Overview

• Predator mission
• Predator weapons integration objective
• MQ-1B Predator weapons integration and test
  – Hellfire
  – Stinger
• MQ-9 Predator B weapons integration and test
  – GBU-12
  – Hellfire
• Summary
Predator Mission

- Interdiction and armed reconnaissance against critical, perishable targets
- Reconnaissance, surveillance and target acquisition in support of the Joint Forces commander
Armed
- Is what it has always been
- Weapons coming off airplanes
- But now with precision accuracy
• **Reconnaissance is now accomplished with:**
  – Persistent airborne platform
  – Day and night streaming video
  – Synthetic aperture radar to image through clouds
  – Near instantaneous distribution world wide
Mission

- **Long Endurance Armed Reconnaissance**
  - 30-50 hr flight times
  - Camera and radar sensors to detect
  - Precision weapons to destroy

- **To make it routine**
  - The pilot/crew had to come out of the airplane
  - The airplane had to be reliable enough to run for 30 – 50 hr per flight
  - A control scheme had to be developed in order to fly the airplane anywhere
  - Unique distribution and reception systems
Ground Control Station (GCS)

- C-Band Line-of-Sight (LOS) data link for take off, landing
- $K_u$-Band satellite link for missions over the horizon
Multi-Aircraft Control GCS
Line of Sight

Forward Pass

Airborne Relay

Satellite Relay

Control from Anywhere in the World
• Overall objective of Predator precision weapons integration:
  – Provide persistent ability to hold time sensitive targets at risk any time, any place
  – Enable compression of end-to-end kill chain
Predator History

- First flown 1994, deployed to the Balkans 1995
- Modified to carry Hellfire 2001
- Fleet hours now over 215,000, 2/3 in combat
**Hellfire**

**HELLFIRE AGM-114C**
- Weight: 98 lb
- Length: 64 in
- Min range: 0.5 km
- Max range: 8.0 km
- Velocity: Mach 1.3

**M-299 Hellfire Launcher**
- Weight (4 rail): 145 lb
- Weight (2 rail): 96 lb
- Standard: 14” lugs
- Built-in safe arm switch

---

General Atomics Aeronautical Systems

12
MQ-1 Hellfire Testing

- **Incremental build-up**
  - Ground static live fire
  - Phase 1 flight test: AGM-114C at low altitude
  - Phase 2 flight test: AGM-114K/M at higher operational altitudes
  - AGM-114 P flight test: AGM-114P designed specifically for Predator to allow high off boresight shots
Hellfire Static Ground Launch
Static Ground Launch (Cont.)
Hellfire Phase 2 Flight Test
Operational Mission Using Hellfire
Air-to-Air Stinger Weapon System

- **Accurate and lethal system**
  - Fire and forget missile
  - Two color IR/UV seeker
  - Effective against all known countermeasures

- **Currently fielded on OH-58C, OH-58D, and MH-60 helicopters**

<table>
<thead>
<tr>
<th>Missile Length</th>
<th>58 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missile Diameter</td>
<td>2.75 in</td>
</tr>
<tr>
<td>Missile Weight</td>
<td>23 lbs</td>
</tr>
<tr>
<td>Missile Speed</td>
<td>Up to Mach 2</td>
</tr>
<tr>
<td>Air-to-Air Carriage System</td>
<td>Two per launcher</td>
</tr>
</tbody>
</table>
Predator Stinger Flight Test Program

• Contract award 25 Sep 02, completed in 56 days

• Captive Carry Tests
  – Functional air-to-ground tests
  – CONOPs development
    • Cessna 206 engagements
    • F-16 engagements

• Live-Fire Tests
  – All air-to-ground launches
  – Operations based from China Lake NAWC
  – Varied aircraft communications
    • C-band LOS
    • Ku-band SATCOM
  – Eight missile launches
    • Four Blast Test Vehicles
    • Four Full-up Rounds
Predator Stinger Flight Test Program

- **Captive Carry Test Results**
  - Robust air-to-ground capability
  - Initial air-to-air CONOPs developed

- **Live Fire Demonstration Results**
  - Safe separation from all eight missile shots
  - Four Full-up Rounds
    - Shot 1: Impact between ground targets
    - Shot 2: Timed self-destruct prior to target
    - Shot 3: Timed self-destruct prior to target
    - Shot 4: No self-destruct – potential missile failure
  - Set world record for highest Stinger Missile launch (20,000’ MSL)
Stinger Operational Use
MQ-9 Predator B System Description

- **Mission:**
  - Hunter-Killer: Prosecute critical emerging time sensitive targets as a radar-based attack asset with organic hard-kill capability
  - ISR and target acquisition

- **History**
  - First flown 2001
  - Currently integrating GBU-12, GBU-38 and Hellfire under the MQ-9 System Development and Demonstration (SDD) program
MQ-9 Predator B System Description (cont)

<table>
<thead>
<tr>
<th></th>
<th>Predator</th>
<th>Predator B</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTOW</td>
<td>2,250 lb (1022 kg)</td>
<td>10,500 lb (4772 kg)</td>
<td>4.6</td>
</tr>
<tr>
<td>HP</td>
<td>105</td>
<td>900</td>
<td>8.6</td>
</tr>
<tr>
<td>Maximum Altitude</td>
<td>25,000</td>
<td>50,000+</td>
<td>2</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>120 KTAS</td>
<td>240 KTAS</td>
<td>2</td>
</tr>
<tr>
<td>Fuel</td>
<td>600 lb</td>
<td>4,000 lb</td>
<td>6.6</td>
</tr>
<tr>
<td>Payload Nose</td>
<td>450 lb (204 kg)</td>
<td>800 lb (363 kg)</td>
<td>1.8</td>
</tr>
<tr>
<td>Payload Wing</td>
<td>250 lb (113 kg)</td>
<td>3,000 lb (1363 kg)</td>
<td>12</td>
</tr>
<tr>
<td>Endurance</td>
<td>40 hr</td>
<td>30 hr+</td>
<td>.75</td>
</tr>
</tbody>
</table>
MTS-B EO/IR Payload
Lynx SAR

1m resolution

0.3m resolution

Dwell spot 0.1m

Drill-down zoom sequence with SAR and EO-imagery
Lynx 3D Targeting

- Spot images collected at three (3) points
- Ability to cue EO/IR sensor or pass target coordinates to weapons

Example 30 Kft Flight Path
**GBU-12 Munition**

- **GBU-12 Munition**
  - 500 lb class weapon
  - Part of the Paveway II family of munitions
  - Semi-active laser guidance
  - Bang-bang autopilot control
  - No electrical connection to the host aircraft

- **Currently in service with the US Air Force and US Navy**

<table>
<thead>
<tr>
<th>Munition Length</th>
<th>129 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Munition Diameter</td>
<td>11 in</td>
</tr>
<tr>
<td>Munition Weight</td>
<td>609 lb</td>
</tr>
<tr>
<td>Fuze</td>
<td>FMU-81</td>
</tr>
<tr>
<td>Booster</td>
<td>FZU-2</td>
</tr>
</tbody>
</table>
BRU-15 Bomb Rack

- **BRU-15/A Bomb Rack**
  - Electro-mechanical gravity rack
    - No pyrotechnics or pneumatic actuation
  - Release via 28 v electrical impulse

- **Currently fielded on the P-3B and P-3C Orion aircraft**

<table>
<thead>
<tr>
<th>Rack Length</th>
<th>23.5 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rack Height</td>
<td>5.4 in</td>
</tr>
<tr>
<td>Rack Weight</td>
<td>16 lb</td>
</tr>
<tr>
<td>Standard Suspension</td>
<td>14 in</td>
</tr>
<tr>
<td>Aero 1A Adapter Suspension</td>
<td>30 in</td>
</tr>
</tbody>
</table>
Human Machine Interface

- Steering Line
- Release Scale
- Height Above Target (HAT)
- Time to go to Release (Optimum)
- Range to Target in NM
- Target Impact Countdown Timer
- Weapon Status
GBU-12 and Hellfire Test Program

• **Standard test program for weapons integration**
  – *Ground*:
    • Ground vibration tests
    • Drop test
    • System Integration Lab (SIL) test
  – *Flight*:
    • Separation tests
    • Handling qualities
    • Guided inert drops/launches
    • Guided live drops/launches
GBU-12 Separation Testing
GBU-12 Live Drop
MQ-9 With Hellfire and GBU-12
MQ-9 Hellfire Flight Test
Summary

- **MQ-1 and MQ-9 are well suited for precision weapons delivery**
  - Designs allow easy mission role expansion
  - Man-in-the-loop allows for positive control of weapons employment
  - Satellite control and persistence allows weapons to be in the right place at the right time to engage time sensitive targets

- **MQ-1 continues to be a vital weapon system in the GWOT**

- **MQ-9 will bring significant additional capability to the fight**