Hard Target Fuzing Perspective

- Weapon Background and Capability
  - Paveway™ IV
- Fuze Background
  - MEHTF-PSFT
- Fuze Second Environment Sensing
- Programme Status
The Paveway™ IV Family Tree

**Raytheon Systems Limited**

**Paveway™ II**
- Laser Guided
- Bomb family

**UK EPII UOR**
- All-Weather
- Dual-Mode GPS & Laser Guided
- Combat Proven

**EP II Lot 3**
- All-Weather Dual Mode
- GPS A/J SAASM
- Mk 80 series/BLU 109

**Common Guidance Electronics**
- Paveway Global Factory
- All manufactured by RSL in Glenrothes

**Paveway™ IV Baseline**
- GPS A/J SAASM
- Air Burst
- Smart Fuze
- Mk 82 Improved Warhead with IM

**Paveway™ IV**
- All-Weather Dual Mode

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Missile Electronics
Paveway™ IV Components

- Low Drag Hardback/Harness cover
- GPS Antennae (top and bottom)
- Integrated GPS Aided Inertial Navigation System and Laser Guidance Electronics Assembly
- Adjustable Mil-STD-1760 connector
- Interoperable with MACE Saddles or Bail Lugs
- Conformal Height of Burst Antennae (two places)
- Modified Paveway™ II Control Section
- Improved Mk 82 Warhead
- Programmable Smart Fuze
- Modified Paveway™ II Tail Section
- Interoperable with MACE Saddles or Bail Lugs

Raytheon Systems Limited

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GPS Antennae (top and bottom)

Integrated GPS Aided Inertial Navigation System and Laser Guidance Electronics Assembly

Low Drag Hardback/Harness cover

Adjustable Mil-STD-1760 connector

Interoperable with MACE Saddles or Bail Lugs

Conformal Height of Burst Antennae (two places)

Modified Paveway™ II Control Section

Improved Mk 82 Warhead

Programmable Smart Fuze

Modified Paveway™ II Tail Section

Raytheon Systems Limited
Company Background

TME is a Fuzing Company
Building hardened fuzes since 1914
World’s first In service Proximity Fuze (710 Electro Optical Pistol) ('42)
World's first hardened and electronic multifunction bomb fuze (MFBF) - 1981
  ■ 27,500 MFBF built
  ■ Successful FCT trial at Eglin - 1992
  ■ Used by RAF, RSAF and USAF in Desert Storm
  ■ Kosovo data indicates >99% reliability for MFBF in 400+ releases
Pioneer in modern fuze hardened electronics

1918 - Shell Fuzing
1940’s - Airborne Radar, Shell Fuzing, Proximity Fuzing (Rockets)
  Bomb Fuze for “Bouncing Bomb” etc.
1950’s - Naval Proximity Shell Fuzing
1960’s - No.907 RF Proximity Fuze for Bombs.
1970’s - No.952 RF Proximity Fuze for Bombs.
  Multi Role programmable Shell Fuze (MRF)
1980’s - SG357 Runway Cratering Weapon
  MFBF (No.960) Multi-Function Bomb Fuze
1990’s - Intelligent Hard Target Fuzing Research
  EPIFS
2000’s - Intelligent Hard Target Fuzing.
  MAFIS, HTSF, MEHTF
  PGB/ABF
  BDI/BDA
  Fuzing in High Speed Impacts
  Paveway IV
TME Bomb Fuzing Family Tree

- MFBF
- MAFIS
  - IF research since 1995
  - MEHTF
    - PSFT
    - FIBDID
    - AURORA
  - Storm Shadow
  - JSOW
Background To PGB Fuze

- MFBF
- MAFIS
- JSOW
- Storm Shadow
- MEHTF
- PSFT
- AURORA
- Paveway IV (PGB)

IF research since 1995

< 2/3 g seen
< 1/3 g seen

Example for Illustration

Accelero meter works

Free Fall Observed

Paveway IV (PGB)
Summary of Requirements for Safety Sensors:

1: Sense the Intentional Release from the launch platform

2: Confirm Weapon has been released into the expected environment

(Operation of at least one of the independent safety features shall depend on sensing an environment after first motion in the launch cycle or on sensing a post launch environment. ) STANAG 4187 6b3
Typical Sensors used in past

Air speed,

Can provide power sources

(Bigger Area :- More Power {& Drag!})

But: Senses an environment that
is not totally unique to “release”
(mainly is “lanyard pulled”)
Also issues with high altitude, thin air,
Damage, drag etc.
Fuze Second Environment Sensing

Typical Sensors used in past

Air pressure:
- Pitot (air speed)
- Motor operating
Typical Sensors used in past

Acceleration sensing:
Parachute operation detection
(Both Mechanically and Electrically)
PSFT Phase II Research added Improvements on MEHTF

- **Improved Safety Architecture**
  - Late Arm
  - Potential for different Arming sensor suites
    - Release Environment Observation
PSFT Fuze Internal “Second” Environment Sensing

PSFT introduced crossed axis MEMS Accelerometers and Processor to sense Post Release Environment.

EXAMPLE: Internal Fuze Accelerometers monitor unique post launch zero g environment to confirm post launch environment. Accelerometer confirmed OK by sensing release & or carriage loads.
AURORA Fuze for PGB (Paveway IV)

Develop, qualify & manufacture, 2003 - 2006

Built on PSFT:

Decided to make system independent of release shocks:

Initially: use a Timed Manoeuvre

- Release from aircraft = T0
- Environment Confirmed
- Unique Manoever sensed
- Accelerometer works

Example for Illustration
AURORA Fuze for PGB (Paveway IV)

PGB PSFT Accelerometers and New Hardware to sense Timed, Co-operative Weapon Post Release Manoeuvre

Release from aircraft = T0

WAM Observed

Modelling undertaken of 1000 simulated releases

WAM Timing and Phase Observed

Accelerometers work
AURORA Fuze for PGB (Paveway IV)

WAM Option
Initial Concept

Release from aircraft = T0

Environment Confirmed

Unique Manouver sensed
Accelerometer works

Example for Illustration
**Further Improved concept:**

- Allow weapon to determine when to make manoeuvre:
- Simplify Manoeuvre into 2 Stages:
- Add Late ARM signal

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**Diagram:**

- **Late Arm Signal**
- **Charge:**
- **ARMED:**
- **Ballistic Free Fall**
- **Pull-Up Manoeuvre**

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**W COMMAND**

- ~ 500 ms
AURORA Fuze for PGB (Paveway IV) ‘WAM’ / ‘WAD’

Advantages:

- Manoeuvre is at commanded time:
  - Can be delayed to Lower Altitudes
  - When convenient to Weapon
  - Expands release envelope

- Is simpler to detect
  - All “Hardware” checking logic
  - No Software

Ballistic Free Fall Pull-Up Manoeuvre

~ 500 ms