horizontal Target Attack
    • Envelope Expansion
    • Real Time Information in the Cockpit
  – Support Equipment Improvements
AGM-142 MISSILE SYSTEM
DESCRIPTION

• Precision Guided, Standoff Weapon for Use Against High-Value/Heavily Defended Fixed Targets
  – Data Link Pod Augments Inertial Navigation
  – Interchangeable TV, IIR, or Z-Seeker
  – Interchangeable 750 Lb. Blast/Frag or 800 Lb. Penetrator Warheads
• Only U.S. Bomber Launched Precision Weapon System
• Weapon of Choice for Multiple Allied Fighter Aircraft
• Standoff Precision Guided Weapon System For Use Against High-Value Fixed Targets
  – Man-in-the-Loop (MITL) Terminal Control
  – Interchangeable TV or IIR seeker
  – Interchangeable MK 84 or BLU-109 Penetrator Warhead
• Integrated on the F-15E Strike Eagle
• Platform - F-15E
• Warheads - MK-84/BLU-109
• Seekers - TV or IIR
• Guidance - Autonomous GPS/INS, Man-in-the-Loop
• Data Link - AXQ-14, ZSW-1
Chief of Staff, Air Force Directed Quick Reaction Capability Program to Provide Adverse Weather Enhancement to Legacy GBU-15 Weapon System

- Based upon “Urgent and Compelling Combat Need”
- Balkans Conflict Depleted Inventory of Precision, Standoff Weapons

Two-Phased Approach

- Phase I Program
  - Design, Test, Produce, and Field 100 weapons in 45 days
  - Provide “Interim” integration

- Phase II Program
  - Design, Test, Produce, and Field 1200 weapons in 12 months
  - Provide “Complete integration”
EGBU-15 STATUS

• Phase I Deliveries Complete; 50 Weapons Delivered in 44 Days; 100 Total Weapons Delivered in 69 Days

• Phase II Deliveries Complete; 1200 Weapons Delivered in 12 Months
  – 5 Development Test and 6 Operational Test Drops -- 11 direct hits!
  – Field Modifications Efforts Completed at Many Locations Worldwide
  – Final Advance Support Equipment, Mission Planning System, and Mission Squadron Trainer Upgrades Nearing Completion
  – Operational Training Completed at Most Operational bases Worldwide
LASER GUIDED WEAPONS
GBU/EGBU-24/27 MISSILE SYSTEM

DESCRIPTION

- Laser Guided Munition Designed for Horizontal and Vertical, Hardened and Deeply Buried Targets
  - Laser Designator (Aircraft or Ground)
  - Laser Guided MK 84 or BLU-109A/B 2000 Lb. Warhead
- Used on Heavily Reinforce Concrete Bunkers, SAM Sites, Etc...
- Integrated on the F-117, F-15, F-16, Navy F-14 & F-18
- Improvement Program
  - Autonomous INS/GPS Laser Guided Provides Adverse Weather Capability
Laser Guided Munition Designed for Super Hardened and Deeply Buried Targets
  - Laser Designator (Aircraft or Ground)
  - WGU 36A/B Laser Guidance Unit
  - BLU-113A/B Penetrator Warhead (5000 LB)

Developed in 34 days during Operation DESERT STORM

Integrated on the F-15E Strike Eagle
  - On Going Integration on the B-2

Improvement Program
  - Examining Improved Penetration
  - Autonomous INS/GPS Adverse Weather Capability
  - Hard Target Smart Fuze
Joint Air Force/navy Program to Develop Affordable, Adverse Weather, & Accurate Guidance Kit for 1000 and 2000 Pound Bombs... Eliminate Higher Cost, Limited Utility Interim Weapons

• INS/GPS Guidance Kit Attached to the Bomb Useing Controlled Tail Fin Movements to Direct Bomb to Target
• Fuzes: FMU-139, FMU-143, FMU-152 & DSU-33
• Allows US Forces Precision Engagement in All Flyable Weather
• Lethal...Multiple Kills Per Pass + Fire and Forget
• Interoperable...Bmbers, Fighters, Carrier, Bare Base – B-2, B-52, B-1, FA-18, AV-8B, F-22, F-117, F-16, F-15, JSF
• Affordable - Extremely High Capability to Cost Ratio
• AGM-158 Joint Air-to-Surface Standoff Munition (JASSM)
• A Joint Air Force and Navy Program to Provide an Autonomous, Medium Range, Conventional, Air-to-Surface, Precision Missile Able to Strike Highly Defended, High Value Targets
  – WDU-42/B (1000 Lb.) Warhead Provides Penetration, Blast & Fragmentation Kill Mechanism Against all Designated JASSM Targets
  – INS/GPS Mid-Course Guidance
  – I2R Seeker
  – Adverse Weather Capability
  – Fuze: FMU-156
• For Integration on F-16, B-52, B-1B, B-2, F/A-18
• 15 Year Bumper-to-Bumper Warranty
## FUZE/WEAPON COMPATIBILITY

<table>
<thead>
<tr>
<th>Weapon System</th>
<th>FMU 143</th>
<th>FMU 124</th>
<th>FMU 152</th>
<th>JUF</th>
<th>DSU 33</th>
<th>FMU 159</th>
<th>FMU 139</th>
<th>FMU 156</th>
<th>MEHTF</th>
<th>MAFIS</th>
<th>FMU 155</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mk 80 Series</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BLU-109/113</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JDAM</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>O</td>
<td>X</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBU-15/AGM-130</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBU-24/27</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JASSM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBU-28/37</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGM-142</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGM-86D</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>AUP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>TTPV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>TBD</td>
</tr>
<tr>
<td>JSOW Unitary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>TBD</td>
</tr>
<tr>
<td>SLAM/SLAM ER</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>TBD</td>
</tr>
</tbody>
</table>
FUZES/SENSORS SCHEDULE HISTORY

| CY | 68  | 69  | 70  | 71  | 72  | 73  | 74  | 75  | 76  | 77  | 78  | 79  | 80  | 81  | 82  | 83  | 84  | 85  | 86  | 87  | 88  | 89  | 90  | 91  | 92  | 93  | 94  | 95  | 96  | 97  | 98  | 99  | 00  | 01  | 02  | 03  | 04  | 05  | 06  | 07  | 08  | 09  | 10  |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| FMU-81 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-124 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FZU-39 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-113 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| DSU-33 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-139 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-143 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-152 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| FMU-159 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| MEHTF |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| MAFIS |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

- Development
- Production

NDIA Brief 4-17-01
Inventory Fuzes

Production/EMD Fuzes
# USAF FUZE INVENTORY
## UNGUIDED CLUSTERS

**Status March 2001**

<table>
<thead>
<tr>
<th>Function</th>
<th>Type</th>
<th>Quantity</th>
<th>Weapon</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>MK-339</td>
<td>81K</td>
<td>M129E1</td>
<td>Leaflets</td>
</tr>
<tr>
<td>Time or Proximity</td>
<td>TMD Fuze/</td>
<td>132K</td>
<td>CBU-87/89/97</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FZU-39</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## USAF FUZE INVENTORY
### GUIDED BOMBS

**Status as of March 2001**

<table>
<thead>
<tr>
<th>Function</th>
<th>Type</th>
<th>Quantity</th>
<th>Weapon</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact or Impact</td>
<td>FMU-81/B</td>
<td>37K</td>
<td>GBU-10/12 (LGB)</td>
<td></td>
</tr>
<tr>
<td>Delay</td>
<td></td>
<td></td>
<td>MK-82, MK-84</td>
<td></td>
</tr>
<tr>
<td>FMU-124</td>
<td>2.5K</td>
<td>GBU-15, AGM-130, AGM-142, MK-84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMU-139A/B</td>
<td>244K</td>
<td>GBU-24, AGM-65</td>
<td>Replaces FMU-81/B</td>
<td></td>
</tr>
<tr>
<td>FMU-143 B/B</td>
<td>11K</td>
<td>GBU-10/24/27, GBU-15, AGM-130, AGM-142, BLU-109/B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FMU-143 F/B, G/B, H/B</td>
<td>112, 157, 73</td>
<td>GBU-28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### FUZE INVENTORY
**GENERAL PURPOSE BOMBS**

Status as of March 2000

<table>
<thead>
<tr>
<th>Function</th>
<th>Type</th>
<th>Quantity</th>
<th>Weapon</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>M-904</td>
<td>824K</td>
<td>No Hi Drag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M-905</td>
<td>1.1M</td>
<td>No Hi Drag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FMU-54A/B</td>
<td>24K</td>
<td>No Hi Drag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FMU-54/B</td>
<td>8K</td>
<td>No Hi Drag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FMU-139 A/B</td>
<td>244K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximity</td>
<td>FMU-113</td>
<td>34.6K</td>
<td>No Hi Drag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSU-33A/B</td>
<td>5010</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DSU-33B/B</td>
<td>2447</td>
<td></td>
<td>(5635 in transit/Prod)</td>
</tr>
</tbody>
</table>
FMU-139B/B FUZE PRODUCT DESCRIPTION

- Electronic impact/impact-delay fuzing system designed for use with general purpose high-explosive bombs
- Delivered with FZU-48/B initiator, power cable (attached) and closure ring
- Provides multiple fuzing options for:
  - Tail fuzing only
  - Nose fuzing only, and
  - Nose and tail fuzing
FMU-139B/B FUZE

- FMU-139B/B fuze is interoperable with all FMU-139A/B applications
- Compatible with laser guided bombs and with low and high speed drag air foil groups
- Compatible with DSU-33A/B and DSU-33B/B proximity sensor
- FMU-139 currently in use with MK80 series Joint Direct Attack Munition (JDAM)
- Being Replaced by FMU-152 Joint Programmable Fuze
FMU-143 A-H/B FUZE DESCRIPTION

• Impact Delay Fuze for Penetrating Warheads (Single 0.060 Sec. Delay)
• Interface - BLU-109, BLU-113, AGM-142 I-800
• Power/safety - FZU-32B/B Bomb Fuze Initiator, GBU-15/AGM-130 Battery
• Used On - GBU-10, 24, 27, 28, 31, AGM-142, and AGM-130, (With BLU-109 or BLU-113 Warheads)
• Being Replaced By FMU-152, JPF
• Manufacturer - Dayron Inc., Orlando FL.
<table>
<thead>
<tr>
<th>Configuration</th>
<th>User</th>
<th>Modification</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMU-143B/B and FMU-143B(D-2)/B</td>
<td>AF, FMS, JDAM</td>
<td>Basic - 60ms Delay, 5.5 or 12 sec Arm Time</td>
</tr>
<tr>
<td>FMU-143D/B and FMU-143D(D-2)/B</td>
<td>AGM-142</td>
<td>21 Sec Arm Time</td>
</tr>
<tr>
<td>FMU-143E/B and FMU-143(D-1)/B</td>
<td>Navy</td>
<td>PBXN-7 Booster/Lead</td>
</tr>
<tr>
<td>FMU-143F/B</td>
<td>GBU-28</td>
<td>30ms Delay/21 Sec Arm</td>
</tr>
<tr>
<td>FMU-143G/B</td>
<td>GBU-28</td>
<td>60ms Delay Same</td>
</tr>
<tr>
<td>FMU-143H/B</td>
<td>GBU-28</td>
<td>120ms Delay Same</td>
</tr>
</tbody>
</table>
ADVANCED FUZES AND SENSORS

Joint Programmable Fuze

Hard Target Smart Fuze

DSU-33B/B Proximity Sensor
JOINT PROGRAMMABLE FUZE (JPF)

FMU-152/B
FMU-152/B JPF SYSTEM DESCRIPTION

- Single Fuze Compatible With Mk82, Mk83, Mk 84, BLU-109, BLU-113 for Use in AGM-130, GBU-10/12/15/16/24/27/28 and All JDAM Variants
- Can Be Used in Current FMU-139 and FMU-143 Applications
- Cockpit Selectable Arm/delay Times
  - Instantaneous to 24 Hours
- Multi-function Capability
  - Hard Target Penetrator Weapons
  - Blast Fragmentation
  - Backward Compatibility With Current Weapons
<table>
<thead>
<tr>
<th>Performance</th>
<th>Threshold Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weapon Interface</td>
<td>AGM-130, GBU-10/12/15/16/24/27/28, JDAM</td>
</tr>
<tr>
<td>Warhead Interface</td>
<td>MK-82/83/84, BLU-109/113</td>
</tr>
<tr>
<td>Low Drag Arm Time (Sec)</td>
<td>4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 10.0, 14.0, 21.0, 25.0</td>
</tr>
<tr>
<td>High Drag Arm Time (Sec)</td>
<td>2.0, 2.6, 3.0, 3.5, 4.0, 5.0</td>
</tr>
<tr>
<td>Impact Delay Times</td>
<td>0, 5, 15, 25, 35, 45, 60, 90, 180, 240 Msecs</td>
</tr>
<tr>
<td></td>
<td>15, 30, 45, 60 Min 4, 8, 12, 16, 20, 24 Hrs</td>
</tr>
<tr>
<td>Reliability</td>
<td>0.98</td>
</tr>
<tr>
<td>Service Life</td>
<td>10 Years</td>
</tr>
<tr>
<td>Shelf Life</td>
<td>20 Years</td>
</tr>
</tbody>
</table>

Note: Yellow Denotes Fuze Panel Switch settings
• Program Phase: Production
• Contractor: Dayron
• Current Unit Price: $2.167K
• Quantities: 62,000 (AF)/25,496 (Navy)
• Joint Service: Air Force (Lead)/Navy
• First Article Acceptance Testing - Summer 01
• JDAM High Altitude Low Airspeed Release Challenges
  – FZU-55 Improvements - LRIP 2 and Beyond
  – Additional FMU-152 Improvements - LRIP 4 and Beyond
HARD TARGET SMART FUZE (HTSF)

FMU-159/B
• Program Phase: EMD
• Contractor: Alliant Techsystems
• Value: EMD $18.5M, Prod $34M
• Quantities: 500+ (AF) / 500+ (Navy)
• Joint Service: Air Force (Lead)/Navy
• “Smart” Fuze for Penetrator Weapons
• Allows Defeat of High Value Hard Targets
VOID SENSING, LAYER COUNTING, DEPTH OF BURIAL CAPABILITIES

- Contains a precision accelerometer and microcontroller
- Senses voids and layers, computes depth of burial
- Detonates warhead at user programmed point within target
- Programmable modes
  - Void or Layer Count, and Depth of Burial
  - Function Distance/Time after Void/Layer event
  - Redundant Backup Timer 0 to 255ms
FMU-159/B HARD TARGET SMART FUZE
EMPLOYMENT PLATFORMS & WEAPONS

- **B-52H**: AGM-86D CALCM Penetrator
- **B-2A**: GBU-37, EGBU-28
- **F-15E**: GBU-28, EGBU-28, GBU-24/27
- **F-117A**: GBU-27
- **F/A-18**: GBU-24G/B (BLU-116)
- **F-14**: GBU-24G/B (BLU-116)
- **Missile Cruisers & Destroyers**: BGM-109H Tactical Tomahawk Penetrator
### FMU-159/B HARD TARGET SMART FUZE

**SCHEDULE SUMMARY MAR 01**

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Start</th>
<th>Finish</th>
<th>1999</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Award</td>
<td>8/11/98</td>
<td>8/11/98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design/Development</td>
<td>1/4/99</td>
<td>4/5/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical Design Review</td>
<td>5/10/00</td>
<td>5/11/00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor Test &amp; Eval</td>
<td>4/23/01</td>
<td>9/26/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qual Tests</td>
<td>6/7/01</td>
<td>9/26/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cannon Tests</td>
<td>4/23/01</td>
<td>6/13/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sled Tests</td>
<td>6/25/01</td>
<td>7/25/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPO1 Exercise / Begin Build</td>
<td>10/26/00</td>
<td>6/29/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DT&amp;E/OT</td>
<td>5/1/01</td>
<td>2/12/02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FZU-60 Flt Test</td>
<td>5/1/01</td>
<td>6/29/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sled Testing</td>
<td>8/9/01</td>
<td>12/4/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flt Test</td>
<td>12/5/01</td>
<td>2/12/02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPO2 Exercise / Begin Build</td>
<td>7/17/01</td>
<td>12/11/01</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NNMSB / WSESRB Final</td>
<td>2/27/02</td>
<td>2/27/02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCA / PRR MSIII</td>
<td>3/6/02</td>
<td>3/6/02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DSU-33 PROXIMITY SENSOR

Air Force Configured System

DSU-33  FZU48/B/55/B Initiator  FMU-139/152 Fuze  M117 Mk 80 Series Bomb

A/B

B/B
Current Production With Alliant Techsystems
Air Burst Proximity Fuzing for Mk80 Series/m117 General Purpose Bombs and JDAM Variants
Continuous Wave Doppler Radar Provides Fire Pulse Signal to the FMU-139 and FMU-152/B
  - Height of Burst (HOB): 20 Feet
  - Over All Water and Land Surface Conditions
Attacks Surface Level Targets
9,996 Units Deliverd Thru Mar 2001 (AF & Navy)
  - 3501 Remaining
CHALLENGES FOR TODAY’S AND TOMORROW’S FUZE PROGRAMS

• Shrinking Industrial Base
• Increasing Complexity & Cost
• Diminishing Verification Opportunities
• Aging Inventory
• Increasing Expectations
• Aircraft & Missile Interface Challenges
SHRINKING CONVENTIONAL FUZE INDUSTRIAL BASE

1987
31 Companies

1991
17 Companies

1995
12 Companies

1999
7 Companies

2001
7 US & International Consortums

* Source: Army Fuze Management Office
JOCG Fuze Subgroup Meeting 11 Aug 99
• Funding Requirements in Support of Current Operations and Declining Acquisition Budgets Negatively Impact Development and Production Efforts
  – Fewer New Starts
  – Smaller Production Quantities Spread Over Longer Periods
• Increasing Reliance on Electronic Fuzing Reduces the Need for Older Mechanical Fuzes
  – Requires Higher Level of Technical Ability
  – Fuze Contractors Must Adapt or Face Dwindling Business
• Opportunity - DSU-33 Production Competition for FY 02-07 Requirements
SHRINKING INDUSTRIAL BASE
(CONT)

- Erosion of Essential Human Resources
  - Technical Expertise is there, but in insufficient numbers
  - Lack of Technical Breadth/Experience impacts Problem Solving
    - No Technical Surge Capability
    - Failure Analysis Slow
    - Limited Understanding of Fuze Design and Operation
      - Government In-house Expertise is Retiring (Vietnam/Post-Vietnam era)
      - Recruiting and Retention is a major Challenge in this Market Sector
- JOCG Fuze Subgroup to Brief JOCG in Sep 01 on Industrial Base Status
INCREASING COMPLEXITY AND COST

• Single Fuze Combining the Function of Several Fuzes
  – e.g., FMU-152/B JPF Is Both a Blast-frag and Penetrator Fuze
• Designs Take Advantage of Modern Electronics and Computer Technology
  – More Versatile, More Precise
  – More Complex Sensing and Logic Functions
• Mission Planning Becomes More Detailed and Critical
• FMU-159/B Hard Target Smart Fuze
  – Void/layer Count, Timer, Back-up Timer
  – Programmable With 22 Settings on the Ground, 11 From the Cockpit
• Multi-event Hard Target Fuze
  – Thin Layer Detection, in Addition to Voids/timers
  – Cockpit Programmable
  – Fuze Information for Bomb Damage Information
DIMINISHING VERIFICATION OPPORTUNITIES

- Advanced Fuze Verification Programs Are Very Expensive and Necessitate Limited Test Programs
  - Targets to Verify Fuze Performance Are Large, Multi-floor Structures
- FMU-152/B - 5 Sled Tests, 193 Flight Tests (DT/OT)
- FMU-157/B (ACTD) - 23 Sled Tests, 32 Flight Tests
- FMU-159/B - 18 Sled Tests, 11 DT Flight Tests, 2 OT Flight Tests
  - No AF GBU OT&E Because of High Cost and Limited AFOTEC Budget
  - Original AF GBU OT&E Planned for 13 Flights Using 19 Weapons
AGING INVENTORY

• Much of Fuze Inventory Is Approaching End of Expected Life
  – Historically at 20 Years Reliability Problems Begin
  – AF Generally Accepts Older Fuzes at 90% Reliability With 90% Confidence
    • After That Either Double Fuze or Put 2 Weapons on Target
• Reliability of Older Fuzes Is a Current Issue
  – FMU-124B/B Surveillance Testing Failures (6 out of 72)
• Lack of Comprehensive Replenishment Plan
  – Insufficient Budgets to Efficiently Replace Older Inventory
• Refurbish or Replace?
  – FMU-139
    • AF - Replace With FMU-152 Over Time
    • Navy - Rebooster Challenges
INCREASING EXPECTATIONS

• Warfighters Expect “First Time - Every Time” Performance
  – Objectives of 98% Reliability
• “Smart” Communications
  – Cockpit Programming Is Now Standard
  – Bomb Damage Information Is Desired for the Future
• Fuze Must Perform in Ever-expanding Performance Envelopes
• Fuze Design Capturing System Responsibilities
  – High Altitude, Low Airspeed Release Conditions
  – Navy Fuze Function Control Set (FFCS)
• Safety Certification of Electronic Fuzes Is More Difficult Than Mechanical Fuzes
  – Old Paradigms Don’t Apply
AIRCRAFT AND MISSILE INTERFACE

CHALLENGES

• Navy Fuze Function Control Set
  – Anomalies Yielding Low Reliability With Electrically Fuzed Bombs (E.G., F/A-18 - 88%)
• High Altitude - Low Airspeed Release
  – Initiator Turbine Starved for Air Causes Arming Problems
  – JDAM Roll Stabilized Flight and AoA Compounds the Situation
• Long Term Storage Reliability and Safety Requirements While Installed in Cruise Missiles
• Allied Interoperability
  – Fuze Well Size
  – Fuze Power Source
  – Communications Interface
POSITIVE RESULTS

• Significantly Increased Capabilities
  – Performance Characteristics
    • Void/layer Detection
    • Increased Survivability
    • Cockpit Programmability
  – Very High Reliability Requirements
    • HTSF and JPF - .98 (Mission), .95 (Storage)
    • MEHTF - .99 (Mission and Storage) Goal
• Joint Programs Are the Norm
  – DSU-33, JPF, HTSF
• Growing Realization of Critical Nature of Fuzing
  – Fuzing Is Small Diameter Bomb’s (SDB) #1 Risk
  – HTSF Is on CALCM 86-D Critical Path
  – Major Growth Area for JDAM
Video
Any Questions?