Homeland Defense

To: 2014 Space And Missile Defense Conference

By: VADM J. D. Syring, USN
Director
Missile Defense Agency
August 13, 2014
FTG-06b Mission Overview
- Successful Intercept -

Successfully Intercepted an Exo-atmospheric Kill Vehicle Target Scene at 22 June 2014.

- Capability Enhancement-II, Exo-atmospheric Kill Vehicle Intercepted a long-range target
- USS Hopper (Aegis BMD ship) acquired the target and sent track data to the Command, Control, Battle Management, and Communications (C2BMC) system
- C2BMC forwarded Aegis BMD track data to GMD Fire Control
- Sea-Based X-band Radar provided track data on the target complex to the GFC

GBI Launch from Vandenberg AFB

Exo-atmospheric Kill Vehicle Target Scene

Intercept

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Agenda

• Program history
• Ground-based Midcourse Defense program achievements
• Testing
• Vision for the future
• Criticisms and responses
North Korea Taepo Dong-1 Launch
31 August 1998

• TD-1 SLV launch demonstrated key technologies needed to develop an ICBM
  - Stage separation
  - A 3-stage SLV could deliver light payload to the United States
  - 3rd stage failed to place a satellite in orbit
• 3rd stage was unanticipated
• US Intelligence had been reporting on the TD-1
  - Timing of the launch was a surprise
• Affirmed 1998 Rumsfeld Commission Findings
• Led to revitalization of National Missile Defense program

Sources: OSD, Proliferation: Threat and Response, 1996, 2001
NASIC, Ballistic and Cruise Missile Threat, 2000

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Recent Ballistic Missile Developments

“If the US imperialists threaten our sovereignty and survival... our troops will fire our nuclear-armed rockets at the White House and the Pentagon, the sources of all evil,“

--North Korean Vice Marshal Hwang Pyong-So, 28 July 2014

“Persistent spoilers. One of them is North Korea. North Korea fired off another missile, another ballistic missile today. North Korea is -- has been in the process of firing off these missiles, been in the media, and they are essentially desensitizing us because they want to know or they want us to know that they have this capability. But that is a -- that is clearly a spoiler.”

--LTG Michael Flynn, Director, DIA

Iran claimed ... to have test fired two homemade missiles, including “a laser-guided surface-to-surface and air-to-surface missile and a new generation of long-range ballistic missiles carrying Multiple Reentry Vehicle payloads,” according to Fars.

SUMMARY OF BALLISTIC MISSILE DEFENSE RDT&E PROGRAM

• Aggressive RDT&E Program
  - Without Commitment To A Single Architecture
  - With No Procurement Until Ready
  - Employs Parallel Risk Reduction Paths To Mitigate Potential Cost/Schedule/Performance Problems
  - Capabilities Based Vs. Requirements Based
  - Robust Testing

• Multilayer, Multi-faceted Development Program
  - Protect U.S., Allies, Friends And Deployed Forces
  - Managed As One System
  - Explores Air, Sea, Ground and Space Concepts
  - Designed To Intercept Any Range Of Threat
  - Designed To Intercept Threat In Boost, Midcourse, Terminal Phase

• Structured To Permit Test Asset For Operational Use On An Interim Basis, If Directed
DIRECTION TO THE MISSILE DEFENSE AGENCY

- Rapidly Capitalize On Promising Concepts And Promptly Adjust Program Priorities By Ensuring Rapid Decision Making Cycle Times
- Streamline Executive Oversight And Executive Reporting Requirements
- Management Of BMDS Elements in Three Phases (Development, Transition, Procurement and Operations)
- Single Development Program For All Work
- Improve BMDS System Through Incremental Improvements
- Ensure International Cooperation Remains Key Long-term Component
- Tailor DoD Planning, Programming And Budget System To Be Consistent With New SECDEF Direction
“... The United States plans to begin deployment of a set of missile defense capabilities in 2004. These capabilities will serve as a starting point for fielding improved and expanded capabilities later.”

“... will not have a final, fixed missile defense architecture... Rather, we will deploy... initial capabilities that will evolve... 2004 and 2005 will include ground-based interceptors, sea-based interceptors, additional Patriot (PAC-3) units, and sensors on land, at sea and in space.”

“... Missile defense cooperation will be a feature of U.S. relations with close, long-standing allies... protecting not only the United States and our deployed forces, but also friends and allies;...”

“Recognizing the evolutionary nature of our missile defense program, the Secretary of Defense, as appropriate, shall update me and propose changes.”
GMD Program History 2002-2004

Eareckson, AS
Cobra Dane
DSCS
IFICS Data Terminal

Across the US
GMD Communication Network

Ft. Greely, AK
LDC-1 thru LDC 5 Jul – Sep 2004
DSCS

Colorado Springs
GFC Node (Schriever AFB)
DSCS

Pacific Ocean
Remote Workstations (Cheyenne Mtn)

Buckley AFB
Aegis BMD AN/SPY-1 Radar

Vandenberg AFB
Launch Facilities LF-02, LF-03

President Bush announced intent to deploy initial system NSPD-23 December 2002

IFT-8 Mar 2002 CE-0
Intercept Test
Successful Intercept

IFT-9 Oct 2002 CE-0
Intercept Test
Successful Intercept

IFT-10 Dec 2002 CE-0
Intercept Test
Successful Simulated Intercept

IFT-13B Jan 2004 MMU+
Booster characterization Test

Five consecutive successful CE-0 Intercept Tests

X Failure in Laser Firing Unit
GMD Program History
2004-2007

October 2004

- LDC-6 FGA Nov 2004
- LDC-7 & 8 VAFB Dec 2004
- SBX Platform and Payload Integration April 2005
- AN/TPY-2 ESG Integration
- Beale UEWR
- GCN Expansion to UK
- LM BV+ Program Terminated Nov 06
- Fylingdales, UK
- 21 GBIs at FGA
- Sea-Based X-Band Radar
- 3 GBIs at VAFB

September 2007

- IFT-13C Dec 2004 CE-0+
  Intercept Test
  - Software Error
- IFT-14 Feb 2005 CE-0+
  Intercept Test
  - Silo Support Arm Failure
- FT-1 Dec 2005 CE-I
  Independent Review Team Established To Review GMD Flight Test Failures
  Successful Demonstration Flight
- FTG-02 Sep 2006 CE-I
  Intercept Test
  Successful Intercept
- FTX-02 Mar 2007
  Successful Simulated Engagement
  Target Failed to reach sufficient altitude
- FTG-03 May 2007
  NO TEST
  Successful Intercept
- FTG-03a Sep 2007 CE-I
  Intercept Test
GMD Program History
2007-2012

October 2007

- FTG-05 Dec 08 CE-I
  - Intercept Test
  - Successful Intercept

- European Interceptor Site Planned Start 1QFY08
- European Midcourse Radar Planned Start 4QFY08
- GM European Component canceled to support MDA PAA 1Q10
- 26 GBIs at FGA Sep 10
- Missile Field 2 Apr 12

September 2012

- FTG-06 Jan 10 CE-II
  - Intercept Test
  - X DACS Lockwire missing and SBX stopped radiating

- FTG-06a Dec 10 CE-II
  - Intercept Test
  - X High Frequency Vibrations caused Track Gate Anomaly

- Return To Intercept Initiated
GMD Program History 2013-Today

SECDEF Announcement March 2013

- Add 14 Ground-based Interceptors at Fort Greely
- Refurbish Missile Field 1 Harden 6 Silos
- Upgraded Inertial Measurement Unit (IMU)
- New Servers and Improved Software Capability
- Booster Avionics Upgrades
- 2nd AN/TPY-2 Radar, Japan (end 2014)

Present

- Ft. Drum IFICS Data Terminal (IDT) Construction

2013

- CTV-01 Jan 2013 CE-II
- FTG-07 Jul 2013 CE-I

2014

- EKV Characterization Test
- Intercept Test
- EKV battery
- Successful Flight Test
- X

Authorized Document Numbers:

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### GMD Flight Test Failures

<table>
<thead>
<tr>
<th>Flight Test</th>
<th>Date</th>
<th>EKV</th>
<th>Failure</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFT-4</td>
<td>JAN 2000</td>
<td>CE-0</td>
<td>Seeker Anomaly</td>
<td>Coolant blockage</td>
</tr>
<tr>
<td>IFT-5</td>
<td>JUL 2000</td>
<td>CE-0</td>
<td>No booster/EKV separation</td>
<td>Surrogate booster data bus failure</td>
</tr>
<tr>
<td>IFT-10</td>
<td>DEC 2002</td>
<td>CE-0</td>
<td>No booster/EKV separation</td>
<td>Failure in Laser Firing Unit</td>
</tr>
<tr>
<td>IFT-13c</td>
<td>DEC 2004</td>
<td>CE-0+</td>
<td>GBI Aborted Launch</td>
<td>OBV booster BIT failure (software error)</td>
</tr>
<tr>
<td>IFT-14</td>
<td>FEB 2005</td>
<td>CE-0+</td>
<td>GBI Aborted Launch</td>
<td>Rusted release arm</td>
</tr>
<tr>
<td>FTG-06</td>
<td>JAN 2010</td>
<td>CE-II</td>
<td>Guidance error</td>
<td>Missing DACS lockwire and SBX stopped providing data earlier than planned</td>
</tr>
<tr>
<td>FTG-06a</td>
<td>DEC 2010</td>
<td>CE-II</td>
<td>Guidance error</td>
<td>High frequency vibrations caused track gate anomaly</td>
</tr>
<tr>
<td>FTG-07</td>
<td>JUL 2013</td>
<td>CE-I</td>
<td>No booster/EKV separation</td>
<td>EKV battery</td>
</tr>
</tbody>
</table>
Track Gate Anomaly (TGA)

- Track Gate Anomaly (Pointing Error) Has Been A Long Historical Issue
  - First observed in 2001 during IFT-6
  - Observed in 8 flight tests over 9 years

- Complex Issue, Difficult to Diagnose and Correct
  - Initial Assessment from 2001 to 2005 - Caused by electromagnetic interference (EMI)
  - Updated Assessment from 2005 to 2014 – Caused by vibrations and IMU sensitivity

- Corrective Actions Implemented Over Time
  - Multiple iterations of software mitigations
  - IMU mounting modification
  - Additional instrumentation
  - Grounding cable changes
  - Divert live fire testing
  - IMU vibration testing
  - Updated IMU firmware
  - Added isolation cradle around IMU

- Resolution successfully demonstrated in FTG-06b
Ground-Based Interceptor Engineering Timeline

1999 2000 2001 2002

1. CE-0 to Test Bed (Manufacturing transition)
   Test Bed – Significant change from laboratory build to manufacturing facility – welded lines, EU, IMU, and sensor producibility, improved discrimination algorithms, global shielding, new battery, new communications link frequency

2. Test Bed to CE-I (Connector Obsolescence)
   CE-I – minor obsolescence modification when new lot of 15 interceptors placed on contract

3. CE-I to CE-II (Processor Obsolescence)
   CE-II – processor obsolescence addressed when new lot of 10 interceptors placed on contract; increases number of objects EKV can track; minor algorithm performance improvements

- Initial Defensive Capability deployment decision (CE-I EKV)
- Performance became Capability-Based
- Some requirements deferred
- Concurrent manufacturing and testing
# GMD Program Timeline

## Drivers for Change

- **NSPD 23**
  - IFT-13c Failure
  - IFT-14 Failure

- **MRTF Charter**

- **Affordability**
  - Missle Defense Plan II Added To Block 2006
  - 10 Additional Silos And GBIs At Ft. Greely
  - 10 GBIs At Third Missile Site
  - 2-Stage variant for 3rd Site
  - Midcourse Radar in Czech Republic
  - Upgrade Thule EWR

- **Presidential Mandate**
  - Refocus program to prioritize verifying capability & improving confidence in the fielded System through operationally realistic testing

- **RTI**
  - FTG-06a Failure Resolutions with Successful CTV-01 and FTG-06b to Support Manufacturing Restart
  - GBI reliability improvement
  - Missile Field 2 completion
  - DSC award and transition

- **SECDEF Mandate**
  - Increase operational fleet of Ground Based Interceptors (GBIs) from 30 to 44 in 2017
  - Missile Field 1 Refurbishment
  - Interceptor Reliability Enhancements
  - Plan for 14 additional GBIs

## Priorities

- **Test Bed Construction**
- **Build, Test, And Verify Initial Defensive Capability**
- **Place BMDS On Alert**
- **Execute Concurrent Testing And Defensive Operations**
- **Continue Development To Incrementally Improve Capability**
- **Demonstrate Increased Confidence in Capabilities and Increase Test Realism**
  - Reduce Booster Risk
  - Conduct Flight Tests to Verify, Not to Discover
  - Conduct the Next Flight Mission As Soon As Practical Within Acceptable Risk Bounds
# GBI Fleet Deployment History

<table>
<thead>
<tr>
<th>Tests</th>
<th>FY04</th>
<th>FY05</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
</tr>
<tr>
<td>Tests</td>
<td>CE-0+CE-0+</td>
<td>CE-1</td>
<td>CE-1</td>
<td>CE-1</td>
<td>CE-1</td>
<td>CE-1</td>
<td>CE-1</td>
</tr>
<tr>
<td></td>
<td>IFT-13 IF-14</td>
<td>FT-1</td>
<td>FT-2</td>
<td>FTG-03a</td>
<td>FTG-05</td>
<td>FTG-06</td>
<td></td>
</tr>
<tr>
<td>EMPLACEMENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GBI #</td>
<td>1-4</td>
<td>5-8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

- **CE-I**: Non Intercept Test
- **CE-II**: Successful Intercept Test
- **FTG**: Failed Intercept Test

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## Ground-Based Midcourse Defense Fielding

<table>
<thead>
<tr>
<th>GMD Subsystem</th>
<th>Initial Defensive Operations 2004</th>
<th>Today’s Capability</th>
<th>Future Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interceptor Fleet</strong></td>
<td>• CE-I GBI</td>
<td>• 30 CE-I and CE-II GBIs</td>
<td>• 44 CE-I, CE-II &amp; CE-II Block 1 GBIs (2017)</td>
</tr>
<tr>
<td><strong>Missile Fields</strong></td>
<td>• Ft Greely Alaska (FGA) Missile Field (MF) 1 – 6 silos</td>
<td>• FGA MF 2 – 14 silos</td>
<td>• FGA MF 1 Upgrade – 6 silos</td>
</tr>
<tr>
<td></td>
<td>• Vandenberg AFB (VAFB) – 2 silos</td>
<td>• FGA MF 3 – 20 silos</td>
<td>• FGA MF 2 – 14 silos</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• VAFB – 4 silos</td>
<td>• FGA MF 3 – 20 silos</td>
</tr>
<tr>
<td><strong>GMD Fire Control and Launch Support Systems</strong></td>
<td>• GMD Fire Control (GFC) • Command Launch Equipment (CLE) • Launch Support Equipment (LSE)</td>
<td>• GFC nodes at Colorado Springs (COS) for planning • Fire Direction Centers (FDC) at FGA for execution • Training centers at COS and FGA • CLE at VAFB and FGA</td>
<td>• CLE / GFC Rearchitecture (2017) • LSE Upgrade (2020)</td>
</tr>
<tr>
<td><strong>IFICS Data Terminals (IDTs)</strong></td>
<td>• Test Bed IDTs at FGA and VAFB</td>
<td>• Operational and Test IDTs at FGA, VAFB, and Earleckson Air Station</td>
<td>• Fort Drum, NY IDT (2015) • Technical Refresh (2017)</td>
</tr>
<tr>
<td><strong>Ground Systems Software</strong></td>
<td>• Initial Capability</td>
<td>• Fielded 6B.1.5 in 2009 – Enabled two TPY-2 radars</td>
<td>• Discrimination Improvements for HD (2016)</td>
</tr>
<tr>
<td><strong>Sensors</strong></td>
<td>• Defense Support Program • Cobra Dane • UEWR Beale • Aegis SPY-1 Radar</td>
<td>• TPY-2 Radar Japan - 2006 • SBX – 2008 • Fylingdales UEWR – 2010 • Thule UEWR – 2011 • 2nd TPY-2 Japan – 2014 (Dec)</td>
<td>• Clear UEWR (2016) • Cape Cod UEWR (2017) • LRDR (2020)</td>
</tr>
</tbody>
</table>
### Aegis BMD Development

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**The First Step**
- Warship Integration of Exo-HTK Missile
- **Liquid DACS**
- Terrier-ER & ASAS & Leap
- Sea Testing 92-95

**Technology Maturation, Development & Demonstration**
- Warship Integration of Exo HTK Missile
- **All Solid Propulsion**
- SM-2 Blk IV & TSRM & Kinetic Warhead
- Sea Tests 2001-2005

**Testing & Production (SM-3 Blk IA)**
- Operational Testing
- Missile Production
- Add Terminal Layer Defense
- Development & Demonstration (IB)
- New Kinetic Warhead
- New Ship Signal Processor

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#### Operational Support
- Operational/Training
- CONOPS Refinement
- System Maintenance
- Ship Modification
- Operational Testing
- Missile Production

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**2005-6**
- 2005
- SM-3 Blk 0
- ALI 2.0/2.2
- 3.0 Cert
- 3.6 Cert
- 3.6.1 Cert

**2006**
- SM-3 Blk I
- 4.0.1 Cert

**2008**
- SM-3 Blk IA
- Aegis BMD SM-3 Blk IA
- ABMD 3.0/3.6.1/3.6.1
- 4.0.2 Cert
- Aegis BL 9.0.1
- (BMD 5.0)

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**2012**
- SM-3 Blk IB
- Aegis BMD SM-3 Blk IB
- ABMD 4.0.1/5.0
- 5.1 Cert

**2018**
- SM-3 Blk IIA
- Aegis BMD/SM-3 Blk IIA/B
- ABMD 5.1

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**2014**
- Added 3 New Stages
- Added New Kill Vehicle To SM-3
- Added 2 Stages To Existing Stack SM-3 Blk IV

**2015**
- New Missiles
- New CONOP (EOR)

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### Build a Little, Test a Little, Learn a Lot
# Aegis BMD Flight Test Failures

<table>
<thead>
<tr>
<th>Flight Test</th>
<th>Date</th>
<th>Missile</th>
<th>Failure Description</th>
<th>Root Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight Mission 5 (FM 5)</td>
<td>JUN 2003</td>
<td>SM-3 Blk 0</td>
<td>SDACS Divert and Attitude Control Failure</td>
<td>Cracked ball in the Attitude Control Assembly causing loss of Kinetic Warhead control</td>
</tr>
<tr>
<td>Flight Test Standard Missile 11 (FTM-11)</td>
<td>DEC 2006</td>
<td>No SM-3 fired</td>
<td>Missile did not fire because of incorrect system setting aboard the Aegis cruiser</td>
<td>Threat engagability settings modified prior to target launch and the system did not achieve engagability requirements, therefore did not fire the SM-3</td>
</tr>
<tr>
<td>Pacific Blitz</td>
<td>NOV 2008</td>
<td>SM-3 Blk I</td>
<td>Infra-Red (IR) Seeker Failure</td>
<td>Initial Deployment Rounds (IDR) had been assembled by Engineering Staff with variable layouts and staking of the IR Cryogenic Cooling System. The cooling gas leaked out of the cryogenic gas bottle</td>
</tr>
<tr>
<td>Japanese FTM-2 (JFTM-2)</td>
<td>NOV 2008</td>
<td>SM-3 Blk IA</td>
<td>SDACS Divert and Attitude Control Assemblies (ACA) Failure</td>
<td>DACS Malfunction</td>
</tr>
<tr>
<td>FTM-16 Event 2</td>
<td>SEP 2011</td>
<td>SM-3 Blk IB</td>
<td>Third Stage Rocket Motor (TSRM) pulse Failure</td>
<td>TSRM had a burn through of the rocket motor case during pulse 2 burn and impinged on the high pressure TSRM Attitude Control System (ACS) causing a rupture of the gas bottle</td>
</tr>
<tr>
<td>Flight Test Intercept 01 (FTI-01)</td>
<td>OCT 2012</td>
<td>SM-3 Blk IA</td>
<td>Inertial Measurement Unit (IMU) Failure</td>
<td>IMU memory chip error</td>
</tr>
</tbody>
</table>
THAAD Development Program Summary

Program Definition Risk Reduction
- Program Office Chartered 1992
- Critical Design Review 1993
- FT-1, FT-2, FT-3 Successful Non-Intercept missions (1995)
- FT-10 and FT-11 Successful Intercepts in June and August 1999 enabled a Milestone B decision in 2000

EMD / Product Development / Production Fielding
- Critical Design Review 2003
- First Manufacturing Contract 2006
- 1st/2nd Battery Activations 2008/2009
- Government Ground Testing (2yrs) 2008-2010
  - Safety, Mobility, Environments
- 1st Emergency Activation 2009
- Deployment to Guam 2013

*Army did not declare IOC. Army has stated initial fielding of April 2012.
THAAD Flight Test Incremental Growth

Capability Proven Through Flight Testing 11 for 11 Successful Intercepts

KEY
- Controlled Flight (No Target)
- Unitary target intercept
- Separating target intercept
- No Test: Target failure

Intercept of Unitary Target
- FTT-01 22 Nov 05 WSMR
- Integrated System Test Virtual Target
- Interceptor Control Flight Test
- High Endo Intercept of Unitary Target

Interceptor Low Endo Control Flight Test
- FTT-06 26 Jan 07 PMRF
- Integrated Element Seeker Characterization Test

Mid Endo Intercept of Unitary Target
- FTT-07 5 Apr 07 WSMR

Exo Intercept of Unitary Target
- FTT-05 26 Jun 07 WSMR

FTT-10A 17 Mar 09 PMRF
- Intercept of Simple Separating Target
- Mid Endo Intercept of Simple Separating Target

FTT-08 26 Jun 08 PMRF
- Target Separating Unitary Target

FTT-09 25 Jun 08 PMRF
- Intercept of Unitary Liquid-Fueled Target

FTT-14 05 Oct 11 PMRF
- Multiple Simultaneous Engagement (MSE) of MRT & FMA Target

BMDS Operational Regional / Theater Flight Test vs. MRBMs
- BMDS Operational Regional / Theater Flight Test vs. MRBM & SRBMs
- BMDS Operational Regional / Theater Flight Test vs. MRBM & SRBMs

FTT-18 4QFY15
- Wake Flight Test vs. IRBM

FTT-15 2QFY17
- Wake Flight Test vs. ELRALT
- Endo engagement

Increased Complexity

Incremental Growth

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GBI Evolution

**CE-I**
- Prototype Design
- "Hit-To-Kill" Demonstrated
- Fielded in Response to Imminent Threat

**CE-II**
- Obsolescence Upgrades
- Increased Processor Throughput
- Software Improvements
- Targeted Corrective Actions to Known Issues
- Minor Productivity Improvements

**CE-II Block I**
- Reliability Improvements:
  - Inertial Measurement Unit
  - Avionics
  - DACS Tanks
  - DACS Thrusters
  - Pulse Code Modulator Encoder
  - Communications Link Sub-system
  - Harness Reshaping

**2004**
- **C1 Heritage (3 Stg / 2 Stg)**
  - 3 Stage Booster (Fielded)
  - Vehicle design and hardware components based on legacy Space Launch vehicles: Pegasus, Taurus, and Minotaur
  - Proven design successfully verified in all Flight Tests
  - 2 Stage Heritage design also developed and successfully flight tested in BVT-1

**2008**
- **C2 Design Upgrade (3 Stg)**
  - 3 Stage design upgrade based on original FAU/OP Program
  - Improves reliability, addresses H/W obsolescence, and reduces risks
  - Avionics upgrades to Flight Controller, Booster Controllers, IMU, TVGs, Batteries, and Flight S/W
  - Compliant with MIL-STD-1901A Ignition Safety
  - Enhanced Natural Environments
  - Non-Tactical Equipment also upgraded for Flight Test vehicles

**2016**
- **C3 Evolution (2 Stg)**
  - 2 Stage Booster combines the 2 Stg C1 design and the 3 Stg C2 Upgrades
  - Improves reliability, addresses H/W obsolescence, and reduces risks
  - Provides flexibility for maximizing coverage with various basing options

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Discrimination Improvements For Homeland Defense

- Discrimination Function
  - Determines which objects from a threat missile launch are ruled as lethal or not lethal

- Importance of Discrimination
  - Insufficient interceptor inventory to engage all lethal objects and non-lethal decoys
  - Cost-effectiveness requires the right balance between number of interceptors and discrimination capability

- Discrimination Plan
  - Near Term (2014-2015)
    - Update threat definitions in existing system components
    - Make better use of current sensors
  - Mid Term (2017-2020)
    - Use available technology to improve sensors, kill weapons, and battle management/fire control capabilities needed to better address countermeasures
  - Far Term (2021+)
    - Field new advanced sensors and upgrade discrimination capabilities made available by the technology development investments we are making now
Robust Homeland Defense
(2020-2025 Timeframe)

Increased Inventory (44 by 2017)

- Redesigned EKV (REKV)
  - Focus on mature technology and component reuse
  - High priority on improved cost effectiveness, manufacturability, supportability, testability, and reliability

C3 Ground Based Interceptor

- Two Stage Booster
  - Producible, Reliable, Maintainable, Cost Effective
  - Integrates with REKV
  - Qualifies all hardware to Two Stage flight environments
  - New HW and SW design to address differences in 3 vs 2 stage flyout


- Key DIHD Objectives
  - Updated threat databases
  - Use of data from all sources
  - KV use of on-board and off-board data
  - Improved discrimination
  - Salvo logic

- Ground Systems Upgrades
  - GFC CLE Re-architecture PH 2 (LSE)
  - On-Demand Comms
  - GCN Modernization
  - Technology Modernization
  - LRDR Infrastructure

Long Range Discriminating Radar (LRDR) (2020)

- Redesigned EKV (REKV)
- Two Stage Booster
- Key DIHD Objectives
- Ground Systems Upgrades
Homeland Defense Criticisms

MDA has not tested against an ICBM

- FTG-06b involved a target missile that approached ICBM speeds and included countermeasures
- MDA test approach is to increase test complexity over time, using realistic scenarios
- Between now and 2024 there are 7 tests against ICBM targets with countermeasures – the first is planned for FY 2016
Homeland Defense Criticisms

We have not demonstrated the capability to do target discrimination.

Exo-atmospheric Kill Vehicle Target Scene

• FTG-06b demonstrated the ability to correctly discriminate and intercept the RV in the presence of operationally realistic countermeasures
• The failures to intercept in FTG-06a and FTG-07 were not associated with an inability to properly discriminate the most lethal object
• Early successful developmental intercept tests (1997 to 2002) included penetration aids (IFT-3, IFT-6, IFT-7, IFT-8, and IFT-9)
Homeland Defense Criticisms

We can’t do hit-to-kill

- MDA has repeatedly proven hit-to-kill technology is technically possible
- Since 2001:

<table>
<thead>
<tr>
<th>System</th>
<th>Number of Test Attempts</th>
<th>Number of Hits</th>
</tr>
</thead>
<tbody>
<tr>
<td>GMD</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>Aegis BMD</td>
<td>31</td>
<td>25</td>
</tr>
<tr>
<td>THAAD</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>PAC-3</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>TOTAL</td>
<td>81</td>
<td>65</td>
</tr>
</tbody>
</table>

≈ 80%
Homeland Defense Criticisms

The GMD tests are scripted for success

- Our test philosophy is to add complexity and reduce the number of controls we place on our flight tests of an element as it matures
- We limit variables in our tests to
  - Derive lessons learned in areas of greatest interest
  - Ensure we follow safety and environmental regulations
Summary

• The Nation has committed itself to the deployment and improvement of homeland defenses against a limited threat
  - We have come a long way since 2001 and Limited Defensive Operations in 2004
  - GMD element was a building block for the development of more robust capabilities in the future
  - Technical and fiscal challenges remain and are being addressed

• Increasing test complexity is central to the BMDS test approach

• Future homeland defenses will feature improved discrimination and hit assessment capabilities and greater warfighter capacity

• Despite progress, there are still many misconceptions about the BMDS