

# ARCHIVED REPORT

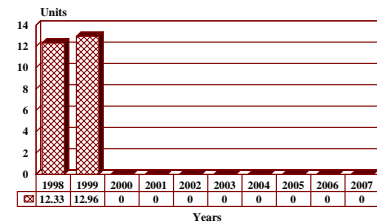
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## Extended Airborne Global Launch Evaluator (EAGLE) - Archived 8/98

### Outlook

- Program continues in development/flight-demonstration stage
- Potential exists for deployment of the system on the world's fleet of AWACS aircraft
- One of many missile defense developments ongoing

10 Year Unit Production Forecast  
1998-2007



### Orientation

**Description.** EAGLE is being developed as a possible Theater Ballistic Missile (TBM) detection, tracking and cueing system for use on the E-3 AWACS aircraft.

#### Sponsors

Ballistic Missile Defense Organization

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#### Contractors

Boeing Defense and Space Group

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(Prime Contractor)

Raytheon Systems Company

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[Acquisition by Raytheon pending]

(Major Subcontractor)

**Status.** Development and flight demonstration.

**Total Produced.** None to date.

**Platform.** E-3 Airborne Warning and Control System (AWACS) aircraft.

**Application.** Boost phase detection and tracking of theater ballistic missiles (TBM) for subsequent engagement by terminal, point or other defenses.

**Price Range.** Indeterminate.

## Technical Data

**Design Features.** The EAGLE program is a Commercial-Off-The-Shelf (COTS) and Non-Developmental Item (NDI) program that will hopefully field a detection, tracking, and cueing system that can be used against tactical ballistic missiles. EAGLE will be compatible with any Boeing 707 type or larger class aircraft. The prototype is currently planned for installation in the Air Force E-3 Airborne Warning and Control System (AWACS) aircraft. EAGLE represents the integration of several existing technologies into a new sensor suite that will add significant leverage to the overall TBM defense architecture as well as provide significant complementary support to the US and NATO AWACS missions.

The principal components of EAGLE are a Wide Area Surveillance Sensor (WASS) from the B-1B program, a High Accuracy Re-acquisition Sensor (HARS) from the F-117A Nighthawk program, and a laser range finder from the Navy's Radiant Mist/Outlaw projects.

The EAGLE sensor suite is made up of five elements: two passive infrared sensors to detect and track tactical ballistic missiles (TBMs), a laser range finder to determine the precise distance to launched missiles, an inertial navigation system to ensure that the missile location is known in standard earth coordinates, and a computer to determine the estimated launch point, missile trajectory, and projected impact location.

EAGLE is being designed to detect and track TBMs at ranges beyond the radar horizon regardless of the flight path of the sensing aircraft, detect and initiate track of boosting TBMs at elevation angles at or slightly below (0 to -10 degrees) the sensing aircraft horizontal plane, and maintain track on the missile up to elevation angles approaching zenith.

Using this data, an accurate ballistic trajectory as well as estimated launch and impact points will be computed shortly after booster burnout. The computer system will also format missile information for use on the Joint Tactical Information System (JTIDS) which allows aircraft and ground crews to exchange data.

**Operational Characteristics.** The EAGLE program plans to develop and field a theater ballistic missile (TMD) detection, tracking, and cueing system for the E-3 AWACS aircraft. The passive infrared search and track

(IRST) sensor suite, coupled with an eye-safe laser range finder will give EAGLE the ability to provide precise TBM flight location cues to Theater Missile Defense (TMD) ground-based radars and SPY-1 fire control radars. EAGLE's precise tracking will begin before booster burnout and continue through the early post-boost phase of ballistic flight. EAGLE will track long-range TBMs, in-flight before their detection by surface-based radars is possible.

Operationally, the EAGLE system will acquire a boosting TBM and track it until shortly after burnout to establish very precise trajectory, launch point, and impact point estimates. This information will be broadcast as a Joint Tactical Information Distribution System (JTIDS) message which will be used to cue active defense radar, support attack operations against the launchers, and provide improved warning for passive defense. The trajectory cue will enable fire control radar from a variety of interceptor systems to efficiently focus their energy into a single beam allowing acquisition much sooner than normally achievable with autonomous operations. This capability maximizes the defended area footprint as required by the Joint Requirements Oversight Council (JROC).

EAGLE can greatly improve the defended area against long range theater ballistic missiles versus autonomous operation. In addition, the improved situational awareness provided through BMC3I to the Joint Force Air Component Commander greatly enhances the coordination of the theater air battle and ballistic missile defenses.

EAGLE target cues will be much more accurate than those provided by either Talon Shield or the Joint Tactical Ground Station (JTAGS) which do not support extended range, single-beam radar acquisition of long range TBMs. The highly accurate prediction of a missile's future trajectory will make it unnecessary for fire control radars to search for the missile, thus enabling these radars to acquire the TBM earlier, at longer range, using a single precisely pointed radar beam. Eliminating the search segment of an encounter increases the number of targets that can be evaluated and maximizes the time available to investigate and respond to each situation. The time saved in the initial target acquisition phase makes it possible to launch an interceptor or other defensive weapon sooner.

This increases the defended area (footprint) of the defensive system.

## Variants/Upgrades

This is new demonstration system that is to be based, to the maximum extent possible, on non-development items. As such, there are no known variants or upgrades.

## Program Review

**Background.** EAGLE is being developed under Project 2160 TMD Existing System Modifications of DoD Program Element 0603872C Other Theater Missile Defense, a DoD Defense-wide effort.

Project 2160 is structured to field a TBM defensive capability as quickly as possible by upgrading existing active defensive systems while continuing to develop more advanced TBM capabilities. It is comprised of three component programs: Cueing and Netting, Talon Shield, and EAGLE.

Studies completed in FY94 verified the operational potential and technical feasibility of IR trackers/laser range finders as a force multiplier for TBM defenses by putting a detection, tracking, and cueing capability on E-3 AWACS aircraft. These studies made a favorable critical assessment of the operational adequacy of available laser range finder technology to support the TBM detection and tracking application. In evaluating the laser range finder, testing took into consideration laser power and pulse rate, two-way transmission losses due to atmospheric scattering and turbulence, detection sensitivity, position determination accuracy, and pointing accuracy and stability (jitter). EAGLE program testing also identified and evaluated alternate sensor configurations and sensor-aircraft integration options.

Following this testing in 1994, the Government released the EAGLE RFP. In early FY95, EAGLE requirements continued to be studied and refined in a long series of activities. Sensor field of regard requirements were confirmed using real-time interactive simulations at the Air Force Theater Command and Control Simulation Facility (TACCSF). Operational, technical and interface requirements for providing target cues to TAD-GBR and SPY-1 fire control radars, and for supporting TAD BMC3 with TBM launch site and impact point predictions were also refined. Operational utility was demonstrated using a surrogate sensor platform (Airborne Surveillance Testbed and Cobra Bell) in field exercises which supported joint-service integration planning activities. To gather flight test data under operating conditions appropriate to the AWACS application, the ARPA Airborne Infrared Measurement

System (AIRMS) test aircraft was commissioned. IR detection and tracking issues were clarified

A memorandum of agreement (MOA) detailing the extent of foreign participation in component design, development and/or fabrication was executed in 1995. In August of that year, the Boeing Defense and Space Group was awarded a sole-source contract, valued at approximately US\$43.5 million by the USAF, to develop and demonstrate an advanced infrared sensor suite for the AWACS aircraft that would enable E-3 crews to detect and track TBMs. Boeing was selected based on its intimate knowledge of the E-3 aircraft as well as its available support facilities.

The contract called for Boeing to work closely with its major subcontractor, Texas Instruments, and Rockwell International Defense Electronics Division (both being acquired by Raytheon Corp) to design and procure a prototype sensor based to the maximum extent possible on non-developmental subsystems for eventual integration into the EAGLE sensor suite. The team would test the new suite in laboratory, field and airborne environments, with the latter accomplished with the equipment installed on board the Test System 3 (TS-3) aircraft. TS-3 is an Air Force E-3 that is based at Boeing Field in Seattle, WA, and is used to support AWACS enhancement developments. Installation on board the TS-3 aircraft was scheduled for late 1997, with operational performance verification tests against live missile launches scheduled to take place in early 1998.

The contract also required that Boeing provide the USAF with the information needed to transition the sensor into a production configuration that is fully integrated with existing E-3 mission systems.

In FY96, the Air Force spent US\$15.6 million to finalize the design, commence sensor rapid prototyping; complete modifications to sensor components, and integrate the sensor subsystems; conduct tests in contractor laboratories to characterize components and subsystems. US\$97,000 was used to update the Air Force Theater Air Command and Control Facility (TACCSF) EAGLE simulation and demonstrate modeling.

FY97 plans were to complete the FY96 efforts (US\$93,000) and characterize sensor performance under conditions more characteristic of the operational environment against TBM targets of opportunity on the AWACS TS-3 aircraft.

FY97 Congressional language mandated that funding be moved from "TBM Existing Systems — EAGLE" to "Airborne Sensor for Ballistic Missile Tracking". Congress also directed the Under Secretary of Defense for Acquisition and Technology to provide a plan for developing an airborne sensor capability for ballistic missile tracking not later than January 19, 1997. The language of the legislation directed that user requirements and perspectives and total program cost be given

a priority consideration in selecting a system to provide this capability.

To meet this mandate, the FY97 funds for Task 3, EAGLE, was moved to Task 4, Airborne Sensor for Ballistic Missile Tracking. The report to Congress was written and a program plan developed for the chosen airborne sensor. The EAGLE program will be allowed to proceed at a slower pace due to the funding limitation while the study is conducted and the report is written.

Plans for FY98 are to continue the FY97 activities, install and integrate the EAGLE prototype sensor aboard the TS-3 aircraft, and conduct EAGLE prototype flight testing.

## Funding

	US FUNDING							
	FY96		FY97		FY98		FY99 (Req)	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
RDT&E (BMDO/USAF)								
PE#0603872C - Joint Theater Missile Defense (Dem/Val)								
2160, TAD Existing System								
Modifications	-	20.4	-	22.4	-	12.3	-	13.0

<sup>(a)</sup>Project 2160 is comprised of three elements - Cueing and Netting, Talon Shield and EAGLE - which are not separately identified. No funding currently was shown FY00 or beyond. FY97 Congressional language mandated that funding be moved from "TBM Existing Systems - EAGLE" to "Airborne Sensor for Ballistic Missile Tracking".

(Funding in US\$ millions)

## Recent Contracts

Contractor	Award		Date/Description
	(US\$ millions)		
Boeing	43.5		Aug 1995 — Sole source contract for the design, development, demonstration and integration of an infrared detection and tracking system on the E-3 aircraft.
Boeing	8.2		Feb 1997 — FVI to FFP contract to provide for restructure of Phase One of the EAGLE Prototype Program to meet revised funding profile. Complete Jul 1998. (F19628-95/C-0180)

## Timetable

	1993/1994	EAGLE concept definition studies
Aug	1995	EAGLE sole-source development contract awarded to Boeing
4Q	1997	Equipment scheduled for installation on T-3 test aircraft

1Q	1998	Operational performance validation flight tests scheduled against live TBM targets
1Q	1999	Start of contract to transition to production (assuming favorable production decision)

## Worldwide Distribution

In its present concept demonstration phase, this is **US** only program. If full operational status is achieved, however, installation on the AWACS aircraft of **NATO**, the **United Kingdom**, **France**, **Saudi Arabia**, and **Japan** is possible.

## Forecast Rationale

AWACS provides a daily presence in international peace-keeping operations in the Middle East, Eastern Europe, and elsewhere as needed. Japan acquired four 767 AWACS which combine the AWACS mission system with a newer, improved-performance Boeing 767 aircraft. In light of an assumed success of EAGLE operational flight demonstrations and the projected strategic scenario of limited-engagement littoral warfare encounters continuing well into the 21st century, it is reasonable to assume that a significant number, if not all, of aircraft in the AWACS fleet will eventually be upgraded to include the EAGLE TBM detection and tracking capability.

Beyond this "immediate" publicized application lies the potential for use of EAGLE in, as stated in Boeing's August 24, 1995, contract award press release, "other elements capable of destroying missile and launchers." The Airborne Laser Program has a missile detection development component with significant commonality to the EAGLE program. Crossover is likely, since Boeing is prime on both efforts. The difference is, the YAL-1 ABL

will carry an on-board laser designed to destroy a missile once detected.

Congress has taken an interest in this area; requiring that the Under Secretary of Defense for Acquisition and Technology develop and present a plan for developing an airborne ballistic missile tracking system. The interest in ballistic missile protection has the potential of becoming counterproductive in some areas because it is calling for too much to be done in too many programs, diluting the funding and technical capability needed to be effective in any one particular area.

There is the potential for EAGLE to be deployed on the world's fleet of AWACS aircraft in its presently identified TBM detection and tracking role. Until ground and/or airborne experimental corroboration data begin to become available, a forecast for such to be premature. The following forecast conservatively documents only the overall expenditure of funds budgeted and planned for the EAGLE development program as estimated from the RTD&E Descriptive Summary.

## Ten-Year Outlook

ESTIMATED CALENDAR YEAR FUNDING (\$ in millions)													
Designation	Application	High Confidence Level				Good Confidence Level				Speculative			Total
		97	98	99	00	01	02	03	04	05	06	07	
EAGLE	THEATER BALLISTIC MISSILE DEFENSE	54.48	12.33	12.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.29
	(USAF)												