

Advanced Anti-Radiation Guided Missile (AARGM)



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Outline



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- What is AARGM?
- Program History and Roadmap
- System Overview
- Development Schedule / Test Results
- Performance Overview
- Platform Integration
- Summary



What is AGM-88E AARGM?



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International Cooperative Development

- U.S. Navy & Italian Air Force

Transforms AGM-88 HARM from single function Suppression-of-Enemy-Air-Defense (SEAD) role to multi-mission Destruction-of-Enemy-Air-Defense (DEAD) and strike:

- Autonomous emitter detection and ID
- Autonomous target geo-location
- Versatile dual-mode seeker
- Lethal active terminal guidance
- GPS/INS precision with collateral damage control capability
- Data-link support for Battle Damage Assessment (BDA)

Lethal capability against current /projected integrated air defenses and time-critical-strike targets

Weapon



Threat



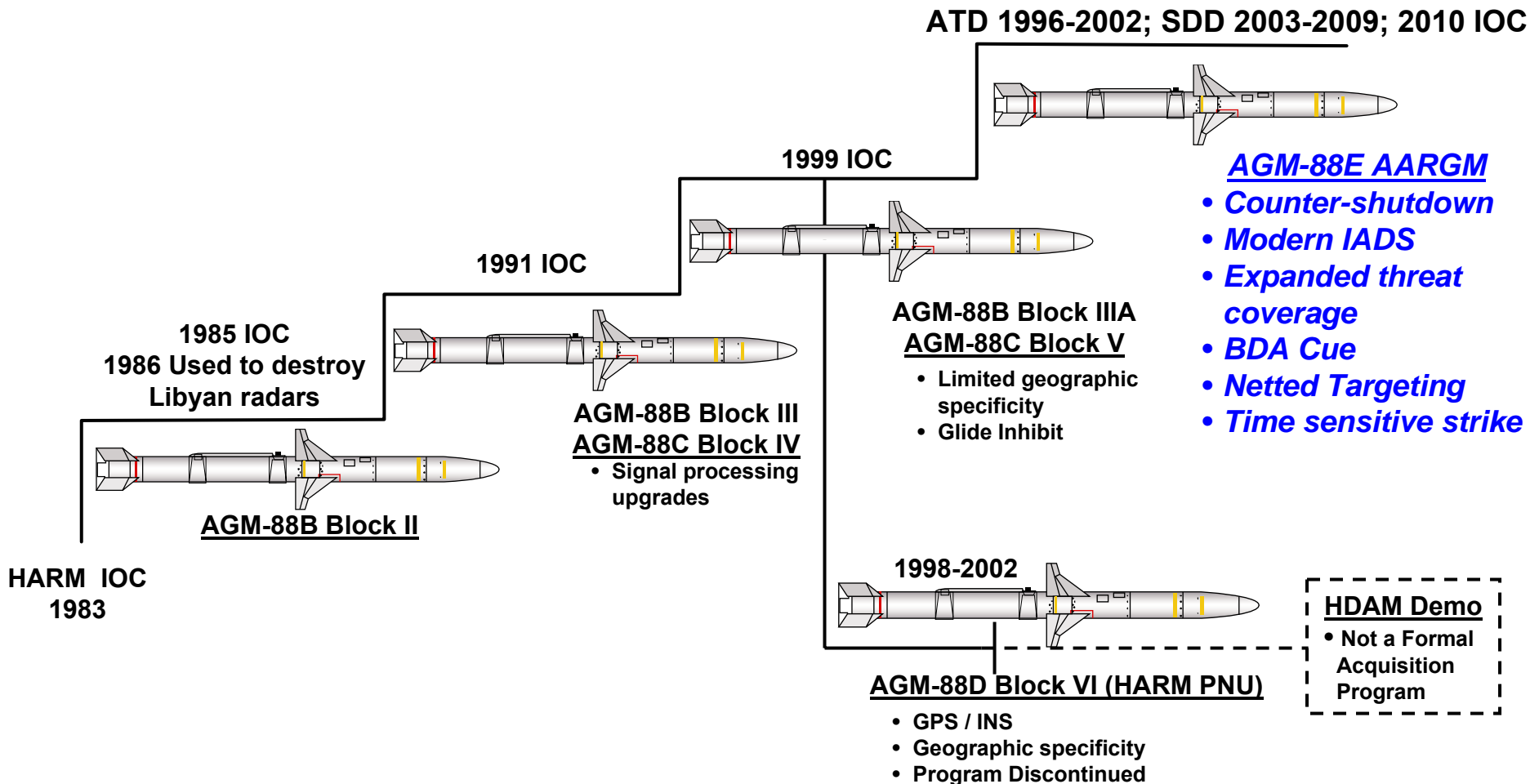
AGM-88E AARGM

Program History / Roadmap

AGM-88 Roadmap



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AGM-88E enables transition from Suppression (SEAD) to Destruction (DEAD) of Enemy Air Defenses

AGM-88E AARGM

System Overview

AGM-88E Advanced Anti-Radiation Guided Missile



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Capabilities

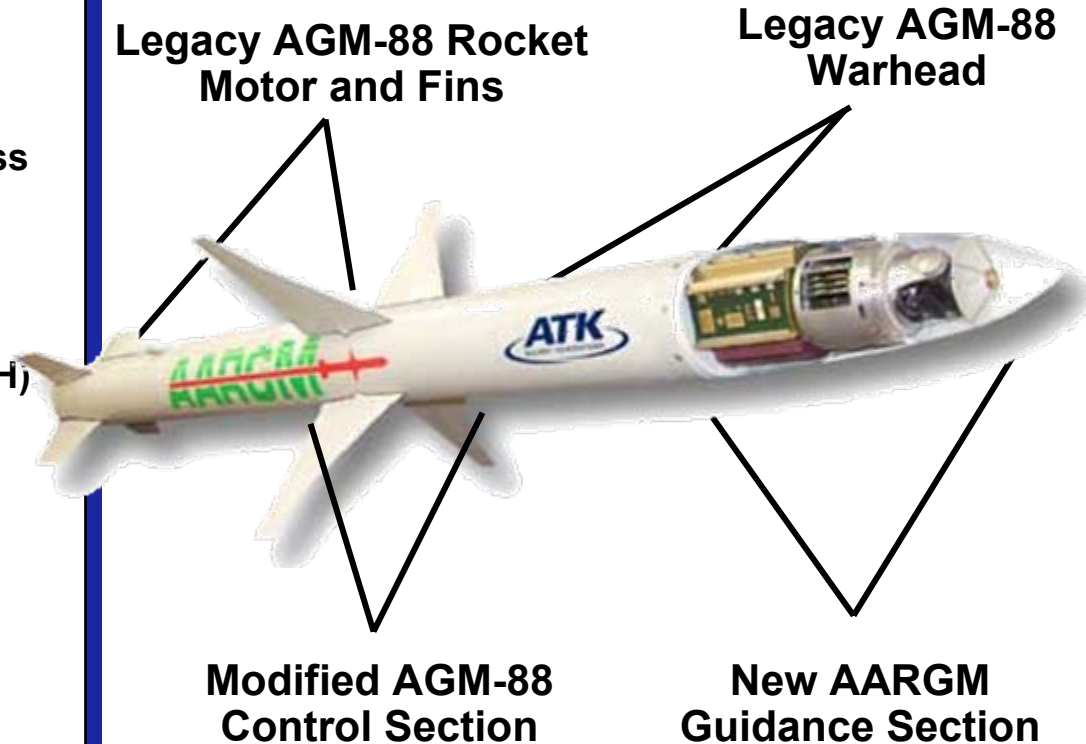
- Advanced IADS With Shutdown
- Greater Lethality
- Geographic Specificity
- BDA Support/Situational Awareness
- High Speed Strike

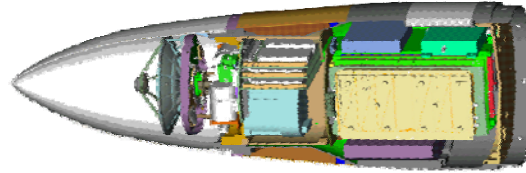
Sensors

- Digital Anti-Radiation Homing (ARH)
- Active MMW Terminal Guidance
- DTED-Aided SAASM GPS / INS
- National Systems Transmitter and Receiver (US Only)
- Missile Impact Transmitter (International)

Physical (*same as HARM*)

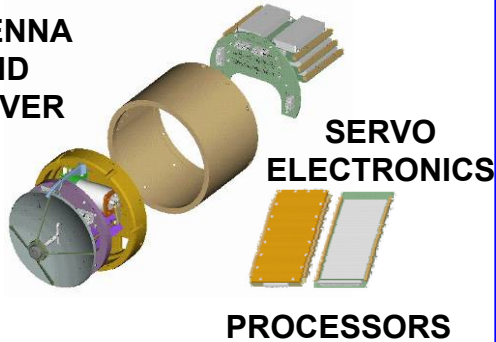
- Length - 164" (417cm)
- Diameter - 10" (25cm)
- Weight - 795 lbs (361kg)





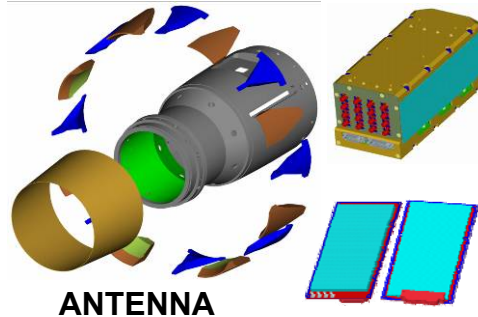
Active Radar Seeker

ANTENNA
AND
XCEIVER



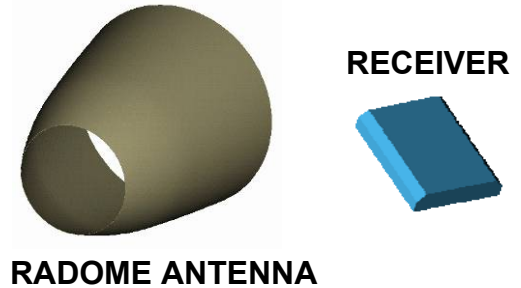
- Performs terminal target acquisition and track
- Large search area counters target movement/shutdown
- Expands AARGM target set to non-emitters

Passive Anti-Radiation Homing Seeker



- Increased sensitivity, frequency band, and field-of-view with digital design
- Autonomous target detection, Identification
- Precision DF enables on-aircraft emitter location

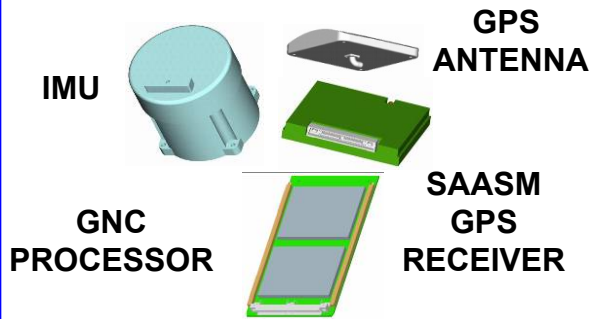
IBS Receiver (US Only)



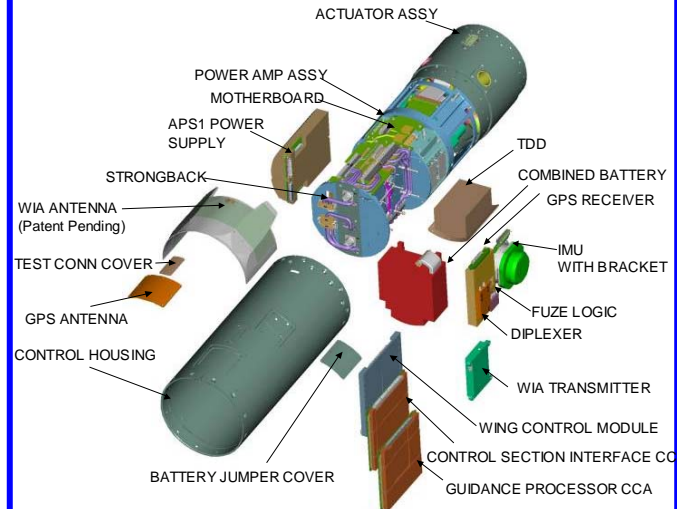
- Receives off-board target information
- Fused with ARH data to form correlated target location/type/track file
- Enables off-board queuing and enhanced cockpit situational awareness

High-performance, multi-mode seeker ensures intended target destruction in countermeasures environment

Guidance, Navigation, and Control Subsystem



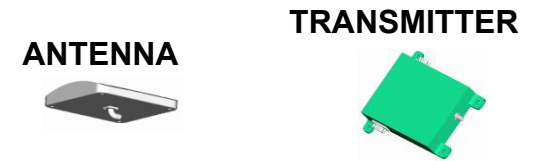
- High performance INS with tightly coupled IMU/SAASM GPS RCVR integrated with DTED data
- Enables fratricide reduction and precision target engagement



Power Subsystem

- New Power Supply
- Extended Life Battery

Weapons Impact Assessment (US Only) / Missile Impact Transmitter (International)



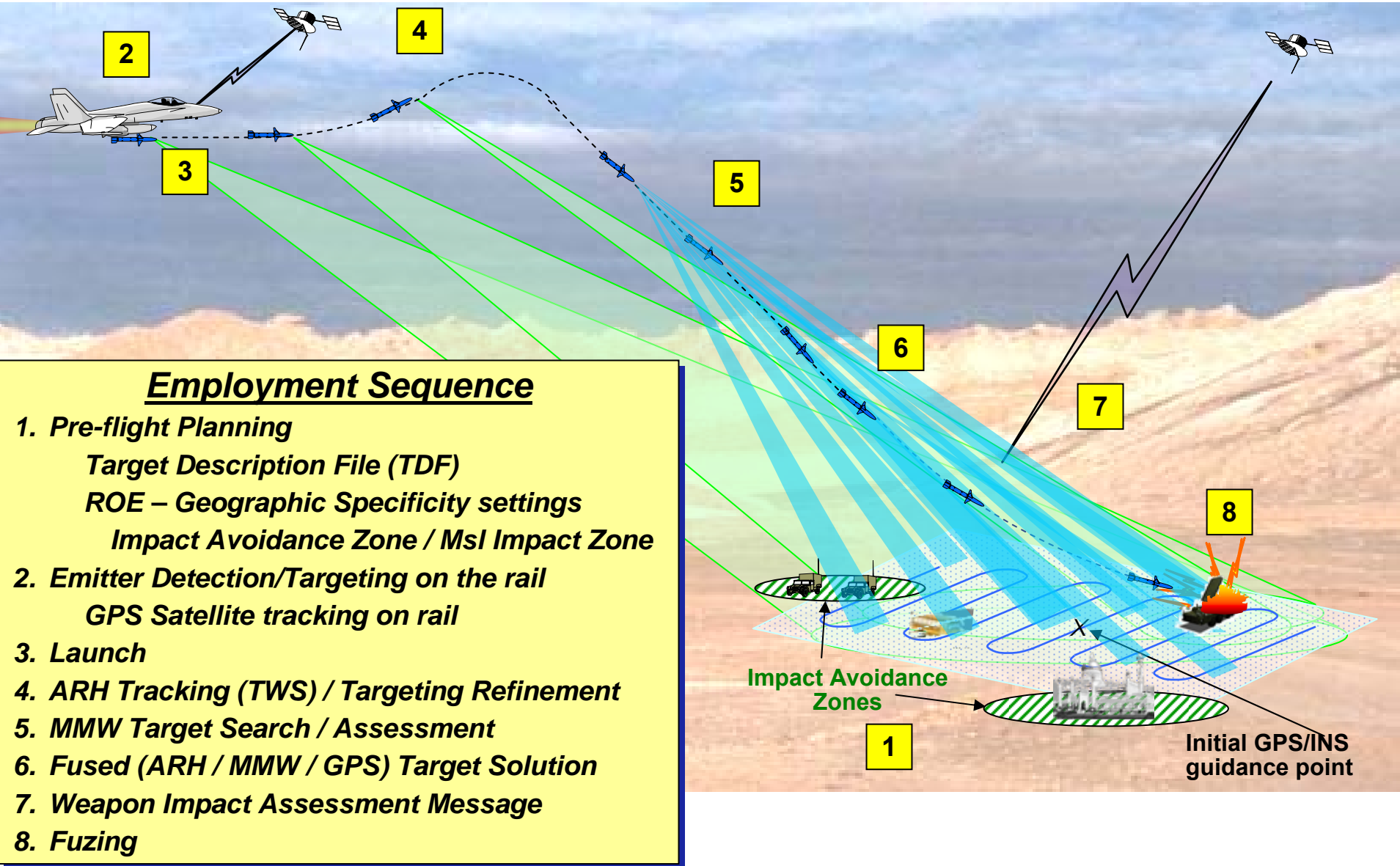
- Connectivity with off-board sensors
- End game transmission of missile state and impact
- Enables BDA support
- Weapons impact location verification

Modular control section design allows for backward compatibility with legacy HARM weapons for precision navigation/point-to-point capabilities as well as providing missile flight/navigation capabilities for AARGM missile

AARGM Flight Profile Overview



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Employment Sequence

- 1. Pre-flight Planning**
 - Target Description File (TDF)
 - ROE – Geographic Specificity settings
 - Impact Avoidance Zone / Msl Impact Zone
- 2. Emitter Detection/Targeting on the rail**
 - GPS Satellite tracking on rail
- 3. Launch**
- 4. ARH Tracking (TWS) / Targeting Refinement**
- 5. MMW Target Search / Assessment**
- 6. Fused (ARH / MMW / GPS) Target Solution**
- 7. Weapon Impact Assessment Message**
- 8. Fuzing**

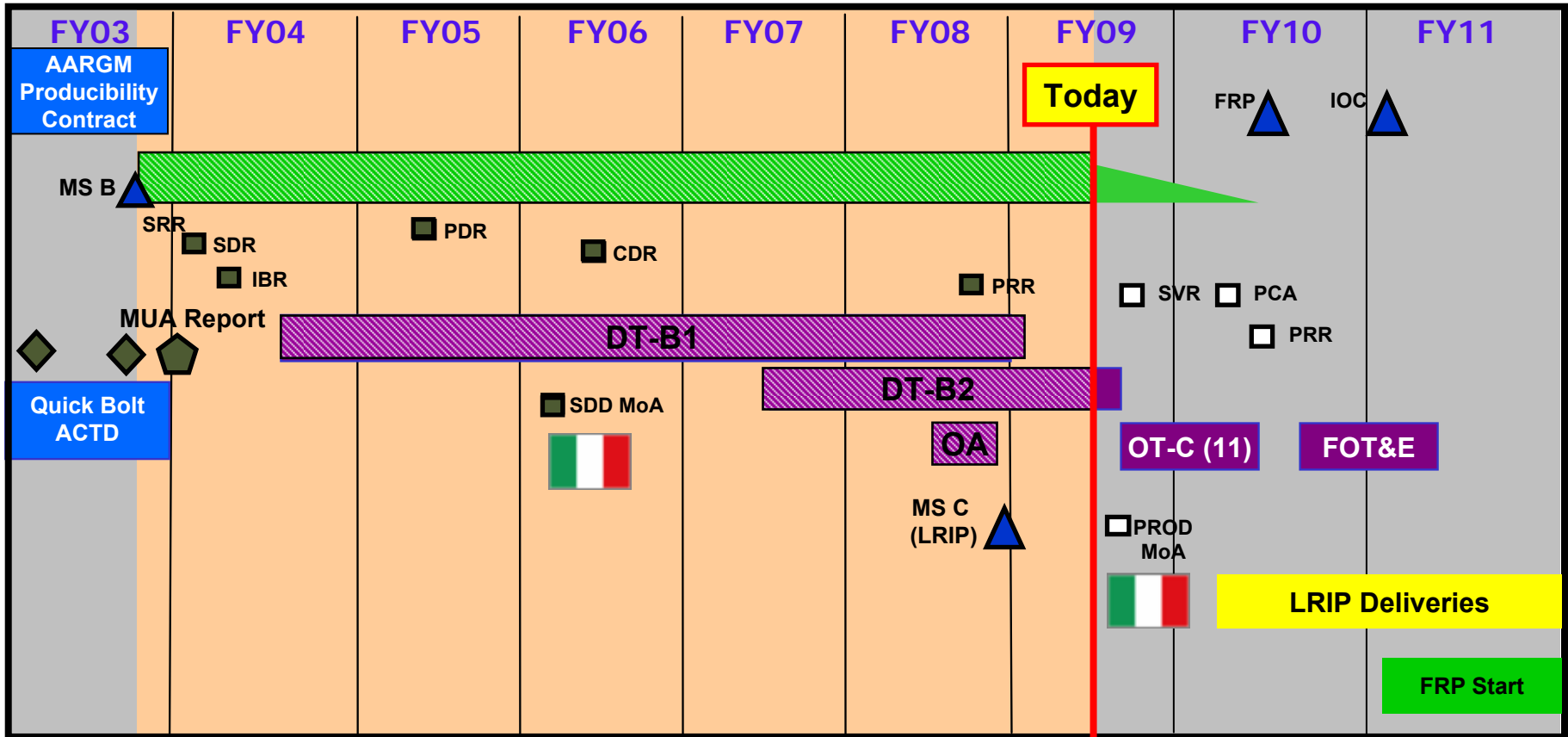
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Development Schedule / Test Results

AARGM Top Level Schedule



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ATD – Advanced Technology Demonstration
ACTD – Advanced Concept Technology Demonstration
CDR – Critical Design Review
DT-B1 – Developmental Testing (Lab/Ground/Captive)
DT-B2 – Developmental Testing (Captive/ Firing)
FCA – Functional Configuration Audit
FOT&E – Follow-On Test and Evaluation
FRP – Full Rate Production
IBR – Integrated Baseline Review

IOC – Initial Operational Capability
MSB – Milestone B
MUA – Military Utility Assessment (Quickbolt)
MSC – Milestone C
LRIP – Low Rate Initial Production
OA – Operational Assessment
OT – Operational Testing
PCA – Physical Configuration Audit
PDR – Preliminary Design Review

PRR – Production Readiness Review
SD&D – System Development and Demonstration
SDR – System Design Review
SRR – System Requirements Review
SVR – System Verification Review

AARGM Shot History



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		Launch Date	GPS	ARH	MMW	Shut Down	Geo Spec	WIA XMIT	IBS CORR
CTV-1	A T D	3/23/2000 Success	√						
CTV-2		6/19/2000 Success	√						
GTV-1		8/28/2001 Success	√	√					
GTV-2		12/21/2001 Success	√	√	√				
GTV-3		8/29/2002 Part Success	√	√	√	√	√		
QB-1	A C T D	11/15/2003 Success	√	√	√	√	√	√	
QB-2		7/15/2003 Success	√	√	√	√	√	√	√
DT-1	S D D	5/25/2007 Success	√	*88B			√		
DT-2		2/21/2008 Success	√	√	√		√		
OA-1		8/03/2008 Success	√	√	√		√		
OA-2		8/11/2008 Success	√	√	√	√	√		

CTV – Control Test Vehicle
 GTV – Guided Test Vehicle
 QB – Quickbolt
 DT – Developmental Test Firing
 OA – Operational Assessment Test Firing
 *w/ AGM-88B seeker

Test Objective

Lethal engagement of a radiating air defense unit employing shutdown in a restricted ROE (rules of engagement) environment

Improvements over HARM

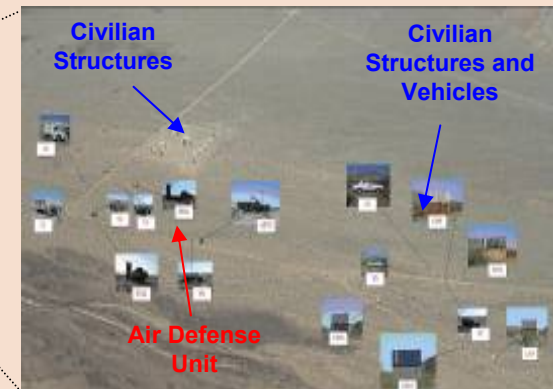
- Defeating Shutdown
- Preventing Collateral Damage

Test Scenario

Flight Profile



Target Area



Test Results

- 7 of 7 Success Criteria Demonstrated
 - Shutdown Defeated
 - Civilian structures not engaged
 - Air Defense Unit Lethally Engaged
 - Direct Hit
 - Probability of Kill > requirement



WAFB/500 OA-2 Live Fire
19 August 2008
Telemetry Derived
UNCLASSIFIED
REPRESENTATION

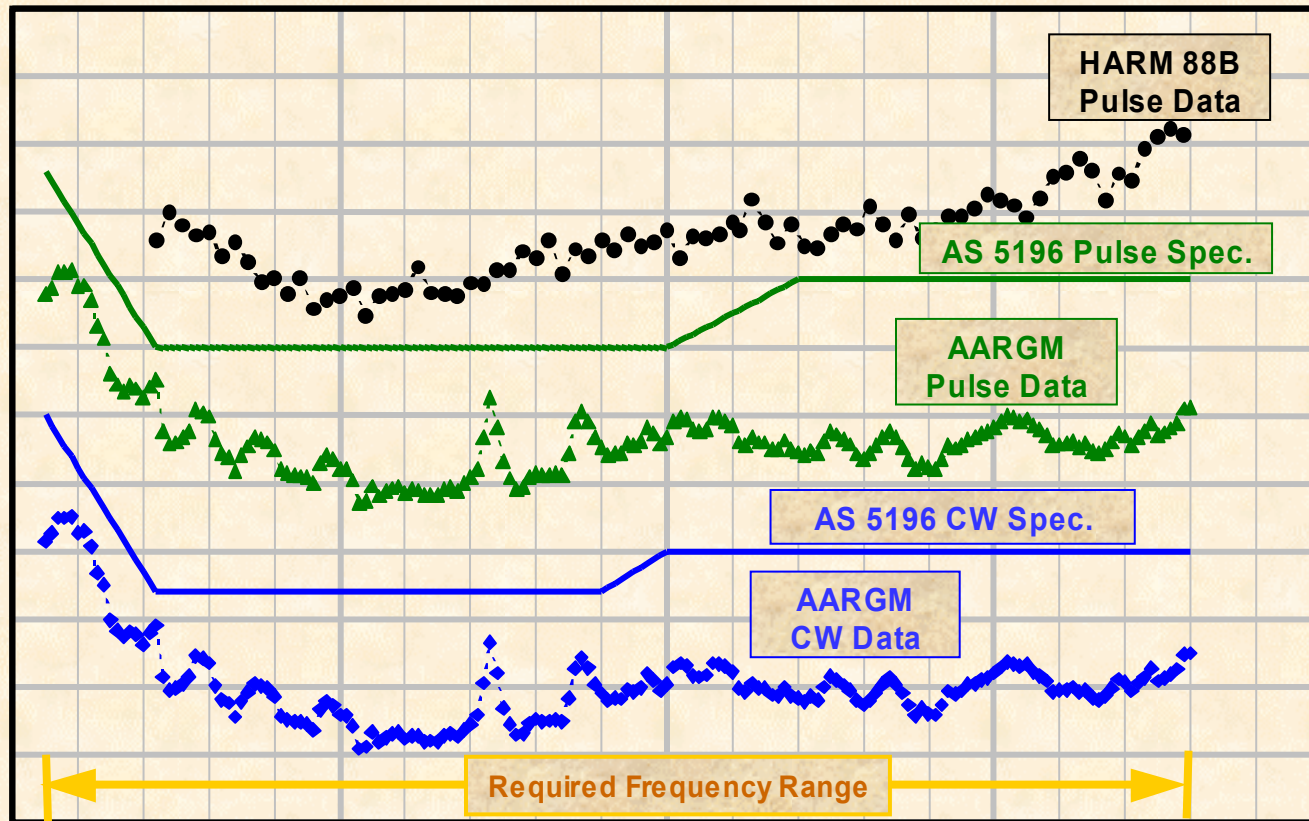
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Performance Overview

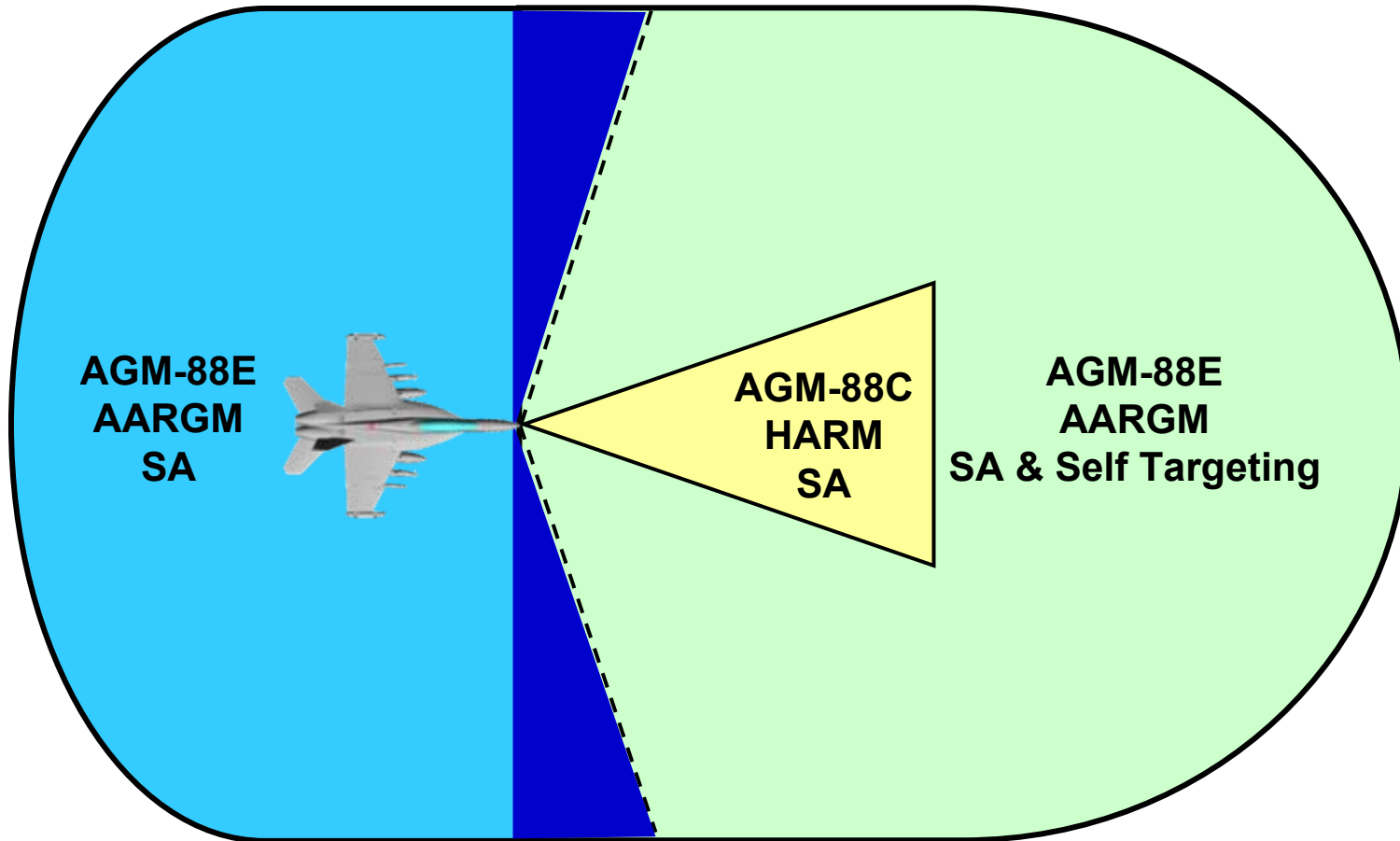
ARH Subsystem – Sensitivity/Detection Range



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Meets threshold frequency range and significantly exceeds legacy HARM detection sensitivity



**SA – Situational Awareness
with network connectivity**

Operational Capabilities

Mode	HARM	PNU	CCS	AARGM
Emitter Engagement	X	X	X	X (OA-1)
Exclusion Zones		X	X	X (OA-2)
Stationary Non-Emitter		X	X	X (DT-1)
Point to Point Attack		X	X	X (DT-1)
BDA Support			X	X (QB-2)
Shutdown Tactics				X (OA-2)
Advanced Emitters				X (OA-2)
Expanded Freq Coverage				X (BFT)
Increased Detection Range				X (OA-1)
Increased DF Accuracy				X (OA-2)
Expanded Field of View				X (BFT)
Self Targeting				X (OA-2)

PNU – Precision Navigation Upgrade

CCS – Common Control Section

DT – Developmental Test Firing

OA – Operational Assessment Test Firing

BFT – Beech Flight Test

X – Demonstrated

AARGM CCS Configuration with HARM Seeker



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AARGM DT-1 Missile Firing

- 25 May 2007 / China Lake Test Range, CA

Objective:

- Demonstrate Long-Range GPS Point-to-Point Engagement beyond 50NM

Test Configuration:

- AARGM Common Control Section (CCS) mated with legacy AGM-88B HARM seeker

Results

- Direct Hit on GPS Target
- Demonstrated compatibility of AARGM CCS with legacy AGM-88B Seeker
 - Legacy AGM-88B Seeker activation and detection of emitter signals





AARGM SD&D Program Development Test 1 5/25/2007










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Platform Integration

Platform Integration Plan



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Platform Integration / GFY	07	08	09	10	11	12	13
 <p>F/A-18 C/D</p>	DT		OT		IOC	Fielding	
 <p>F/A-18 E/F</p>	Planned Funding in PR09		Design & Development			Fielding	
 <p>Tornado</p>	Italian ECRs Planned		Design & Development			Fielding	
 <p>EA-18G</p>	Planned Funding in PR09		Design & Development			Fielding	
 <p>F-35 JSF</p>	External Only Block 6		<i>USN / USMC / Int'l TBD</i>				
 <p>EA-6B</p>	To be determined		<i>Feasible, but not currently funded</i>				
 <p>F-16</p>	HDAM/PNU interface design compatibility		<i>Feasible, but not currently funded</i>				

Transformational AARGM design provides greatly enhanced:

- **Lethality against advanced IADS employing shutdown tactics**
- **Capability vs. mobile / time-sensitive targets**
- **Collateral Damage / Fratricide Management and Control**
- **Battle Damage Assessment Support**

AARGM is in Low Rate Production TODAY – Milestone C Sept 2008

- **Initial Operational Capability (IOC) in Nov 2010 on the FA-18C/D**
- **Integration on Italian ECR Tornado, FA-18E/F, and EA-18G is underway**
- **Compatible with the F-16**
 - **Identical to HARM in mass properties and aerodynamics**
 - **AARGM Interfaces derived from existing HARM and J-Series interfaces currently implemented**

For follow-up information or questions regarding the AARGM program please contact:

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- AARGM – Advanced Anti Radiation Guided Missile
- A/C – Aircraft
- ACAT – Acquisition Category
- ACTD – Advanced Concept Technology Demonstration
- AGM – Air-launched Guided Missile
- AOR – Area of Responsibility (Regard)
- ARH – Anti Radiation Homing
- ATD – Advanced Technology Demonstration
- ATK – Alliant Techsystems, Inc.
- BDA – Battle Damage Assessment
- CATM – Captive Air Training Missile
- CCS – Common Control Section
- CDR – Critical Design Review
- CEP – Circular Error of Probability
- CFT – Captive Flight Test
- CLC – Command Launch Computer
- DEAD – Destruction of Enemy Air Defenses
- DF – Direction Finding
- DT – Developmental Test
- Freq – Frequency
- GFE – Government Furnished Equipment
- GNC – Guidance Navigation and Control
- GPS – Global Positioning System
- HARM – High speed Anti Radiation Missile
- HDAM – HARM Destruction of Enemy Air Defenses (DEAD) Attack Module
- IADS – Integrated Air Defense Systems
- IAZ – Impact Avoidance Zone
- ID – Identification
- IMU – Inertial Measurement Unit
- INS – Inertial Navigation System
- Int'l – International
- IOC – Initial Operating Capability
- JMPS – Joint Mission Planning System
- MIT – Missile Impact Transmitter
- MIZ – Missile Impact Zone
- MIs - Missile
- MMW – Millimeter Wave
- MoD – Ministry of Defense
- OPNAV – Office of the Chief of Naval Operations
- OT – Operational Test
- PDR – Preliminary Design Review
- PNU – Precision Navigation Unit
- RCVR – Receiver
- ROE – Rules of Engagement
- SA – Situational Awareness
- SAASM – Selective Availability Anti Spoofing Mode (GPS)
- SDD (SD&D) – System Design & Development
- Spec – Specification
- TCS – Time Critical Strike
- TLE – Target Location Error
- WAU – Warhead Assembly Unit
- XCEIVER -- Transceiver