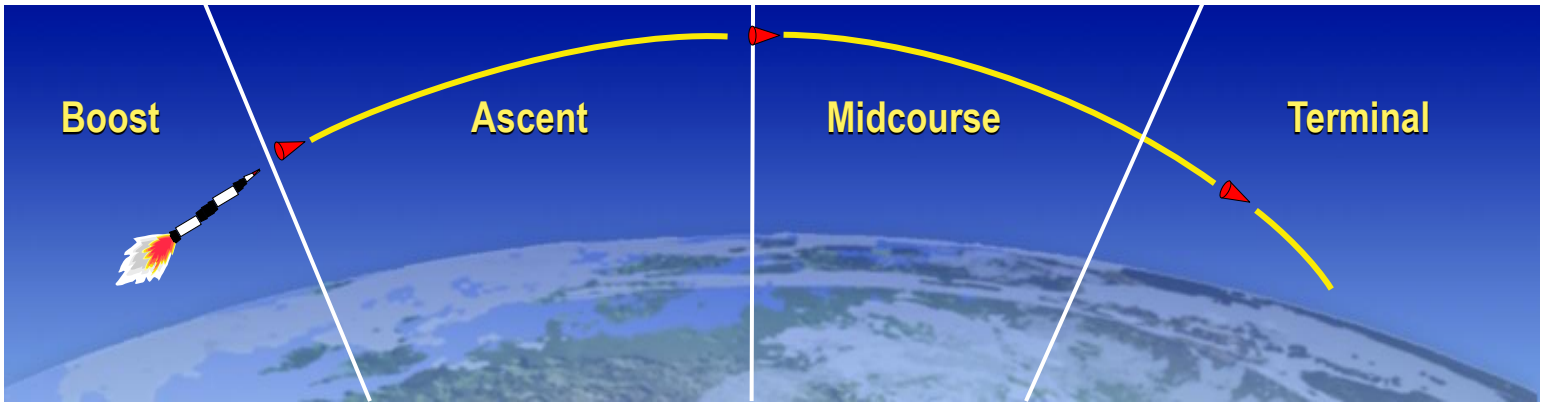

# Ground-based Midcourse Defense (GMD) Program Overview

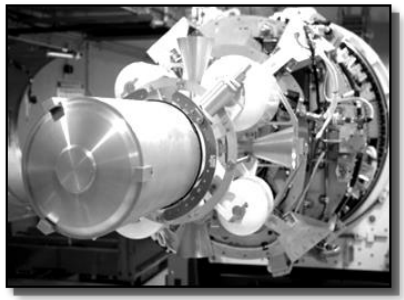
# Agenda

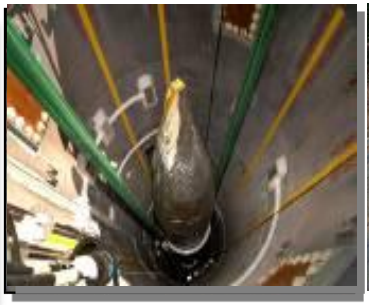
- GMD Mission and Focus Areas
- System Architecture
- Configuration and Locations
- Readiness and Operations and Sustainment
- Ground Based Interceptors (Including Boost Vehicle and Kill Vehicle)
- Ground Systems and Fire Control
- Systems Engineering and Integration
- System Testing (Ground and Flight)
- Market Research
- Path Forward

# GMD Mission

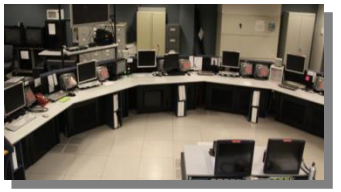
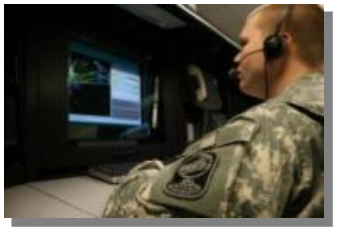
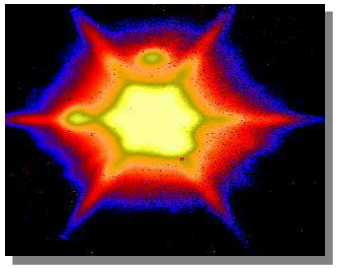
***Provide Combatant Commanders the capability to engage and destroy limited intermediate and long-range ballistic missile threats in the midcourse battle space to protect the U. S. Homeland.***







# Focus Areas

- Maintain 24/7 operations and availability for the Warfighter
- Field 44 operationally ready Ground Based Interceptors (GBIs) by 2017
- Improve reliability, maintainability, and availability of the GMD Ground System by 2020
- Deliver a more reliable, survivable, capable, and cost effective weapon system to defeat current and emerging threats with initial capability in 2020 and full capability by 2025
- Demonstrate Homeland Defense capability through system ground and flight testing

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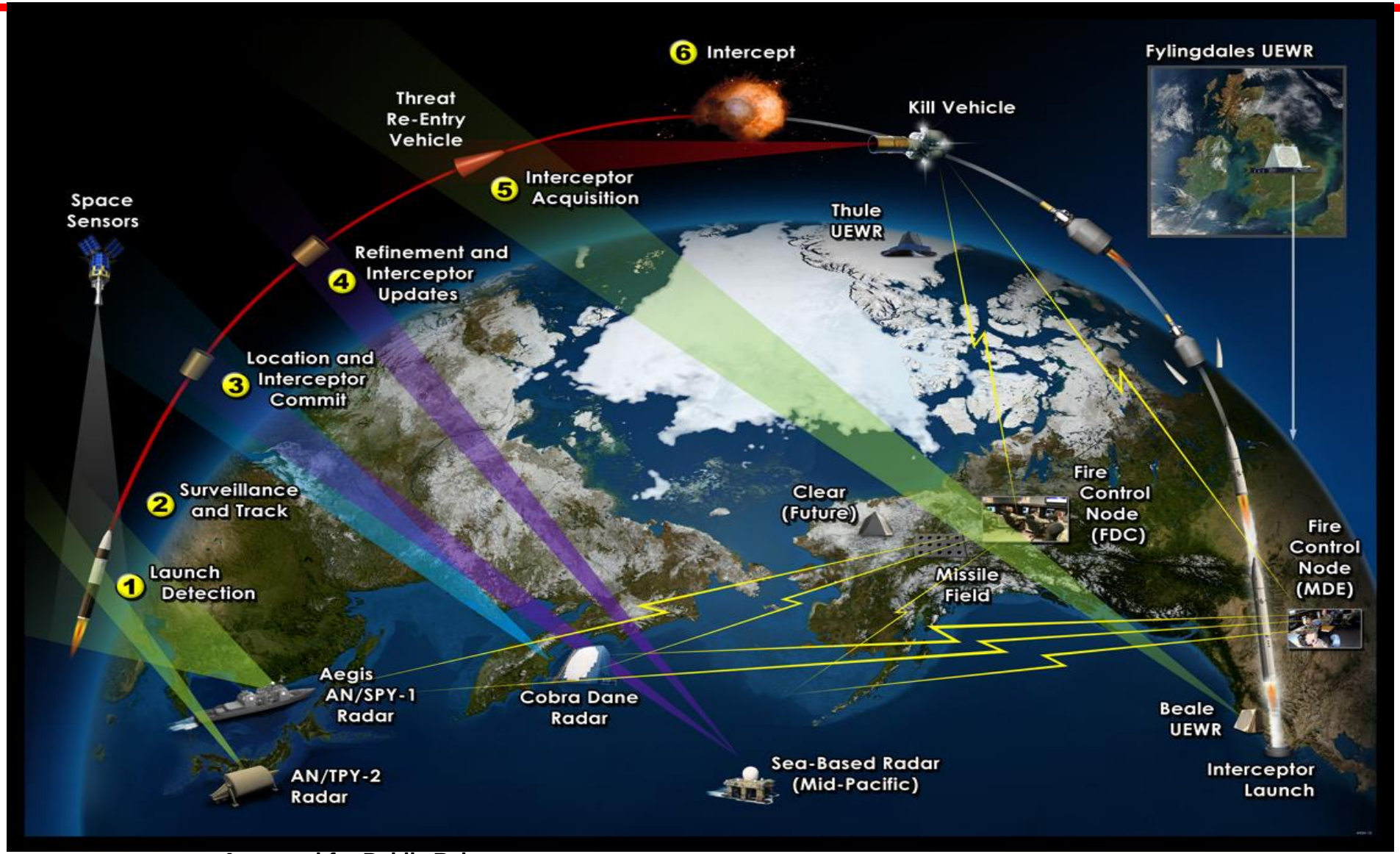
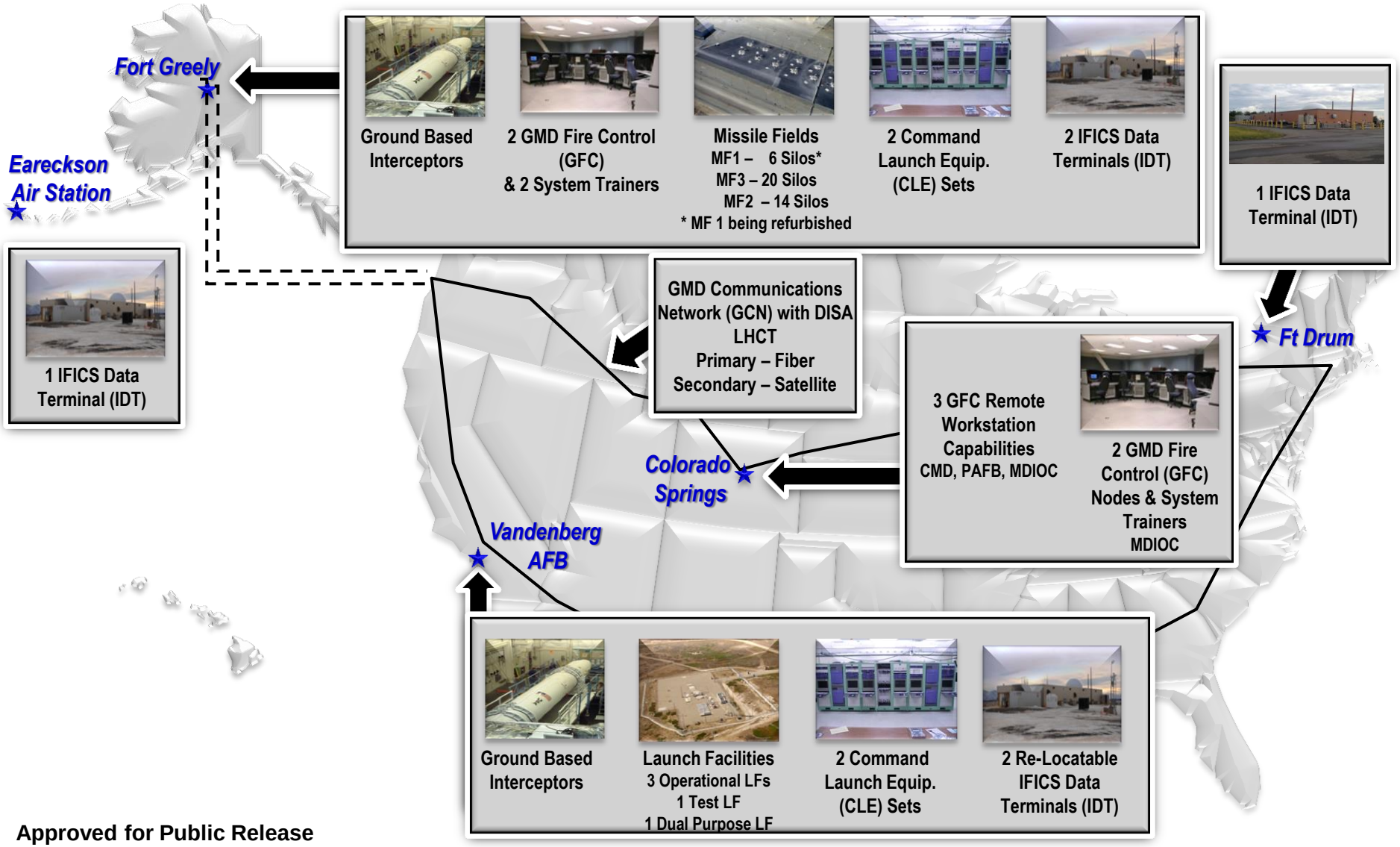
# Notional GMD Steps to Intercept



# GMD Configuration and Locations

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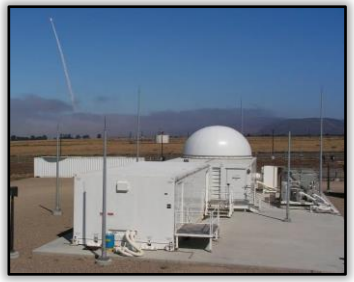
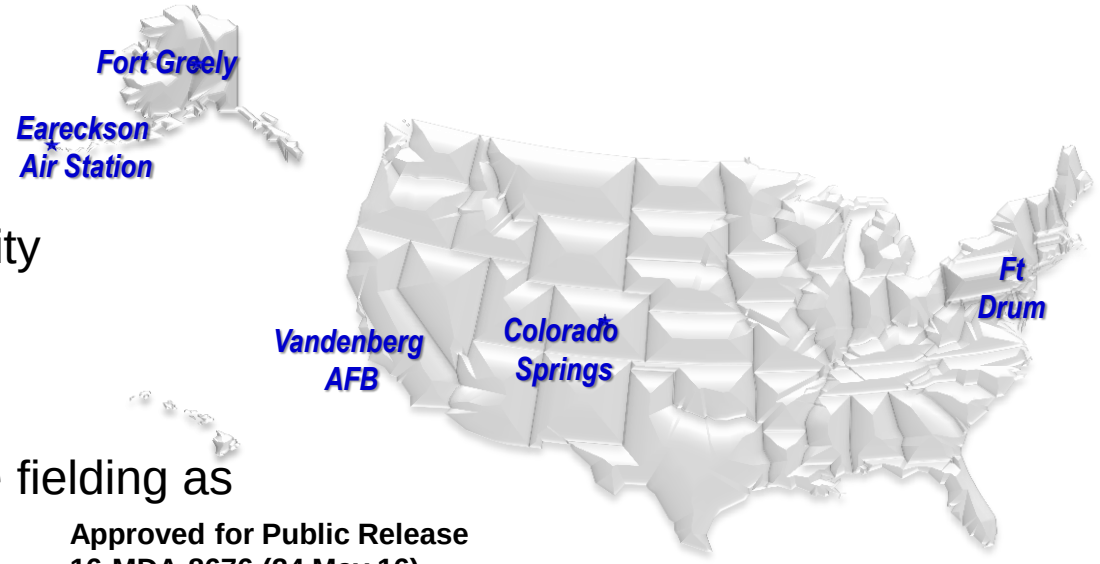
# Ft Greely Site Overview

# Readiness and Operations and Sustainment (O&S)

- 24/7 Prime Mission Equipment Support towards 100% availability and maintenance
- Train the Warfighter
- Critical infrastructure maintenance and upgrades at all 3 sites
- Transport GM Prime Mission Equipment and spares
- Strengthen cyber defenses
- Manage Communication Security
- Manage Obsolescence
- Support hardware and software fielding as well as GM system upgrades



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# GM Readiness Responsibilities

## OPERATIONS

**Weapon System Sustainment**
- Plan & Execute GM Weapons System Sustainment
- Assess Life-Cycle Logistics supportability
- Evolve into "Performance Based Logistics"
- Evolve Product Support Management

**Information Assurance**
- Ensure Network Availability & Defense
- Perform Active Network Monitoring Identify, Thwart & Report Network Intrusions / Attacks
- Maintain all Cybersecurity Documentation
- Manage Network Access Control

**Reliability & Maintainability**
- Apply Analysis Tools & Processes measuring, grading and reporting on GM Weapon System reliability & availability

**Site Operations**
- Site Coordination & Integration (Alaska, California, Colorado)
- Host Installation Coordination
- Site and System Wide Situation Awareness Reporting to MDA Leadership
- Activities Schedule Synchronization

## WARFIGHTER INTERFACE

**GM Chair for Warfighter Engagement and Integration Operational & Collaborative Forums**

- Interface w/ Multiple levels of Agency and WF Command Structure
- MDA DDW (SOIA)
- JFCC-IMD
- SMDC, ARSTRAT
- USNORTHCOM / NORAD

## CONTRACTOR LOGISTICS SUPPORT

- Readiness/O&S Contract Performance & Compliance Monitoring
- Provide GM Weapon System Availability Requirements Direction
- $S_A$ / $G_A$ Grading and Award Fee

## SUSTAINMENT

**Weapon System Sustainment**
- Develop & Maintain Comprehensive Life-Cycle Sustainment Plan
- Meet WF requirements by optimizing readiness
- Initiate Logistics & Sustainment Processes & Procedures to reduce ownership costs and logistics footprint
- Institute Property Accountability Initiatives

**Information Assurance**
- Provide Network Defense In-Depth Protection & Cybersecurity
- Maintain IATO & ATO Compliance
- Maintain Certifications & Accreditations

**Reliability & Maintainability**
- Assess the GMD Weapon System and GBI's for Current Status and Lifetime Expectancy

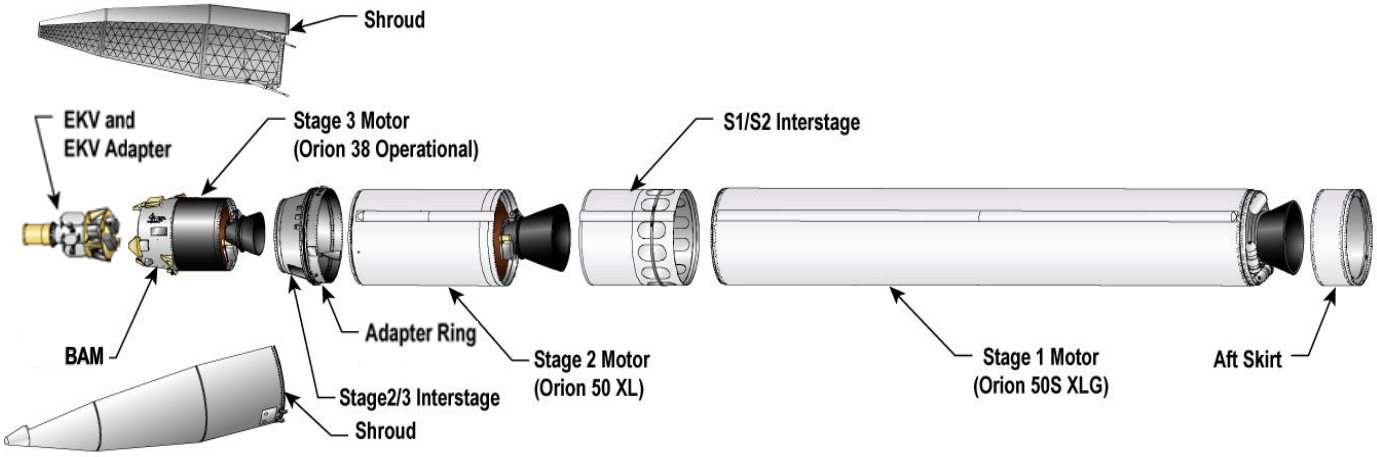
**Site Operations**
- Site Infrastructure Planning, Maintenance and Sustainment – Coordination, Integration & Execution
- Manage Site Working Group Structure
- Provides direct support to GM Program Managers developmental and operational activities

**Maximizes GM Weapons System Availability**

SOIA – Single Operational Integrating Authority
JFCC-IMD – Joint Functional Component Command - Integrated Missile Defense

# GBI Configuration

- **Ground Based Interceptor (GBI):**
  - **Integrated Boost Vehicle (IBV)**
    - Built by Orbital ATK; Integration facility at Vandenberg Air Force Base AFB, CA
    - 3 Stage, Solid Fuel Propulsion System; Orion Rocket Motors built by Orbital ATK in UT
  - **Exoatmospheric Kill Vehicle (EKV)**
    - Built by Raytheon in Tucson, AZ
    - Multiple configurations: Capability Enhancement I & II (CE-I/II)




**EKV: Exoatmospheric Kill Vehicle**
**BAM: Booster Avionics Module**

# GBI Booster and Kill Vehicle Evolution

## Configuration 1 (C1) Heritage (3 Stage)

- 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

## Configuration 2 (C2) Design Upgrade (3 Stage)

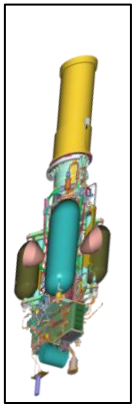
- 3 Stage design upgrade based on original Fleet Avionics Upgrade/ Obsolescence Program
- Improves reliability, reduces risks and addresses H/W obsolescence
- Avionics upgrades to Flight Controller, Inertial Measurement Unit, Booster Controllers, Thrust Vector Controllers, Batteries, and Flight S/W
- Compliant with MIL-STD-1901A Ignition Safety
- Enhanced protection against Natural Environments
- Non-Tactical Equipment also upgraded for Flight Test vehicles

## Configuration 3 (C3) Evolution (3 Stage)

- Increased protection against Natural Environments
- Hardened components and increased shielding to protect against hostile environments
- Improves reliability, addresses H/W obsolescence, and reduces risks
- Options for two-way communications and kill assessment enhancements
- Provides flexibility for maximizing coverage for various basing options

- System Selectable 2/3 Stage mode booster and ground systems software tested and fielded in CY18
  - Fielded on all booster configurations

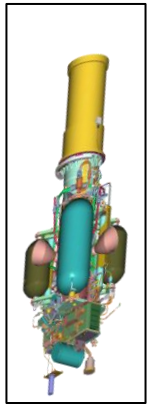
## Capability Enhancement-I (CE-I)



CE-I

- Uncradled Inertial Measurement Unit (IMU) with Version 0 firmware
- Heritage Thruster
- Software Recovery

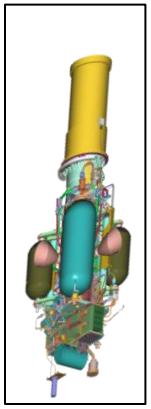
## CE-II



CE-II New and Upgraded

- Cradled Inertial Measurement Unit w/ V10 Firmware (CV10)
- Heritage Thruster
- Improved Battery

## CE-II Block 1



New CE-II Block 1

- CV10
- Alternate Thruster
- Improved Battery
- Ground Tie
- New DACS Tank
- Redesigned Pulse Code Modulator Encoder
- New High Reliability Transmitter
- Redesigned Communications Link Sub-system
- Harness Reshaping

## RKV

Redesigned Kill Vehicle (RKV)

- Improved cost, producibility, testability, maintainability, survivability, and reliability
- Modular design

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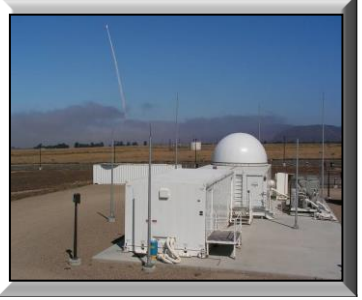
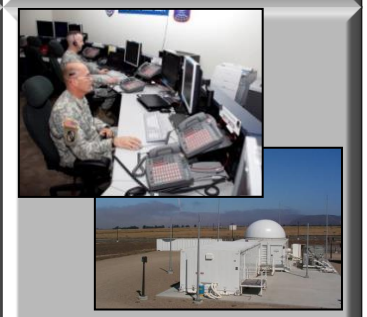
# Ground Systems Modernization

| | |
|---|---|
| Command Launch Equipment (CLE) Re-architecture |  |
| GMD Fire Control (GFC) |  |
| IFICS Data Terminal (IDT) |  |

| | |
|---|---|
| GMD Communication Network |  |
| Launch Systems Equipment |  |
| On-Demand Comms |  |

**Mitigate obsolescence for a ground system based on 1990s technology and hardware from early 2000s**

# Ground Support and Fire Control Systems Responsibilities

**GMD Fire Control (GFC)**
- Human-in-Control (HIC) directed engagement planning, command and control of the GMD Element. Provide data connectivity for external components and elements (Aegis, SBX, AN/TPY-2, SBIRS)

**In-Flight Interceptor Communications System (IFICS) Data Terminal (IDT)**
- Transmit and receive in-flight updates to/from the Exo-atmospheric Kill Vehicle and GFC nodes

**Launch Support Systems (LSS)**
- Monitor GBI health and status and commands launch of GBI.

**GMD Communication Network (GCN)**
- Connects all GMD Components and major BMDS interfaces to GFC Nodes at MDIOC and FGA

**Comms Infrastructure**
- Provide configuration management of mission comms
- Upgrade comms infrastructure to industry standards

**Silo Refurbishment**
- Conduct post-flight silo refurbishment

**Missile Field Refurbishment**
- Refurbish current silos
- Refurbish current SIVs
- Refurbish launch equipment rooms

# Systems Engineering & Integration

- Acquisition of spare parts to minimize testing downtime in EKV Hardware-In-The-Loop (HWIL) Space Chamber

- Enhanced Modeling and Simulation (M&S) capabilities with integration of the new wrapped tactical code
- Upgrade and integrate GMD-level digital simulation (GMDSim) into Objective Simulation Framework (OSF)
- Initiate rigorous Independent verification and validation (IV&V) and system engineering analysis of GMD software to increase Warfighter confidence in the tactical system performance and reliability
- Incorporate Independent Expert Panel recommendations to improve Systems Engineering processes that will increase system reliability and decrease late failure discovery/redesign.

# System Engineering & Integration Responsibilities

**Develop Short/Long Range Requirements**

- GMD Requirements Development
- Top Level BMDS Capabilities
- Element Behaviors & Interfaces
- System Specification Variances
- Verification/Planning Allocation
- Configuration Management

**Models & Simulations (M&S)**

- M&S Integration into BMDS
- M&S Development
- M&S VV&A
- M&S Strategy / Management
- Test Support
- Warfighter Exercise Support

**BMDS & GMD Performance Analysis**

- Program & Event Long-Range Planning
- Flight / Ground Test Analysis & Reporting
- Future / Evolving System Architecture Analysis
- System Performance
- BMDS Digital Simulation Event Analysis (Technical Assessments/ Performance Assessments)
- Real World Cell Activities

**Test & Assessment**

- Test Planning
- Test Design (Test cases and scenarios)
- Technical Assessment of objective evidence (e.g. GMD Event Document, Timeline Analyses, Link Analyses)
- Test Target Requirements Development
- Quick Look Reports, Congressional Reports

**Design, Integration & Warfighter Interface**

- System & Product Integration
- H/W & S/W Build Content Development
- Baseline Management
- Configuration Deliveries
- System Capabilities & Limitations
- Configuration / Change Management
- GMD Fielding Activities

**Strategic Systems Engineering**

- GMD Strategic Plans
- Special Studies
- Develop Top Level BMDS Capabilities
- Future BMDS System Specs
- System Engineering Plan, Integrated Master Plan

# System-Level Testing

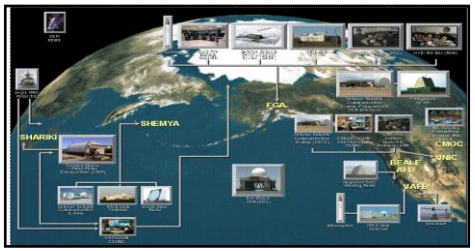
## Ground Test Strategy


**Component Laboratory Tests**

- Component Design and Development
- Component Hardware/Software Tests
- Subsystem Integration
- Test System Capability Envelope

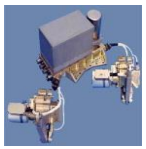
**Integrated Ground Tests (GTX/GTI) (ISTC Lab)**

- Demonstrate Capability w/ Operational Scenarios
- Use Single Stimulation or Objective Simulation Framework
- Support Evolving BMDS Architectures
- Support Alert Capability Assessment Analyses
- Warfighter Operators




**Distributed Ground Tests (GTD)**

- Live Tests on Ops Hardware
- System Capability Assessment
- System Readiness Testing
- Use Single Stimulation or Objective Simulation Framework
- BMDS Architecture Test
- Warfighter Operators

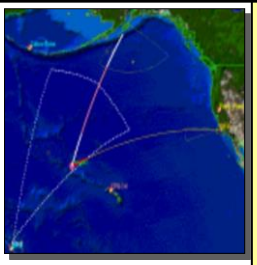


## Component Level Testing

## Flight Testing Strategy


*Pre-Mission Tests (PCIL)*

*Targets of Opportunity*



*Integrated Flight Tests*

*Post-Flight Reconstruction (HWIL Facilities)*

- Generate High Fidelity Data for Anchoring Models and Simulations
- Test Hardware and Software in Flight Environments
- Test in Cycles to Facilitate Component Upgrades
- Test Operational Equipment with Warfighter Involvement

HWIL – Hardware-in-the-Loop
ISTC – Integrated System Test Capability
PCIL – Prime Consolidated Integration Laboratory

# System-Level Test Responsibilities

**Flight & Ground Test**

- Manage mission planning, coordination and execution of GM flight and ground tests, including HWIL-based pre-mission tests and post-flight reconstruction activities
- Oversee contractor test activities and integrate Government activities
- Use Mission Manager construct to execute BMDS Test CONOPs & conduct pre-test executive reviews
- Manage interface with MDA Test and Engineering Directorates as well as with other Elements to execute GMD and BMDS test activities
- Develop and manage test support requirements
- Manage PCIL planning & upgrades, as well as GM component upgrades in the ISTCs

**Operations & Integration**

- Maintain GMD Test Baseline and IMTP
- Manage strategic-level GMD test planning
- Integrate GMD test program with external organizations
- Develop executive briefs and responses to test planning-related queries (i.e., Congressional RFIs, GAO, etc.)
- Collaborate with contractors on GMD Test Plan
- Participate in integrated baseline reviews for Test
- Manage test security program

**Business & Contracts**

- Conduct daily & strategic business process coordination for test-related issues
- Provide test financial management support
- Develop cost estimates for GMD test program
- Develop budget inputs for GMD test program
- Develop recommended test program funding
- Define, integrate, and execute test program contract requirements
- Perform test program-related contract management functions (i.e., award fee, Earned Value Management, COTR responsibilities)

CONOPS – Concept of Operations
COTR – Contracting Officer Technical Representative
DSC – Development and Sustainment Contract
GAO – General Accounting Office
HWIL – Hardware in the Loop
PCIL – Prime Consolidated Integration Laboratory
IMTP – Integrated Master Test Plan
ISTC – Integrated Systems Test Capabilities laboratory
PRIDE – Program Resource Internet Database Environment
RFI – Request for Information

✓ Completed Task

# GMD Market Research Techniques

- **Leverage existing MDA Market Research Reports/Efforts**
  - ✓Reuse MDA Market Research Reports
  - ✓Previous GMD 2010 Market Research Report
- **Apply Lessons Learned—from GAO/DoD Reports, MDA, and Others**
  - ✓Developed the GMD Market Research and Business Case Analysis Plan
  - ✓Train the Team and Develop a Request for Information Evaluation Tool (Consistency)
- **Release multiple RFIs (2 so far) and Other Associated Activities**
  - ✓Release on FedBizOpps; keep Market Research Information current on FedBizOpps
  - Brief RFI at Small Business Conferences (previously in TX and OH; Huntsville June 2016)
  - ✓Develop GMD-DOSP Email Box and a RFI Market Research Question Form
  - ✓Document communications with Industry (e.g., email exchanges, etc.)
- **Conduct a Missile Defense Industry Trends Analysis (FY2011-2016)**
  - ✓Analyze business information—e.g., mergers and acquisitions, health of market etc.
- **Collect /analyze Information for Trends Analysis and Market Research**
  - ✓Extract key information from reputable, viable sources
  - ✓Use Federal Procurement Data, Interviews, Internet, and Trade Journals/Publications
- ✓ **Conduct Industry One-On-One Sessions (14-17 March and 8 April 2016)**
- ✓ **Document Results/Findings in Market Research Report**
- ✓ **Develop Acquisition Strategy Courses of Actions (COAs)**

# Path Forward

- **Market Research vendors recommend breaking up GMD scope into separate contract actions to create a competitive environment**

- **There are capable sources (large and small businesses) available to meet GMD Needs/Requirements**
  - **The market landscape shows a competitive environment—NAICS 336414**
  - **Researching GMD scope that can be portioned for small businesses**

- **Continue to communicate with industry—RFIs, Draft RFPs, One-On-One Sessions, and Emails**
  - **Release Draft RFPs to tailor requirements and seek industry feedback**
  - **Draft RFPs could reveal additional vendors who did not respond to the RFI**
  - **Continue communications with industry**
  - **Conduct scope specific (e.g., O&S) One-On-Ones and Industry Days**
  - **Attend Small Business Conferences**

**Brief MDA Leadership on Market Research Results to obtain an approval on an Acquisition Strategy**