



AEGIS

BALLISTIC

MISSILE

DEFENSE

***Aegis Ballistic Missile Defense Overview
for the George C. Marshall Institute***

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Aegis BMD Program Director***

03 August 2009

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for Public Release; Distribution is Unlimited**



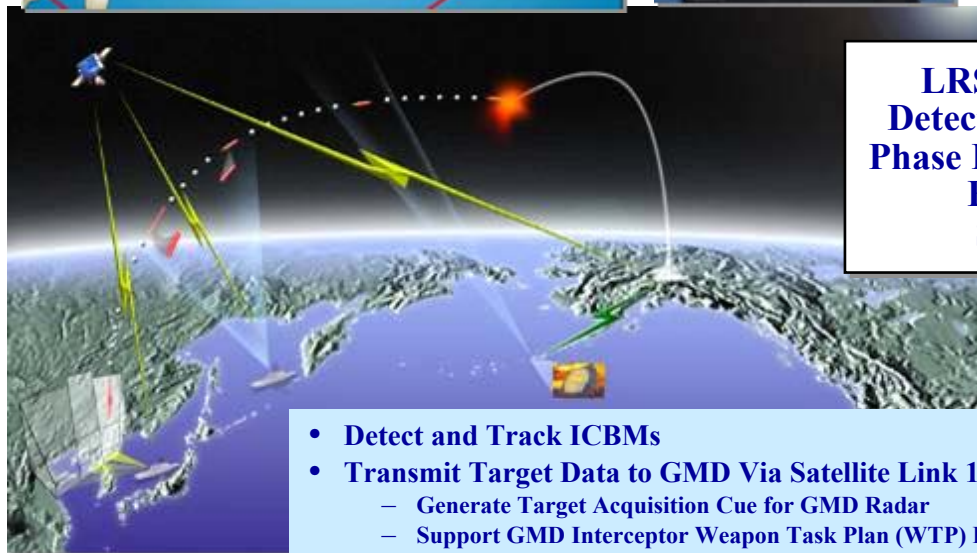
Aegis BMD's Role In The BMDS

Aegis BMD



**Mid Course Engagement
Capability with SM-3
Defeats SRBMs, MRBMs,
& Some IRBMs**

**Terminal Defense
Capability Defeats SRBMs**



**LRS&T Capability
Detects in Early Ascent
Phase Providing Forward
Based BMDS
Surveillance**

- Detect and Track ICBMs
- Transmit Target Data to GMD Via Satellite Link 16
 - Generate Target Acquisition Cue for GMD Radar
 - Support GMD Interceptor Weapon Task Plan (WTP) Initialization

**Proven Against Single Salvo,
Dual Salvo & Separating Targets**



Aegis BMD Element Description

Aegis BMD

Launch on Remote (Aegis BMD) 2006

Launch on Remote (BMD Sensors) 2010

Engage on Remote 2015

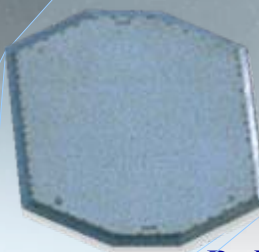
Link 16



**Open
Architecture
2012**



**Aegis Ballistic
Missile Defense
Signal Processor
(BSP) Upgrade
2010**



**Radar System
AN/SPY-1**



**Blk I / IA / IB
2004/2006/2011**



SM-3

**Blk IIA
2015+**



**Vertical
Launching
System Mark 41**

**Sea-
Based
Terminal**



SM-2



TBD

**Blk IV
2008
Near
Term**

**2018
Far
Term**

Quantities Thru 2015

	PB09	PB10
	3	5
	15	22
	147	218
	2	2

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Aegis BMD Fleet Today (July 2009)

Aegis BMD

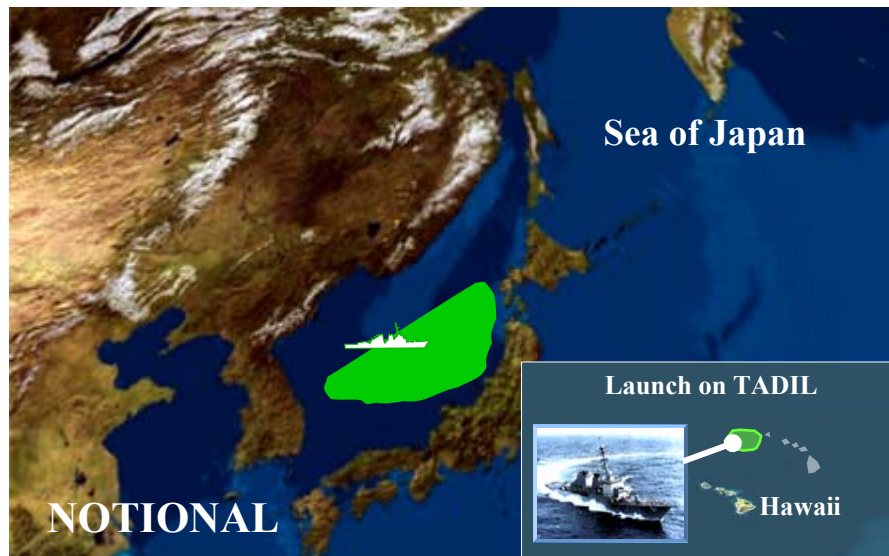
SM-2 Blk IV Deliveries (47)

FTM-14 (2)                                    

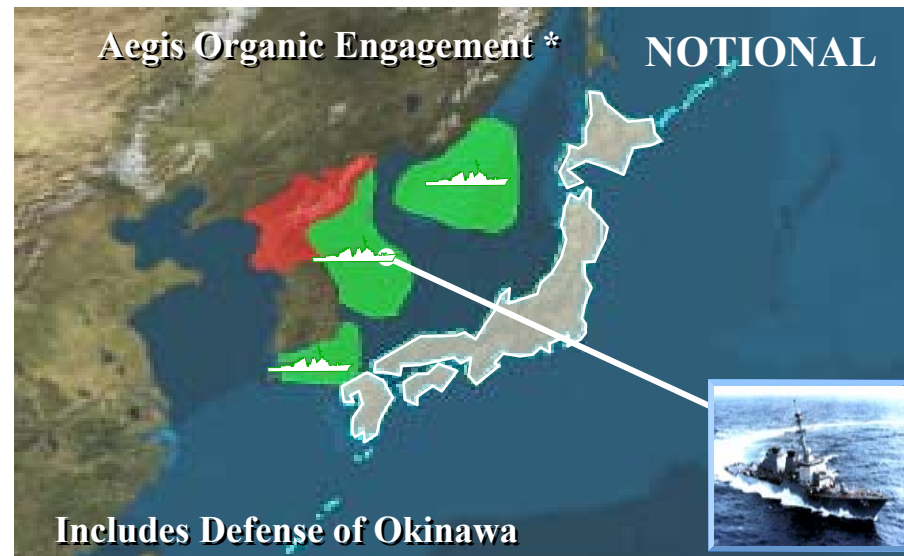


Notional Aegis BMD Patrol Areas & Defended Regions for Homeland, Theater and Regional Defense Roles

Aegis BMD



**Homeland
Defense Role**



Theater Defense Role



**Theater / Regional
Defense Role**



Aegis BMD – Proof That it Works

Aegis BMD

Joint Cooperative Research



17 Dec 07
JFTM 1

- First Firing from Japanese Destroyer



19 Nov 08
JFTM 2

- First Japanese No-Notice Launch
- Separating Target

Terminal Defense



24 May 06
Pacific Phoenix



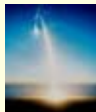
5 June 08
FTM 14

- Engage SRBM w/ SM-2 Blk IV

Homeland Defense



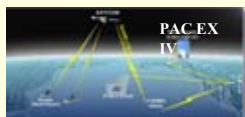
GT-180 Glory



IFT-9/10



PAC EX I, II, III



PAC EX IV

- First ICBM Tracking: 19 Sep 02

30 Jul 09

Stellar Avenger

26 Mar 09

Stellar Daggers 09

1 Nov 08

PACBLITZ 08

20 Feb 08

Intercept of Satellite

6 Nov 07

FTM 13

22 Jun 07

FTM 12

26 Apr 07

FTM 11 Event 4

7 Dec 06

FTM 11

22 Jun 06

FTM 10

17 Nov 05

FTM 04-2(FM-8)

24 Feb 05

FTM 04-1(FM-7)

11 Dec 03

FM-6

17 Jun 03

FM-5

21 Nov 02

FM-4

13 Jun 02

FM-3

25 Jan 02

FM-2

- Separating Warhead

- SM-3 BLK 1A
- Aegis 3.6
- First Coalition Test

- No Notice Firing

- Aim Point Adjust

- Ascent Phase Intercept

- First Fleet SM-3 Firing

- First Launch on Remote Operation

- Engage Dual SRBMs

- Simultaneous BMD/AAW Engagements
- Auto-BMD
- Pulse DACS

Video

Future Testing

- FTX-06 First At-Sea Testing of Aegis BMD 4.0.1
- FTM-15 Engage IRBM (Launch on TADIL)
- FTM-16 SM-3 Block IB Engage MRBM

“The Aegis BMD System is Operationally Effective and Operationally Suitable” – COMOPTEVFOR (OCT 2008)



Aegis BMD Operational Realism

Aegis BMD

“Aegis provided a real time kill assessment [during FM-6]. A ‘no notice’ target launch and the use of intelligent messages developed by the Navy’s Operational Test Agency enhanced the test’s operational realism”

- DOT&E FY04
Annual Report

“Test events were conducted under increasingly operationally realistic conditions with the involvement of the Navy Operational Test Agency”

- DOT&E FY05
Annual Report

“The Aegis BMD Program Continued to Include a Good Degree of Operational Realism in its Flight Test Program.”

- DOT&E FY05
Annual Report

“The Aegis BMD program is progressively increasing the operational realism in its flight test program”

- DOT&E FY06
Annual Report

- **On 21 October, 2008, Operational Testing of the Aegis BMD 3.6 System Completed**

• **COMOPTEVFOR Found:**

- **“The Aegis BMD System is Operationally Effective and Operationally Suitable”**
- **“The Tests Executed a High Degree of Operational Realism and Testing Rigor”**

• **COMOPTEVFOR Recommended:**

- **“The Transition of 18 Aegis BMD Ship Sets and Up to 90 SM-3 Block IA Missiles from the Missile Defense Agency (MDA) to the Navy.”**

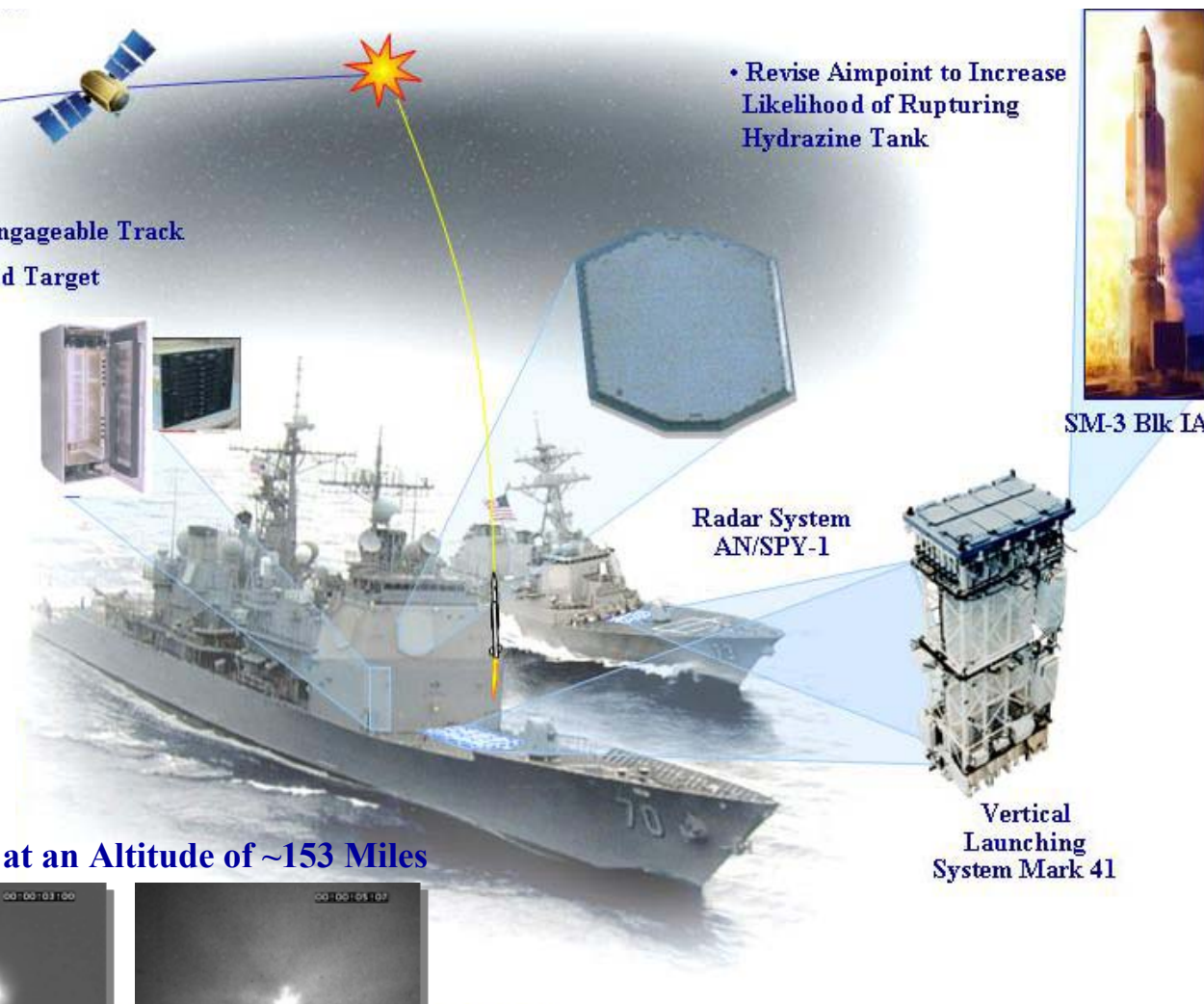


“Operation Burnt Frost”

Aegis BMD

- Report Satellite as an Engageable Track
- Identify Satellite as Valid Target
- Compute Valid Intercept Points

- Revise Aimpoint to Increase Likelihood of Rupturing Hydrazine Tank

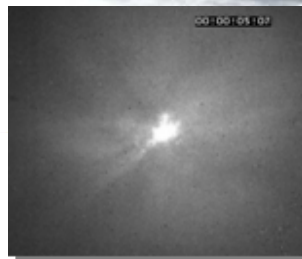
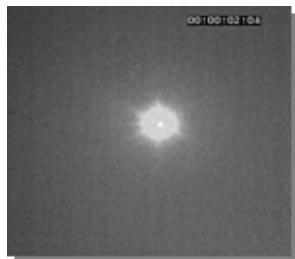


SM-3 Blk 1A

Radar System
AN/SPY-1

Vertical
Launching
System Mark 41

SM-3 Successfully Intercepted at an Altitude of ~153 Miles





Contributing to an Increasingly Capable BMDS

Aegis BMD

Today

Single Layer – Single Ocean



NOTIONAL

BMD 3.6

- Defeat SRBMs, MRBMs, and Limited IRBMs
- Surveillance Support to BMDS

“Deliver a Basic Capability Quickly”

- Integrated Defense & Strike Capability
- Engagement Capability
- Launch on Remote
- LRS&T

Near-Term

2 Defense Layers & 2 Ocean Coverage



NOTIONAL

BMD 3.6.1/4.01

- SRBM, MRBM & Limited IRBM Defense
- Sea-Based Terminal Defense w/SM2 Blk IV
- Enhanced Integration with Other Systems

“Improve Sensors to Make Missiles More Effective”

- Improve Radar Resolution
- Add Terminal Layer
- SM-3 IR Sensitivity & Discrimination

Far-Term

Larger Broader Full Capabilities



NOTIONAL*

NOTIONAL*

BMD 5.0/5.1/5.2

- SRBM, MRBM & Enhanced IRBM
- Limited ICBM Defense
- Sea Based Terminal Defense
- Enhanced Integration with Other Systems

“Improve Missiles”

- Engage on Remote
- Convert Program for Broader U.S. and International Ship Population- Open Architecture
- Increased Battlespace - SM-3 Block IIA (21" Missile)
- Improved BMDS C2BMC Performance

*Alternative Approaches to Defend Europe and Other Regional Allies is Part of Ballistic Missile Defense Review

**“An Integral Part Of The BMDS - All Ranges,
All Phases, All Regions”**



Sea-Based Terminal Defense

Aegis BMD



SM-2
Block IV

- Fuze Modifications
- Auto Pilot Modifications

- **Near Term Objective: Early Capability to Defeat Ballistic Missiles in the Terminal Phase**
 - Modify 70 - 80 SM-2 Block IV Missiles to Attain BMD Capability
 - Modify Aegis BMD 3.6 Baseline for Terminal Capability with SM-2 Block IV
 - Eighteen Ships, Installations Commenced in FY08 (HAMILTON, HOPPER, STOUT)



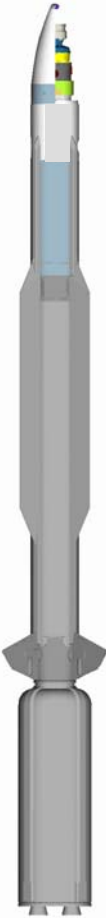
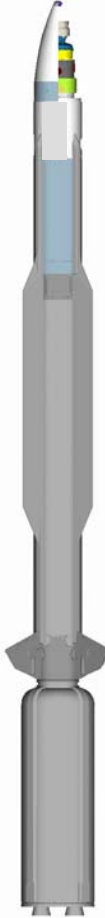




- **Objective: Expanded Capability to Defeat Ballistic Missiles in the Terminal Phase**
 - MDA/Navy Supported Approach
 - Potential Acquisition Approach: Directed Competition for New Missile
 - Certified Tactical Capability Integrated in Aegis Modernization Program / Open Architecture
 - Capability to be Delivered NLT 2018



Aegis BMD SM-3 Evolution

Spiral Development with Incremental Capability Improvements

Aegis BMD

SM-3 Blk IA	SM-3 Blk IB	SM-3 Blk II	SM-3 Blk IIA
<ul style="list-style-type: none"> • Blk IA Kinetic Warhead (KW) <ul style="list-style-type: none"> – 1-Color Seeker – Pulsed Divert/Attitude Control System (DACS) • 13.5" Propulsion <ul style="list-style-type: none"> – 2nd & 3rd Stage • MK 72 Booster • MK 41 Vertical Launch System (VLS) Compatible 	<ul style="list-style-type: none"> • Blk IB KW <ul style="list-style-type: none"> – 2-Color Seeker – All-Reflective Optics – Advanced Signal Processor – Throttleable Divert/Attitude Control System (TDACS) • 13.5" Propulsion <ul style="list-style-type: none"> – 2nd & 3rd Stage • MK 72 Booster • MK 41 VLS 	<ul style="list-style-type: none"> • 21" Nosecone Japan Cooperative Research (JCR) • Blk IB KW • 21" Propulsion <ul style="list-style-type: none"> – 2nd & 3rd Stage  • MK 72 Booster • MK 41 VLS Compatible Light Weight (LW) Canister 	<ul style="list-style-type: none"> • 21" Nosecone JCR • Large Diameter KW <ul style="list-style-type: none"> – Adv Discrim Seeker – High Divert DACS • 21" Propulsion <ul style="list-style-type: none"> – 2nd & 3rd Stage  • MK 72 Booster • MK 41 VLS LW Canister 

(Part of IIA Development;
Not Planned to be a Fielded Capability)



Sea-Based Ballistic Missile Defense International Activities



Aegis BMD

United Kingdom (UK):



- MDA Framework MOU
 - RDT&E Annex
- Exploring potential for Link-16 implementation and test
- Planning Type 45 participation in a future FTM

Netherlands:



- LCF Frigates (3) SMART-L (L-Band) APAR, MK 41 VLS
- Conducting Ballistic Missile Defense Capability Feasibility studies. Phase I near completion
- Phase II in planning stages; will culminate in at-sea demo (3-4 year effort)
- Liaison Officer onsite at Aegis BMD soon

Japan:



- Upgrading 4 KONGO DDGs to JB1.X; equivalent BMD capability to USN BMD 3.6
- First Engagement Capable Ally in Dec 07
- Largest BMD Co-Development - SM-3 Blk IIA Co-Development – Flight Test in 2014/15
- Discussions on SM-3 Joint Maintenance Facility in Japan
- Radar (JUSRR) and Open Architecture (BMDOAR) Co-Research Annexes
- JFTM-3 in 1QFY2010

Spain:



- 4 Aegis (F-100) Ships: B/L 5.3, SPY-1D, MK 41 VLS
- 2 Additional Aegis Ships w/B/L 7.1
- F-104 participated in FTM-12 and detected and tracked a ballistic missile

Germany:



- F 124 Frigates (3)
 - SMART-L (L-Band) & APAR
 - MK 41 VLS
- Plan to implement LRS&T capability
- Liaison officer onsite at Aegis BMD

South Korea:



- 3 Aegis Ships Under Construction
- KDX-III Destroyers
 - B/L 7.1
 - Have requirement for Sea Based Terminal capability

Denmark:



- Plan to build 3 patrol frigates
- SMART-L/MK 41 VLS

NATO ALTBMD Requirements:



- Integration Test Bed
- Aegis BMD provided sensor support to initial lower tier efforts
- Completing lower tier efforts and waiting for upper tier efforts to begin

Australia:



- 3 Aegis Ship Procurement (DDG 101-103)
 - B/L 7.1
- MDA Framework MOU
 - 07 July 2004



Aegis BMD

SM-3 Cooperative Development Program

Aegis BMD

- **Program Start: 22 Dec 05**
- **The 21" SM-3 Blk IIA Combined with BMDS Remote Sensor Data Provides:**
 - Increased Defended Area
 - Increased Probability of Kill Against a Broader Threat Set
 - Improves Operational Flexibility
- **PB07 Program Assumes Japan Work Share**
 - Post System Design Review Independent Cost Estimate Completed ~ \$3.1B Development and Testing
 - MKV Program Cancellation Impacted Unitary KV Development
 - Loss of Commonality Investment
 - Increased Cost of KV Development and Test Program Borne on US Share





At Sea Demos / Testing with Allied Partners

Aegis BMD



**FTM-11 December 2006
HNLMS TROMP**



**FTM-12 June 2007
SPS MENDEZ NUNEZ**



**JFTM-1 December 2007
JS KONGO**



**JFTM-2 November 2008
JS CHOKAI**





Navy's Initiatives in Missile Defense

Aegis BMD



Aegis Modernization (AMOD)
Navy Investment
Greater Than \$1B



Some of our Philosophies - In a Nutshell (1 of 2) -



Aegis BMD

- **We Test to Verify -- not Discover**
- **The Devil is Always in the Details**
- **Test as you Intend to Fight -- Fight as you Tested**
- **Never Accept Being Hardware Poor**

Our Mantra: Build a Little, Test a Little, Learn a Lot



Some of our Philosophies

- In a Nutshell (2 of 2) -

Aegis BMD






- **Anticipate Change and Embrace it**
- **Assess all of the Data, all of the Time**
- **Accept bad Results – They Mean Something Important**
- **Deliver - and What is Delivered Will Work as Designed**
- **Design the Weapon System to Work in a Hostile Environment**

Our Mantra: Build a Little, Test a Little, Learn a Lot

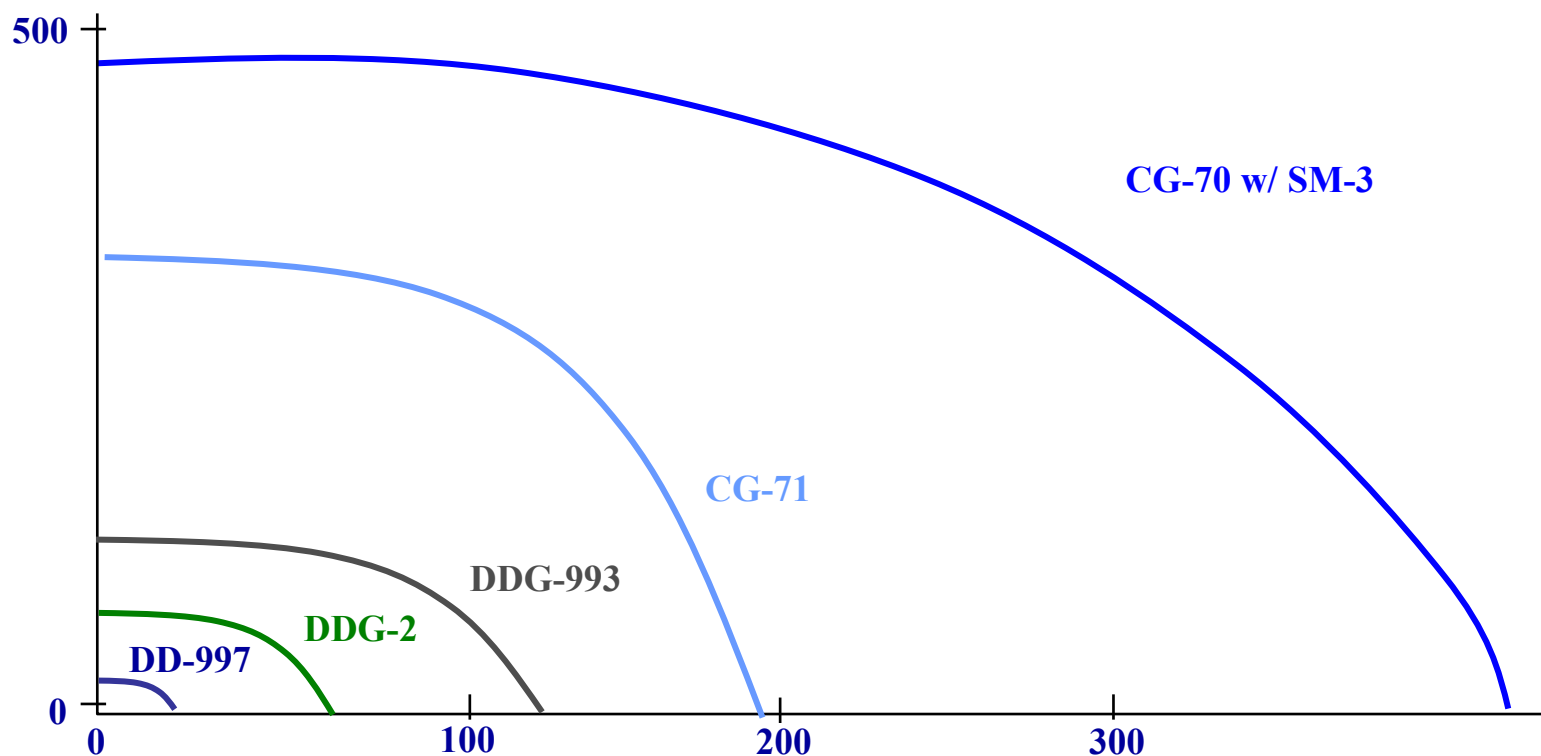


What A Difference 30 Years Make

Aegis BMD

<u>DDG-2</u> 275km Radar 40km Missile	<u>DDG-993</u> 350km Radar 80km Missile	<u>DD-997</u> 2500km T-Hawk Sea Sparrow 2D Radar	<u>CG-71</u> (Aegis AAW) 400km Radar 150km Missile	<u>CG-70</u> (ABM) 1000km Radar ~400km Range Missile	<u>CG(X)</u> ?
					
Ensign	LT	CDR	CAPT	RADM	

Approved for Public Release 09-MDA-4285 (10 FEB 09)





Aegis BMD

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**"AN INTEGRAL PART OF THE BMDS - ALL RANGES
ALL PHASES. ALL REGIONS"**

Partial E4 Development is
 100% if all 4 are completed. 100% if 3 are completed.

Additional Ships 2009 (LANT)

USS LAKE ERIE (CG 70) 3.6 CAPABILITY REMOVED OCT 08 FOR 4.8.1 EDM INSTALLATION

“AEGIS BMD - WE DELIVER”



Where Is the...

Aegis BMD

...Missile Defense Fleet?

Forward...At Sea...On Patrol



Enabling Capabilities, Providing Options for U.S. and Allies