BMDS UEWR (Upgraded Early Warning Radars) & LRDR

Status: New Development
System Type: Ground-based Radar (Fixed-Site) & BMD Radar

Program Briefing

The ***Ballistic Missile Defense System (BMDS) UEWR (Upgraded Early Warning Radars)*** radars compose large, fixed-site, phased-array radar complexes originally developed for detection and early warning of Soviet strategic submarine launched ballistic missile (SLBM) attacks against the United States. They have been known by several designations, including AN/FPS-115/120/123(V)/126 and Pave Paws and BMEWS (Ballistic Missile Early Warning System). There are currently two FPS-123(V)3 Pave Paws UEWR sites in the United States (on perimeter coastlines on Cape Cod and at Beale AFB, CA), and three FPS-120 (was FPS-115) BMEWS UEWR sites, in Alaska (Clear), Greenland (Thule), and the UK (Fylingdales).

Pave Paws and BMEWS radars have now been upgraded for the BMD System (BMDS), and will be a major component of future BMD systems. Continuing upgrades are currently underway and very well-funded.

In November 2000, Taiwan requested a possible sale of two Pave Paws radars. By August 2001, the plan had changed to one modified FPS-115 Pave Paws radar. In March 2004, the US DoD finally announced it had okayed the sale, now planned as one initial radar, to be followed by a second when Taiwan's finances allow. In June 2005, Taiwan contracted for the first radar, worth $752 million.

As part of the BMDS Integrated Discrimination strategy, plans in March 2014 introduced the addition of a new ***Long Range Discrimination Radar (LRDR)*** to the BMDS, to provide improved persistent 24/7 precision tracking and discrimination capability. By February 2015, the Long Range Discrimination Radar (LRDR) acquisition strategy had been approved. A full and open competition was conducted in order to award a single contract for the development, installation, and initial operations and sustainment of the radar system, with the LRDR expected to become operational no later than 2020.

In October 2015, design, development, manufacture, integration & test, and fielding of LRDR prime mission equipment was won by Lockheed Martin, Moorestown, NJ.

By February 2018, the LRDR was to become an element of the BMDS Increment 6b in support of the Ground-Based Midcourse Defense (GMD) Program's Homeland Defense (HLD) Capability. This capability is representative of LRDR Configuration 1. Initial fielding of

the LRDR is planned for 2020 leading to an Operational Capability Declaration in FY22. The Secretary of the Air Force approved Clear Air Force Station, Alaska as the LRDR site. The Air Force Space Command (AFSPC) is the designated Lead MAJCOM. The LRDR operates in the S-band (*not* X-band) frequency, features scalable and open systems architecture to mitigate evolving threats, and integrates into the BMDS through the Command and Control, Battle Management, and Communications (C2BMC) system. LRDR also supports additional mission areas including Space Situational Awareness.

Executive

US DoD
Missile Defense Agency (MDA)
Washington, DC

(UEWR)

US Air Force
Air Force Materiel Command (AFMC)
Electronic Systems Center (ESC)
Hanscom AFB, MA 01731-5000
http://www.hanscom.af.mil

(Pave Paws/BMEWS)

Manufacturers

Prime

Raytheon Systems Co.
Raytheon Electronics Systems (Marlborough)
1001 Boston Post Rd.
Marlborough, MA 01752
tel: (508) 490-1000
fax: (508) 490-2822

Lockheed Martin Corp.
Mission Systems
Moorestown, NJ

(LRDR)

Subcontractors

- Alphatech
- Control Data Corp., Minneapolis, MN
- ITT, ITT Federal Services: BMEWS Operations and Maintenance ($20+ million/year, up to FY97)
- Litton Industries, Electron Devices Div.: Engineering services
- Lockheed Martin Federal Systems, Gaithersburg, MD
- Mason and Hanger, Colorado Springs, CO: BMEWS Operations and Maintenance ($25 million/year, FY98 on)
- MIT/Lincoln Labs
- MITRE Corp., Bedford, MA: general system engineering
- PRC: Engineering services
- Raytheon Co., United Engineers and Constructors, Boston, MA: design of technical facilities
- TRW, Defense & Systems Group, Redondo Beach, CA
- Xontech, Van Nuys, CA: Sensors and upgrades (9/98)

Functional Description

Long Range Discrimination Radar (LRDR) (2018)

Overview

The mission of the Long Range Discrimination Radar (LRDR) program is to design, develop, integrate, deliver, field, and sustain the LRDR as an element of the BMDS Increment 6b in support of the Ground-Based Midcourse Defense (GMD) Program's Homeland Defense (HLD) Capability. This capability is representative of LRDR Configuration 1. Initial fielding of

the LRDR is planned for 2020 leading to an Operational Capability Declaration in FY22.

The LRDR is comprised of a LRDR Equipment Shelter (LES), housing two radar array faces, a Mission Control Facility (MCF) which supports radar operations, and supporting facilities and infrastructure. The Secretary of the Air Force approved Clear Air Force Station, Alaska as the LRDR site. The Air Force Space Command (AFSPC) is the designated Lead MAJCOM.

The LRDR operates in the S-band (*not* X-band) frequency, features scalable and open systems architecture to mitigate evolving threats, and integrates into the BMDS through the Command and Control, Battle Management, and Communications (C2BMC) system. This Program Element includes BMDS threat discrimination improvements to enhance BMDS effectiveness against the evolving threat. The result will be a BMDS architecture more capable of discriminating and intercepting re-entry vehicles with a higher degree of confidence to improve Warfighter shot doctrine, and conserve homeland defense interceptor inventory. LRDR also supports additional mission areas including Space Situational Awareness.

Acquisition Strategy

The LRDR acquisition strategy, which was approved on January 7, 2015, incorporates robust acquisition practices to ensure delivery of a best value solution that meets mission performance requirements and reduces lifecycle costs. MDA awarded a fixed-price incentive contract to Lockheed Martin Corporation of Moorestown, New Jersey, on October 21, 2015 to design, develop, manufacture, integrate & test, and field the LRDR prime mission equipment. The prime contract included other fixed-price and cost-reimbursable line items and options in order to properly balance acquisition costs and risks. Performance and cost incentives were included to motivate contractor performance. The radar prime contractor will deliver a full technical data package, which will enable the government to effectively and affordably sustain the system. MDA will synchronize the radar development contract efforts with a simultaneous MILCON effort which will be executed through the US Army Corps of Engineers. The LRDR is expected to complete development and initial fielding in 2020 for BMDS integration and testing.

BMDS (2015)

Ballistic Missile Defense System (BMDS)

The Ballistic Missile Defense System (BMDS) network of layered sensors provides essential situational awareness and fire control data for the command and control of BMDS weapon systems, such as Ground-based Midcourse Defense (GMD), Aegis Ballistic Missile Defense, and Terminal High Altitude Area Defense (THAAD). The suite of remote ground/naval-based sensors provides early warning, midcourse, and terminal ballistic missile defense threat data enabling layered detection and tracking of ballistic missile targets, providing fire-control quality position, velocity, and discrimination data through Command and Control, Battle Management, Communications (C2BMC).

Overlapping coverage of geographically diverse sensors provides improved threat track data as well as reducing the importance of the loss of any one sensor and reducing the potential impact of countermeasures. The extended coverage and accuracy provided by a network of layered sensors increases the defensive footprint and reduces the number of target engagements required, thereby conserv-

ing interceptor inventory and ensuring a high probability of successful engagement. Networked forward-based sensors enable C2BMC to pair the best sensor coverage with the best available weapon system to provide the most effective defense against ballistic missile threats.

Ground-based Midcourse Defense (GMD)

The Ground-based Midcourse Defense (GMD) program is the element of the BMDS that provides combatant commanders with a continuously available capability to defend the Homeland against limited Intercontinental Ballistic Missile (ICBM) attacks. The GMD capability consists of Ground Based Interceptors (GBI), GMD Fire Control system (GFC), GMD Communications Network (GCN), In-Flight Interceptor Communications System Data Terminals (IDT), and all of the ground Launch Support Systems (LSS) (silos, silo interface vaults (SIVs), environmental control systems, command launch equipment (CLE), firing circuits, and safety systems).

By the end of FY16, the Missile Defense Agency (MDA) will deploy an additional 6 GBIs,

Increasing the force from 30 to 36 operationally deployed GBIs, located at Fort Greely, Alaska (32 GBIs) and Vandenberg Air Force Base, California (4 GBIs). Each GBI delivers a single Exoatmospheric Kill Vehicle (EKV) to defeat threat warheads in space during the midcourse phase of the ballistic trajectory.

The GMD Fire Control system consists of fire control nodes in Fort Greely, Alaska and the Missile Defense Integration and Operations Center (MDIOC), Colorado Springs, Colorado. IDTs are currently located in Fort Greely, Alaska, Vandenberg Air Force Base, California, and Eareckson Air Station, Alaska, and the Missile Defense Agency (MDA) plans to deliver an additional IDT to Fort Drum, New York. The GMD capability leverages integration of Ballistic Missile Defense System sensors in Alaska, California, United Kingdom, Japan, and Greenland.

Development objectives for GMD include: testing and validating the performance of the Capability Enhancement I and II (CE-I and CE-II) GBIs, development and testing of capability upgrades, manufacturing additional GBIs in support of operational requirements, flight testing, upgrading fielded GBIs, and conducting comprehensive component ground testing that will improve GBI reliability and minimize the number of GBIs required to destroy each ICBM threat.

Discrimination Improvements for Homeland Defense (DIHD)

The Discrimination Improvements for Homeland Defense (DIHD) effort has a goal to develop and field an integrated set of element capabilities to improve BMDS reliability, lethality, and discrimination. The end result will be a deployed future BMDS architecture more capable of discriminating and destroying a reentry vehicle with a high degree of confidence that will improve Warfighter shot doctrine and preserve inventory. The effort will encompass a Near-Term, Mid-Term, and Far-Term DIHD capability fielding. DIHD is a combined effort between Systems Engineering, Ground-based Midcourse Defense (PE# 0603882C), BMD Sensors (PE# 0603884C), C2BMC (PE# 0603896C), Aegis BMD (PE# 0603892C), and Advanced C4ISR (PE# 0603179C).

BMD Command and Control, Battle Management and Communications (C2BMC)

The BMD Command and Control, Battle Management and Communications (C2BMC) program links together the sensors and weapons of separate elements into a layered missile defense system such that the whole is more capable and robust than the sum of its parts – thus

increasing the footprint of the BMDS with greater performance and defensive coverage. The C2BMC enables the BMDS to manage complex threats – near simultaneous enemy missile shots aimed at theater, regional, or homeland assets.

The systems linked through C2BMC include Patriot, Terminal High Altitude Area Defense (THAAD), Aegis Ballistic Missile Defense (BMD), Aegis Ashore, Ground Based Midcourse Defense (GMD), Army Integrated Air and Missile Defense Battle Command system (IBCS); and sensors such as the Army Navy/Ground Transportable Radar Surveillance model 2 (AN/TPY-2) radar, Sea-Based X-Band Radar (SBX), Space-Based Infrared System (SBIRS), and BMDS Overhead Persistent Infra-Red (OPIR) Architecture (BOA).

In FY14, the C2BMC Program shipped a C2BMC Deployable Interface Node (CDIN) in support of a second forward based TPY-2 to the Pacific Command (PACOM). The C2BMC program will install communications, support Hardware-in-the-Loop (HWIL) integration testing, and provide operations and sustainment, and training.

Based on the Missile Defense Agency's defined architectures and system specifications, the C2BMC program will provide the warfighter the capability to plan the BMD fight while concurrently tracking all potential ballistic missile threats, and pairing any sensor with any shooter to defeat ballistic missile threats at any range, in all theaters. C2BMC battle management will deliver full TPY-2 X-Band radar sensor control and capabilities for improved threat object correlation which calculates a common threat track from multiple sensors through data fusion, with sufficient data accuracy and timeliness for

BMDS weapon elements to enable successful engagements via Link-16 and satellite communications. The C2BMC program also works to increase coalition partners' capabilities.

C2BMC capability will be developed and delivered incrementally. The FY17 delivery (Spiral 8.2-1) supports Enhanced Homeland Defense

capability by providing increased Ground-based Midcourse Defense (GMD) battlespace, Link 16 track reporting of additional sensors, enhanced sensor tasking to meet track quality and discrimination timeliness requirements to support GMD engagements, and space situational awareness tasking support.

The FY19 delivery (Spiral 8.2-3) supports Presidential mandate EPAA Phase 3 capability declaration by providing critical sensor management and track reporting improvements to Aegis BMD Engage-on-Remote functionality, as well as integration with the new Army IAMD Battle Command System (IBCS).

BMD Sensors (2015)

UEWR Overview

The UEWR (Upgraded Early Warning Radars) radars compose large, fixed-site, phased-array radar complexes originally developed for detection and early warning of Soviet strategic submarine launched ballistic missile (SLBM) attacks against the United States. They have been known by several designations, including AN/FPS-115/120/123(V)/126 and Pave Paws and BMEWS (Ballistic Missile Early Warning System).

For Ballistic Missile Defense System (BMDS) use, the UEWRs detect, track, and count individual targets early in their trajectory, and also cue the higher resolution X-Band radars to the location and trajectory of incoming targets. Planned upgrades will provide precise tracking early enough to significantly expand the battlespace for ground-based interceptors (missiles).

UEWR for BMDS

The Ballistic Missile Defense System (BMDS) network of sensors includes the UEWRs at Beale Air Force Base, CA, Fylingdales Royal Air Force, United Kingdom, and at Thule Air Force Base in Greenland. These Ultra High Frequency Early Warning Radars (EWR) have been upgraded to include missile defense functionality. This upgrade expands the capabilities of the US to include defense against limited long-range threats.

The Clear EWR, located at Clear Air Force Station, AK, and the Cape Cod EWR, Located at Cape Cod Air Force Station, MA are also being upgraded to include missile defense functionality. Upgrade activities began in FY12 and are expected to be completed in FY17. The addition of the Clear UEWR and Cape Cod UEWRs the BMDS sensor architecture will improve BMDS sensor coverage and provide new engagement options against long-range missile threats.

UEWR Acquisition Strategy

The Missile Defense Agency (MDA) conducted a full and open competition for the Clear Early Warning Radar (EWR) Upgrade. MDA issued a Request for Proposal (RFP) in 2QFY12 with an award in 4QFY12. The Cape Cod EWR upgrade option under this contract was awarded in 1QFY13.

BMD Vision Study

The BMD Vision Study, conducted by MDA with USSTRATCOM, identified the need to enhance the discrimination capabilities of US sensors and weapon systems. There is an Enhanced Discrimination and sensors program that will improve discrimination capabilities of the TPY-2 THAAD, Cobra Dane, Sea Based X-Band (SBX), and the UEWR radars against the long range missile threat.

The BMDS Sensors Program also contributes to the testing and proving of the U.S. missile defense systems through modeling and simulation (M&S) efforts to include: enhanced sensor models, development of Radio Frequency scene generators, integration of digital simulations into the BMDS M&S architecture, and Verification, Validation, and Accreditation of radar models.

LRDR Planned Development & Production

By February 2015, the Long Range Discrimination Radar (LRDR) acquisition strategy had been approved. MDA will follow robust acquisition practices to ensure delivery of a best value solution that maximizes mission performance and minimizes lifecycle costs. The Joint Requirements Oversight Council was briefed and concurred with LRDR requirements in September 2014.

A full and open competition will be conducted in order to award a single contract for the development, installation, and initial operations and sustainment of the radar system. The radar prime contract will contain both fixed-price and cost-reimbursable line items in order to properly balance acquisition costs and risks. Performance and cost incentives will be used to motivate contractor performance. The radar prime contractor will deliver a full technical data package, which will enable the government to effectively and affordably sustain the system. MDA will synchronize the radar development contract efforts with a simultaneous MILCON effort which will be executed through the US Army Corps of Engineers. The LRDR is expected to become operational no later than 2020.

Beginning in FY15, funding was realigned to the Long Range Discrimination Radar (LRDR) Program Element# 0604873C, Project #MD96, from the Ballistic Missile Defense Sensors Program Element# 0603884C, Project #MD96.

The FY16 funding increase in PE# 0604873C reflects a ramp up for hardware and software design/development efforts, conducting the Preliminary Design Review and initiating procurement of long-lead items for the Long Range Discrimination Radar (LRDR).

Platforms

Pave Paws and BMEWS radars are mounted in a large, hardened structure.

Specifications

	AN/FPS-115
Frequency:	420-450 MHz
Pulse width:	16 millisec
Module peak power:	322 kW
Output (search mode):	100 KHz
Output (track mode):	1 KHz

Funding History

RDT&E ($ Millions)	FY11	FY12	FY13	FY14	FY15*	FY16**	FY17	FY18*	FY19**	FY20**
PE# 0603879C Ballistic Missile Defense Sensor Test										
	—	—	—	—	71.3	86.8	104.3**	n/a	n/a	n/a
Proj. #MT11 BMDS Radars Test										
	—	—	—	—	71.3	82.9	99.3**	n/a	n/a	n/a
Proj. #MD40 Program-Wide Support										
	—	—	—	—	—	3.8	4.9**	n/a	n/a	n/a
PE# 0603882C BMD Midcourse Defense Segment										
	n/a	n/a	n/a	1,064.4	873.9	1,284.9	1,034.9	957.1	926.4	1,046.2
PE# 0603884C Ballistic Missile Defense Sensors										
	n/a	n/a	n/a	340.4	270.9	233.6	252.7	278.1	220.9	250.2
Proj. #MD11 BMDS Radars	n/a	n/a	n/a	273.1	246.1	222.1	216.4**	n/a	n/a	n/a
Proj. #MC11 Cyber Operations										
	—	—	—	1.5	1.2	1.2	1.3**	n/a	n/a	n/a
Proj. #MD11 BMDS Radars Test										
	n/a	n/a	n/a	49.9	—	—	—**	n/a	n/a	n/a
Proj. #MD40 Program-wide Support										
	n/a	n/a	n/a	15.9	23.6	10.3	10.8**	n/a	n/a	n/a
PE# 0603890C BMD Enabling Programs										
	n/a	n/a	n/a	369.0	402.0	409.1	435.2	465.6	540.9	542.3
PE# 0603896C BMD Command and Control, Battle Management & Communication										
	n/a	n/a	n/a	390.2	428.3	450.1	465.4	454.9	475.2	515.2
PE# 0603898C Joint Warfighter Support										
	n/a	n/a	n/a	41.1	46.4	49.6	47.4	49.0	48.8	53.4
Proj. #MD03 Joint Warfighter Support										
	n/a	n/a	n/a	38.6	14.6	16.2	16.4**	n/a	n/a	n/a
Proj. #MT03 Joint Warfighter Support Test										
	—	—	—	—	29.1	31.1	31.7**	n/a	n/a	n/a
Proj. #MD40 Program-Wide Support										
	n/a	n/a	n/a	2.4	2.7	2.2	2.4**	n/a	n/a	n/a
PE# 0603914C Ballistic Missile Defense Test										
	n/a	n/a	n/a	342.7	366.3	274.3	294.4	316.2	365.7	349.4
Proj. #MT04 BMDS Test Program										
	n/a	n/a	n/a	325.3	344.8	259.8	281.8**	n/a	n/a	n/a
Proj. #MC04 Cyber Operations Joint Warfighter Support Test										
	—	—	—	1.0	1.7	2.4	2.5**	n/a	n/a	n/a
Proj. #MD40 Program-Wide Support										
	n/a	n/a	n/a	16.3	19.8	12.1	14.1**	n/a	n/a	n/a
PE# 0604181C Hypersonic Defense										
	—	—	—	—	—	—	—	75.3	120.4	157.7
PE# 0604673C Hypersonic Defense										
	—	—	—	—	—	—	—	—	95.8	164.2
PE# 0604873C Long Range Discrimination Radar (LRDR)										
	—	—	—	—	50.5	137.6	186.2	357.7	164.6	91.6
Proj. #MD96 Long Range Discrimination Radar (LRDR)										
	—	—	—	—	50.5	131.5	174.5	341.6	158.6	89.3
Proj. #MD40 Program-Wide Support										
	—	—	—	—	—	6.0	11.6	16.0	6.0	2.3

Procurement ($ Millions)	FY11	FY12	FY13	FY14	FY15*	FY16**	FY17	FY18*	FY19**	FY20**
BMDS Procurement										
BMDS Procurement (#0208886C)	n/a	n/a	n/a	n/a	n/a	n/a	1,585.4	2,417.5	2,432.0	1,945.1
BMDS – Upgrade Early Warning Radar (UEWR), Clear AFS, AK	n/a	n/a	n/a	17.2	—	—	—**	n/a	n/a	n/a
BMDS Operations & Maintenance										
BMDS O&M (#0208886C)	n/a	n/a	n/a	n/a	n/a	n/a	459.6	504.1	499.8	502.7

**Appropriation*
***Request*

Costs

AN/FPS-115 system unit cost was about $123 million. Taiwan's potential buy of two Pave Paws radars had an estimated unit cost of $400 million per radar in 2000.

In a GAO report in July 1998, the BMDO estimated the cost of developing and deploying a BMD system in the next few years to range from $18.4 billion to $28.3 billion.

By early 2000, the baseline system to be deployed in 2005 had a cost objective of $10.5 billion and a 20-year life-cycle cost of $23 billion.

In mid-2000, the DoD estimated total costs between 2005 and 2015 of $1.1 billion for the GBR and $1.2 billion for Upgraded Early Warning Radars (UEWR). The Congressional Budget Office (CBO) estimated $1.2 billion for GBR and $1.3 billion for UEWR.

Program Overview

History

FPS-115 Pave Paws Development

The AN/FPS-115 Pave Paws program was developed under project designation 474N SEEK SIN, beginning in 1975. The aim was to upgrade an older system which consisted of three AN/FSS-7 radars on each coast. The SLBM Radar Warning System consists of Pave Paws sites at Otis AFB (Cape Cod, MA), Beale AFB (CA), Robins AFB (GA), Goodfellow AFB (Eldorado, TX), and the Perimeter Acquisition Radar Attack Characterization System (PARCS) in North Dakota. The program was aimed at improving the coverage of the continental US against sea-borne attack by ballistic missile submarines. The system covers the historical Soviet submarine patrol areas for warning and assessment of SLBM attacks.

Three contractors bid on the project: Raytheon, Westinghouse, and a GE/TRW/Control Data team. Raytheon received the development contract. Software work was undertaken by IBM and TRW, and Control Data provided the basic site computers. The first two high-priority sites selected were at Otis AFB in Massachusetts and Beale AFB in California. A second pair of sites to improve southern coverage were selected in 1981 for Robins AFB in Georgia and Goodfellow AFB in Eldorado, Texas. Initial operation of the first systems began in 1979, and the final site at Goodfellow AFB was turned over in 1987.

In August 1988, Raytheon was awarded an upgrade contract to bring the first two sites up to the standards of the two newer sites. The systems have been subject to a variety of environmental lawsuits.

FPS-115 BMEWS

The FPS-115 was used in modified form to upgrade the BMEWS (Ballistic Missile Early Warning System). The mission of BMEWS is to detect and provide warning of a ballistic missile attack on the United States, Canada, the United Kingdom, and Europe. BMEWS consists of three sites at Thule (Greenland), Clear (Alaska), and Fylingdales (England).

Clear Air Station to Get Phased-Arrays From Southern Pave Paws Sites

In June 1997, the ESC announced it intended to upgrade the outdated mechanical radar at Clear Air Station, AK, to a Pave Paws phased-array radar. The contract will require site adaptation to a design based on the current Pave Paws sites, with options for the construction of a facility, and integration and test of two phased-array faces and associated computer strings. Included in these requirements will be the acceptance, removal, and shipment of one face and associated Prime Mission Equipment (PME) from each of the southern US Pave Paws radars located at Eldorado AS, TX, and Robins AFB, GA.

In order to support rapid reconstitution/reactivation to a single face, single string, operation at both of these Pave Paws sites, the prime con-

tractor team shall procure/manufacture, install, integrate, and test those unique PME items which support both faces. These unique PME items shall be in addition to and in conjunction with the removed PME for use at Clear AS. No new mission processing automated data processing will be acquired.

In addition, the Air Force requires the highest degree of commonality (radar and automated data processing equipment and associated software) among this newly deployed system and the existing Pave Paws radar systems. The intended Initial Operational Capability (IOC) for the Clear phased-array radar is January 2001.

Clear BMEWS Upgrade Complete

In April 2001, Raytheon announced it had completed moving components from Eldorado, TX to the Clear, AK BMEWS site.

Taiwan Requests FPS-115

In November 2000, Taiwan allocated $30 million in its 2001 defense budget for a radar modernization program which would involve acquiring two FPS-115 Pave Paws radars. The Pentagon preliminarily agreed to the sale, which would cost about $800 million for two Pave Paws systems and $225 million for additional equipment and maintainance.

In August 2001, the plan had changed to one modified FPS-115 Pave Paws radar (in conjunction with two AN/SPY-1D(V) radars, for Taiwan's northern and southern regions).

$1 Billion Support Contract to ITT Industries

In January 2002, ITT Industries won a $519 million support contract (with options to $959 million over 18 years) from the US Air Force. The Systems Engineering and Sustainment Integrator (SENSOR) contract calls for sustainment and modernization of a number of ground-based radars and optical sensors for missile warning, missile defense, and space-tracking duties. Sensors include Pave Paws, BMEWS, PARCS, and space surveillance systems such as GEODSS, Eglin Radar, and Have Stare.

The SENSOR program is a follow-on to the existing Integrated Tactical Warning/Attack Assessment (ITW/AA) Sensors Integrated System Support (ISISS) contract, being performed by Northrop Grumman.

US Requests Radar Upgrades

In January 2003, the UK Parliament discussed the US request to allow upgrading of the radar at Fylingdales, England, and agreed in principle to allow it. The upgrade will be conducted at US expense, and will consist of hardware and software modifications with no external changes to the radar complex.

Denmark has also been asked to permit upgrades to the radar at Thule, Greenland.

ARCTEC Support Contracts

In October 2003, the Air Force 21st Space Wing, Petersen AFB, CO, issued ARCTEC Services, Colorado Springs, CO, a $41.1 million add-on contract to fund support services for the phased array radar (PAR) system. The award was released as the Year 4 (FY04) add-on to an FY99 fixed-price-incentive-fee (FPIF) action. Services will include management, operation, maintenance, and logistics support of the solid state PARs at Cape Cod AFS, MA; Beale AFB, CA; Thule Air Base, Greenland; Clear Air Station, AK; and RAD Fylingdales, UK. ARCTEC is to perform these efforts at Colorado Springs, CO; at Clear Air Station, AK (68%); and at other unannounced locations. The work is to be completed in September 2004. Contract funding will come from Air Force O&M (F-5604-99-C-9004/PO298).

In September 2004, the 21st Space Wing issued ARCTEC Services a $41.2 million fixed-price-incentive-fee (FPIF) contract modification to finance option year five (FY05), to support the solid state PARs (as above). The bulk of the work is to be performed in Colorado Springs, CO and in Thule Air Base, Greenland, with September 2005 the projected completion date (F05604-99-C-9004).

Missile Defense Upgrade Status

In November 2003, Boeing announced it will spend $111.7 million on ballistic missile defense upgrades to the Pave Paws radar at Fylingdales (UK), as part of its $823 million contract modification for the Ground-based Midcourse Defense Block 2004 Capability Enhancement (CE) Program. Work is to be completed by the end of 2005.

Similar upgrades at Thule (Greenland) could be completed by 2006. The radar at Beale AFB (CA), and the Cobra Dane radar at Eareckson Air Force Station on Shemya Island (AK) will also receive upgrades, to allow them to become part of the missile defense test bed in 2004.

The radars at Clear (AK) and Cape Cod, MA will retain their early warning roles, but will not receive missile defense upgrades, according to a MDA spokesman.

Sale to Taiwan Okayed

In March 2004, the US DoD finally announced it had okayed the sale of long-range UHF early warning radars to Taiwan. The plan is now for one initial radar (worth $830 million) to be built at Loshan Mountain in northern Taiwan, to be followed by a second radar to be built at Longshan in southern Taiwan when Taiwan's finances allow. The second phase would also include two Missile Warning Centers, and bring total costs up to about $1.8 billion.

However, the acquisition may now be competed, rather than a guaranteed Pave Paws sale, with Lockheed Martin offering a version of the MEADS (Medium Extended Air Defense System) radar.

Scaleable Antenna Panels (SPEAR) Solicitation

In October 2004, the Sensors Directorate (SN) of the Air Force Research Laboratory (AFRL), Wright Research Site, Wright-Patterson

AFB, OH, announced it will host a one-half day, classified briefing of the planned Sensor Technology Research, Development, Test & Evaluation Open-Ended Broad Agency Announcement (STROEB), BAA 04-03-SNK, entitled Scaleable Panels for Efficient Affordable Radars (SPEAR) Spiral 1.

The objective of this program is to develop technology needed to produce modular/scaleable, low power density antenna panels that meet future Ballistic Missile Defense Systems (BMDS) radar requirements. This technology development should demonstrate the feasibility of producing tiles/panels at significantly lower per element costs than current "brick" architectures. This effort should validate a panel design with respect to: radio frequency performance, power consumption, thermal performance, mechanical characteristics, and implementation of an open system architecture. It should produce sufficient hardware for future experiments investigating array-level issues such as coherence, calibration and system thermal management.

The briefing will be limited to interested representatives of US Government agencies and US contractors only. Contractor participation will be subject to the same restrictions specified on the STROEB BAA. The briefing will be held in October 2004. Organizations wishing to attend the Bidders Conference should respond via e-mail to Ms. Noelle Spalding, Det 1 AFRL/PKSR, email: Noelle.Spalding@wpafb.af.mil. SOL is BAA-04-03-SNK, due December 2008. POC is Noelle Spalding, Contract Negotiator, tel: (937) 656-9837, fax: (937) 255-8100; John Stovall is the Contracting Officer, tel: (937) 255-5380, fax: (937) 656-9074, email: John.Stovall@wpafb.af.mil.

IDC Sensor Schedule

Block 2004 GMD (Ground Based Midcourse Defense) is being completed in two phases. The first phase, the initial BMDS Test Bed with a limited defensive capability, was completed on September 30, 2004. The second phase provides an enhanced capability and additional assets that can also be utilized for the BMDS Test Bed. It is to be completed in December 2005.

The Initial Defense Capability (IDC) sensors consist of radars at multiple sites. The BMDS Test Bed provides for an upgraded Cobra Dane radar on Shemya, an Upgraded Early Warning Radar (UEWR) at Beale AFB in 2004 and a Sea-Based X-Band radar in 2005, and communications interface to the Aegis AN/SPY-1 radars. The IDC initiative provides for an UEWR at Fylingdales, United Kingdom in 2005. An additional prototype X-band radar, Ground-Based Radar Prototype (GBR-P), is located at the Reagan Test Site (RTS) as part of the BMDS Test Bed and will continue to support the flight test program.

Taiwan Gets Its Radar

In June 2005, the Air Force ESC awarded Raytheon a $752 million cost-plus award-fee, firm fixed price contract to provide Taiwan with an early warning Surveillance Radar System. The system includes a Pave Paws radar integrated with Taiwan-furnished IFF beacons, two Missile Warning Centers, and communications and interface architecture and protocol consistent with United States government restrictions. At this time, $349 million of the funds have been obligated. The work will be completed by September 2009.

Thule Radar Upgrade

MDA issued Raytheon, Woburn, MA, a not-to-exceed (NTE) letter contract of $114.1 million to upgrade the early warning radar at Thule Air Base, Greenland. The period of performance is from April 2006 to September 2010. Contract funding will come from the Defense Agencies O&M and procurement (PDA) accounts (HQ0006-06-C-0012).

UEWR Maintenance to BAE Systems

In May 2006, the 21st Space Wing, Peterson AFB, CO, awarded a $5.1 million firm-fixed-price (FFP), incentive with award-fee and award term, cost reimbursement contract to BAE Systems in Fort Walton Beach, FL, to fund operations and maintenance (O&M) services for all five UEWR radar sites. The contract was the result of an April 2005 solicitation that saw negotiations completed in January 2006. The work is to be completed in September 2018. Contract funding is coming from Air Force O&M (FA2517-06-C-8001).

Work is to include radar and mission computer maintenance, communications systems maintenance including the maintenance of military satellite communications systems (SATCOM), communications-electronics (C-E) maintenance, local area network management, precision measurement equipment calibration and maintenance, logistics support, civil engineering, vehicle maintenance, and environmental compliance management.

Operation & Maintenance Contracts

In September 2007, the Air Force Space and Missile Systems Center (SMC) at Peterson AFB, CO, issued BAE Systems a $38.3 million add-on to Systems extend the period of performance covering operation and maintenance and logistics support to the Solid State Phased Array radar systems at Cape Cod AFS, MA; Beale AFB., CA; Thule AFB, GL; Clear AFS, AK; and RAF Flyingdales, UK. The work is to be performed at Fort Walton Beach, FL; Peterson AFB, CO; and at the locations shown. Contract funding, all of which was obligated, is coming from Air Force O&M (FA2517-06-C-8001/PO46).

Also in September 2007, the Air Force 3rd Contracting Squadron (CS), Elmendorf AFB, AK, issued ARCTEC Alaska a $34 million contract to continue financing of the Alaska Radar System. The work is to

be performed in Alaska and is to be completed by September 2008. Contract financing will come from Air Force O&M (FA5000-04-C-0011).

Future UEWR Studies Contract

In December 2007, the Missile Defense Agency (MDA), Washington, DC, had a requirement to expand the scope of Raytheon contract HQ0006-06-C-0012, to analyze the feasibility and impacts of future Early Warning Radar (EWR) applications for the Missile Defense System. SOL is HQ0006-06-C-0012, due January 2008. POC is Charles Clements, tel: (703) 882-6517, fax: (703) 882-6349; Mary Small is the Contracting Officer, tel: (703) 882-6644, fax: (703) 882-6356. POP is Woburn, MA, at Beale, Fylingdales, and Thule, and multiple CONUS and OCONUS locations. Email: Charles.Clements.ctr@mda.mil, Mary.Small@mda.mil.

$400M European Radar Contract

In April 2008, the MDA issued Raytheon a $400 million (maximum) ID/IQ contract to support the design, development, and activation of a European-based mid-course radar. The effort is to be accomplished through task orders, with distinct scope and pricing. The first task order is to obligate $5.3 million and will be limited to site surveys, studies, analysis, planning, design, and similar activities permitted specifically permitted in section 226(d) of the FY08 National Defense Authorization Act. Additional activities necessary to this deployment will be conducted through the Army Corps of Engineers. Work is to be conducted in Woburn, MA, and at unreported locations in Europe, and is to be completed by February 2013. Contract finance will come from the MDA Ballistic Missile Defense (BMD) Midcourse Defense Segment R&D program (PE# 0603882C) (HQ147-08-D-0001).

PE# 0603882C (GMD) Plans

In May 2009, the MDA budget for PE# 0603882C (Ground Based Midcourse Defense [GMD]) requested $983 million in FY10, compared to $1.507 billion appropriated in FY09. Much of the decrease is attributable to transferring the European Capability funding (including testing of the two-stage boost vehicle) to its own, new PE. Also, the MDA intends to stop construction of Missile Field #2 at Ft. Greely, AK, curtail GMD development, and decrease the planned number of emplaced GBIs from 44 to 30. This reduction in silos still provides the United States with a substantial inventory of operational GBIs, considering the very limited number of ICBM launch complexes in North Korea and Iran.

Although an in-depth review of our test plans is still being conducted, the MDA claims that, at a minimum, the FY10 request supports continued rigorous ground testing and execution of one intercept flight test in FY10. In accordance with the warfighter's request, the MDA has programmed $26 million to transition the GMD Communications Network (GCN) to the warfighter's DISN network. With the remaining midcourse funding, the MDA intends to apply $195 million for sustainment—largely for Ft. Greely and Vandenberg Air Force Base, CA.

PE# 0603884C (Sensors) Plans

In May 2009, the MDA budget for PE# 0603882C (BMD Sensors) requested $637 million for FY10, compared to $768 million appropriated for FY09. Major programmatic content in the request includes $98 million for contractor logistics support and another $28 million for additional operations support for the AN/TPY-2 THAAD radars (the TPY-2 #3 radar was successfully deployed to Israel in 2008). To sustain the Beale, Fylingdales, and Cobra Dane early warning radars, the MDA allocates $15 million in FY10. On the development side, the MDA requests $30 million for development work related to unifying missile defense functions (UMDF), such as sensor registration, system track, and discrimination; $22 million for test and evaluation of the Cobra Dane radar; $16 million for modeling and simulation program support; and $53 million for test and evaluation of the TPY-2 radars, including warfighter exercises and flight and ground tests.

PE# 0603882C (GMD) Plans

In February 2011, the MDA budget for PE# 0603882C (BMD Mid-Course Segment) allotted $1.3 billion in FY11 and $1.2 billion in FY12, compared to $1.0 billion appropriated in FY10. The MDA will continue the development and fielding of the Ground-Based Midcourse Defense capability to defend the US against a limited number of launches of Intermediate-Range Ballistic Missiles and Intercontinental Ballistic Missiles. Planned developments include:

To prove the Ground-Based Midcourse Defense capability works, MDA will execute a rigorous test program that includes expanding flight and ground test programs to test capabilities against intermediate and long-range threats to build confidence in the Ballistic Missile Defense System, bolster deterrence against their use, and send a message to potential adversaries looking to acquire ballistic missiles.

The MDA will continue to provide for the operations and sustainment of Ground-Based Midcourse Defense fielded capability at Fort Greely, Alaska; Eareckson Air Station, Alaska; Vandenberg Air Force Base, California; the Missile Defense Integration Operations Center (MDIOC), Colorado and across the nation-wide Ground-Based Midcourse Defense Communications Network.

Ground-Based Midcourse Defense will pursue a competitive Development and Sustainment Contract (DSC) for future development; fielding; test; systems engineering, integration and configuration management; equipment manufacturing and upgrade; training; and opera-

tions and sustainment support for the Ground-Based Midcourse Defense system and associated support facilities.

The MDA will continue execution of a lifecycle management plan to sustain the Ground-Based Midcourse Defense system through 2032 and beyond. To increase reliability of the Ground-Based Interceptor fleet, the MDA will rotate newer Ground-Based Interceptors into the operational fleet and upgrade older Ground-Based Interceptors for flight testing and operational spares. MDA will execute an obsolescence and technology refresh program for Ground Systems components to mitigate obsolescence issues.

The MDA will complete Missile Field 2 (MF2) at Fort Greely, Alaska and plan for the decommissioning of Missile Field 1 (MF1).

The MDA organized a Failure Investigation Team (FIT) that was formed to investigate the cause of the unsuccessful intercept of Flight Test Ground-Based Midcourse Defense-06 (FTG-06). FIT findings were published in August 2010.

The MDA established a Failure Review Board (FRB) to investigate the cause of unsuccessful intercept of Flight Test Ground-Based Midcourse Defense-06a (FTG-06a).

PE# 0603884C (Sensors) Plans

In February 2011, the MDA budget for PE# 0603884C (BMD Sensors) allotted $454.9 million in FY11 and $222.4 million in FY12, compared to $544.4 billion appropriated in FY10. Major programmatic content in the request includes:

Participation in BMDS flight and ground test campaigns.

Modeling and simulation efforts to include: enhanced sensor models, development of radio frequency (RF) scene generators, integration of digital simulations into the BMDS modeling and simulation architecture, and verification, validation, and accreditation (VV&A) of radar models.

Development and implementation of Concurrent, Test, Training, and Operations (CTTO) capabilities.

Development of advanced radar discrimination algorithms and Common X-Band software for X-Band radars to address evolving threats.

Operations and support of the External Sensors Lab (ESL) – a research and development lab critical to researching potential capabilities gained from sensors external to the BMDS; after FY11, the MDA Directorate of Advanced Technology will assume responsibility for the ESL; funding will reside in the Advanced Technology Program Element (0603175C); the ESL technology effort supports evolution and advances for the BMDS Overhead Persistent Infrared (OPIR) Architecture (BOA) capabilities, as well as the development of the Precision Tracking Space System (PTSS) and Airborne Infrared (ABIR) sensor capabilities.

Clear/Cod Upgrades

In July 2011, The Missile Defense Agency (MDA-DAC), Alexandria, VA, reported that the Government UEWR Program Office would host an Industry Day Conference in August 2011 to encourage information exchange between Government and Industry regarding upgrades to the UEWR radars at Clear, AK and Cape Cod MA. POCs for Industry Days: Ms Hilda Avalos, email: Hilda.avalos@hanscom.af.mil; Mr Peter Rivera, email: Peter.rivera@hanscom.af.mil, and Ms Carol Rivard, email: ClearCompetition@mda.mil. SOL is HQ0147-11-R-0002.

Clear and Cape Cod UEWR BMDS Upgrades

In March 2014, the Clear UEWR and the Cape Cod UEWR were still being upgraded to include missile defense functionality. Upgrade activities began in FY12 and were expected to be completed in FY17. The addition of the Clear and Cape Cod UEWRs to the BMDS sensor architecture will improve BMDS sensor coverage and provide new engagement options against long-range missile threats.

The Missile Defense Agency (MDA) conducted a full and open competition for the Clear Early Warning Radar (EWR) Upgrade. MDA issued a Request for Proposal (RFP) on this effort in 2QFY12, with the award in 4QFY12. The Cape Cod EWR upgrade option under this contract was awarded in 1QFY13.

Enhanced Discrimination and Sensors Upgrade

In March 2014, an Enhanced Discrimination and Sensors program was planned, to improve discrimination capabilities of the AN/TPY-2, Cobra Dane, Sea Based X-Band, and UEWR radars against the long range missile threat.

Long Range Discrimination Radar (LRDR) Planned

In March 2014, a critical need identified for future BMDS was the need to provide a more robust discrimination capability to support the defense of the Homeland. As part of the BMDS Integrated Discrimination strategy, the addition of a Long Range Discrimination Radar (LRDR) to the BMDS would address this critical need through providing persistent 24/7 precision tracking and discrimination capability.

The development, integration and fielding of the LRDR will provide an improved persistent midcourse Ballistic Missile Defense System (BMDS) discrimination capability in the Pacific architecture, optimize the Ground-Based Midcourse Defense (GMD) interceptor inventory, and address evolving threats. In addition the radar will provide larger hit assessment coverage potentially supporting improved warfighting capability to manage the GBI inventory and improving the capacity of the BMDS.

MDA will initiate the MILCON planning and design in FY15 to support the LRDR.

GMD Funding Boost

The Ground-based Midcourse Defense (GMD) system became operational to protect the homeland in 2004. In 2014, the Missile Defense Agency (MDA) commissioned a study to assess GMD system health and status. As a result of the study and warfighter input, in the February 2015 budget, MDA increased the FY16 budget request. The additional funding will address study findings and improve the overall reliability, performance, producibility, testability, and extend the life and health of the overarching GMD system. Funding changes shown in the February budget included funding increases of about $150 million in both FY14 and FY16, with a $130 million decrease in FY15.

Near-Term C2BMC Increments

C2BMC capability is developed and delivered incrementally. The FY17 delivery (Spiral 8.2-1) supports Enhanced Homeland Defense capability by providing increased Ground-based Midcourse Defense (GMD) battlespace, Link 16 track reporting of additional sensors, enhanced sensor tasking to meet track quality and discrimination timeliness requirements to support GMD engagements, and space situational awareness tasking support.

The FY19 delivery (Spiral 8.2-3) supports Presidential mandate EPAA Phase 3 capability declaration by providing critical sensor management and track reporting improvements to Aegis BMD Engage-on-Remote functionality, as well as integration with the new Army IAMD Battle Command System (IBCS).

LRDR Planned Development & Production

By February 2015, the Long Range Discrimination Radar (LRDR) acquisition strategy had been approved. MDA will follow robust acquisition practices to ensure delivery of a best value solution that maximizes mission performance and minimizes lifecycle costs. The Joint Requirements Oversight Council was briefed and concurred with LRDR requirements in September 2014.

A full and open competition will be conducted in order to award a single contract for the development, installation, and initial operations and sustainment of the radar system. The radar prime contract will contain both fixed-price and cost-reimbursable line items in order to properly balance acquisition costs and risks. Performance and cost incentives will be used to motivate contractor performance. The radar prime contractor will deliver a full technical data package, which will enable the government to effectively and affordably sustain the system. MDA will synchronize the radar development contract efforts with a simultaneous MILCON effort which will be executed through the US Army Corps of Engineers. The LRDR is expected to become operational no later than 2020.

Beginning in FY15, funding was realigned to the Long Range Discrimination Radar (LRDR) Program Element# 0604873C, Project #MD96, from the Ballistic Missile Defense Sensors Program Element# 0603884C, Project #MD96.

The FY16 funding increase in PE# 0604873C reflects a ramp up for hardware and software design/development efforts, conducting the Preliminary Design Review and initiating procurement of long-lead items for the Long Range Discrimination Radar (LRDR).

Current Developments

LRDR Planned Schedule

In February 2018, the Missile Defense Agency's planned schedule for LRDR in PE# 0604873C was Build 1.0 Software Delivery in 3QFY18; Build 1.1 Software Delivery in 1QFY19; Initial Fielding in 1QFY21; Technical Capability Declaration (TCD) in 3QFY21; and Operational Capability Declaration (OCD) in 1QFY22.

LRDR Development Plans

In February 2018, the MDA's plans for the Long Range Discrimination Radar (LRDR) program were to design, develop, integrate, deliver, field, and sustain the LRDR as an element of the BMDS Increment 6b in support of the Ground-Based Midcourse Defense (GMD) Program's Homeland Defense (HLD) Capability. This capability is representative of LRDR Configuration 1. Initial fielding of the LRDR is planned for 2020 leading to an Operational Capability Declaration in FY22.

The LRDR is comprised of a LRDR Equipment Shelter (LES), housing two radar array faces, a Mission Control Facility (MCF) which supports radar operations, and supporting facilities and infrastructure. The Secretary of the Air Force approved Clear Air Force Station, Alaska as the LRDR site. The Air Force Space Command (AFSPC) is the designated Lead MAJCOM.

The LRDR operates in the S-band (*not* X-band) frequency, features scalable and open systems architecture to mitigate evolving threats, and integrates into the BMDS through the Command and Control, Battle Management, and Communications (C2BMC) system. This Program Element includes BMDS threat discrimination improvements to enhance BMDS effectiveness against the evolving threat. The result will be a BMDS architecture more capable of discriminating and intercepting re-entry vehicles with a higher degree of confidence to improve Warfighter shot doctrine, and conserve homeland defense interceptor inventory. LRDR also supports additional mission areas including Space Situational Awareness.

LRDR Acquisition Strategy

In February 2018, the LRDR acquisition strategy (which was approved on January 7, 2015) incorporated robust acquisition practices to ensure delivery of a best value solution that meets mission performance requirements and reduces lifecy-

cle costs. MDA awarded a fixed-price incentive contract to Lockheed Martin Corporation of Moorestown, New Jersey, on October 21, 2015 to design, develop, manufacture, integrate & test, and field the LRDR prime mission equipment. The prime contract included other fixed-price and cost-reimbursable line items and options in order to properly balance acquisition costs and risks. Performance and cost incentives were included to motivate contractor performance. The radar prime contractor will deliver a full technical data package, which will enable the government to effectively and affordably sustain the system. MDA will synchronize the radar development contract efforts with a simultaneous MILCON effort which will be executed through the US Army Corps of Engineers. The LRDR is expected to complete development and initial fielding in 2020 for BMDS integration and testing.

Teal Group Evaluation

The requirement for SLBM launch detection diminished drastically in the years after the collapse of the Soviet Union. Although the Russian submarine force remained formidable on paper, it ended most of its periodic missile patrols off the US coast. This ended the need for round-the-clock use of Pave Paws/BMEWS radars for early warning of attack. Attacks by stationary submarines from their harbors in the Murmansk area of northern Russia, or from Pacific ports, can be detected by other strategic systems including the DSP satellites.

This change in the strategic environment, combined with heavy budget cuts, undercut major efforts to upgrade the early warning radar sites beyond operations and maintenance requirements. Air Force reluctance to spend only $4 million in the 1990s to undertake blanking modifications at Robins AFB was an indication of the new realities of funding on strategic programs of this type. Funding for Pave Paws was limited to O&M funding for a few years.

But then, playing to a new national concern, in August 1996 the Air Force announced a possible program to use ***Pave Paws*** and ***BMEWS*** radars for ***Ballistic Missile Defense (BMD)***. The plan has now come to fruition, and the last BMEWS site has been upgraded to Pave Paws standards, including two phased-array faces removed from the Eldorado, TX, Pave Paws sites to replace the mechanical radar at the Clear Air Station, AK BMEWS site. Considerable hardware and software enhancements for BMD at all BMEWS sites have come from healthy BMD program funding, worth billions of dollars. In mid-2000, the DoD estimated total costs between 2005 and 2015 of $1.1 billion for the Ground Based Radar (GBR) and $1.2 billion for Upgraded Early Warning Radars (UEWR).

And there has even been new production. In November 2000, Taiwan requested a possible sale of two Pave Paws radars. By August 2001, the plan had changed to one modified FPS-115 Pave Paws radar. In March 2004, the US DoD finally announced it had okayed the sale, intended as one initial radar, to be followed by a second when Taiwan's finances allow. In June 2005, Taiwan contracted for the first radar, worth $752 million.

As part of the ***Ballistic Missile Defense System (BMDS)*** Integrated Discrimination strategy, plans in March 2014 introduced the addition of a new ***Long Range Discrimination Radar (LRDR)*** to the BMDS, to provide improved persistent 24/7 precision tracking and discrimination capability. By February 2015, the Long Range Discrimination Radar (LRDR) acquisition strategy had been approved. A full and open competition was conducted in order to award a single contract for the development, installation, and initial operations and sustainment of the radar system, with the LRDR expected to become operational no later than 2020.

In October 2015, design, development, manufacture, integration & test, and fielding of LRDR prime mission equipment was won by Lockheed Martin, Moorestown, NJ.

By February 2018, the LRDR was to become an element of the BMDS Increment 6b in support of the Ground-Based Midcourse Defense (GMD) Program's Homeland Defense (HLD) Capability. This capability is representative of LRDR Configuration 1. Initial fielding of

the LRDR is planned for 2020 leading to an Operational Capability Declaration in FY22. The Secretary of the Air Force approved Clear Air Force Station, Alaska as the LRDR site. The Air Force Space Command (AFSPC) is the designated Lead MAJCOM. The LRDR operates in the S-band (*not* X-band) frequency, features scalable and open systems architecture to mitigate evolving threats, and integrates into the BMDS through the Command and Control, Battle Management, and Communications (C2BMC) system. LRDR also supports additional mission areas including Space Situational Awareness.

Note that nearly all MDA "procurement" funding for the BMDS is included in the RDT&E Program Elements. This funding covers all initial production of BMDS systems, and there are few detailed procurement line breakouts. Thus, BMDS RDT&E funding is often comparable to *combined* RDT&E+Procurement+O&M funding for most other programs, and there is currently no way to accurately break this funding down.

Our forecasts are speculative. C2BMC (Command and Control, Battle Management & Communication) funding forecasts are included in the THAAD report.

Funding Forecast

RDT&E (FY18$ Millions)	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
UEWR										
	46.0	54.0	64.0	62.0	56.0	54.0	60.0	62.0	64.0	60.0
Procurement (FY18$ Millions)	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
UEWR Modifications										
	66.0	70.0	84.0	106.0	114.0	102.0	98.0	88.0	90.0	94.0
UEWR Operations and Maintenance										
	74.0	76.0	70.0	72.0	70.0	70.0	78.0	76.0	78.0	80.0
Total Procurement	**140.0**	**146.0**	**154.0**	**178.0**	**184.0**	**172.0**	**176.0**	**164.0**	**168.0**	**174.0**
RDT&E+Proc (FY18$ Millions)	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
All RDT&E and Procurement and Upgrade & Support										
LRDR	360.0	220.0	240.0	320.0	320.0	360.0	340.0	360.0	340.0	320.0

November 2018