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TPQ-47(V) (PBS2) - Archived 9/2007

Outlook

- Program has been terminated in lieu of pursuing Light Weight Counter Mortar Radar and EQ-37 development
- Termination Letter issued in Oct 2004
- Efforts to develop TPQ-47 ended in FY05
- This report will be archived next year (2007)

Orientation

Description. This was to be a new transportable, ground countermortar tactical radar for weapon location that would have replaced the TPQ-37(V) FIREFINDER. It was given the popular name *Phoenix Battlefield Sensor System (PBS2)*.

Sponsor

U.S. Army
Communications-Electronics Command (CECOM)
PEO-IEW-FIREFINDER
Fort Monmouth, NJ 07703-5000
USA
Tel: + 1 (201) 532-2534
Web site: <http://www.monmouth.army.mil>
(Project manager)

Status. System Demonstration and Development effort terminated.

Total Produced. Through 2004, two prototype systems had been produced. There will be no further production.

Application. To detect and locate hostile mortar, artillery, and rocket fire, and register friendly counterfire.

Price Range. Estimated unit price from \$5 million to \$7 million.

Price is based on an analysis of contracting data and other available cost information, and a comparison with equivalent items.

Contractors

Prime

ThalesRaytheonSystems

<http://www.thalesraytheon.com>, 1801 Hughes Dr, PO Box 34055, Fullerton, CA 92834-9455 United States, Tel: + 1 (714) 446-3118, Fax: + 1 (714) 446-3260, Prime

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TPQ-47(V) (PBS2)

Technical Data

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Operating shelter	1,135 kg	2,500 lb
Characteristics		
Frequency	2 to 4 GHz	
Search sector	90°	
Beam width		
Elevation	0.6°	
Azimuth	0.9°	
Range	60 km (artillery) 150-300 km (tactical ballistic missiles)	
False alarms	< 1 every 12 hr	
Target capacity	50/min	
Emplace time	8 min	
Displace time	5 min	
Transport	C-130 roll-on/roll-off CH-47 lift (desired)	
Features	AFATDS interface Classify weapons by caliber Identify boosting projectiles First round target location Single C-130 sortie transport (Ro/Ro) CH-47 or UH-60 lift	
Crew	9	

Design Features. The FIREFINDER operates from a shelter that can be transported by a HMMWV. It is a computer-controlled, electronically scanned radar that uses a “fence” of pencil-shaped beams (adjustable according to the terrain) that sweep several times a second along a 90-degree sector of the horizon.

When an object penetrates the fence, the radar immediately transmits an automatic verification beam. Should the beam also detect the target, the computer commands a rapid succession of tracking beams at a much higher data rate. The radar continues to scan and locate other targets and develop tracks on them while it tracks the original target. Each projectile has a separate track channel, with one additional channel designated to perform uninterrupted scanning for new targets.

When the computer determines that a target is valid, it evaluates the measured track data and calculates a trajectory that extrapolates back to the firing location. This is displayed on a visual map and printed out in map coordinates, which can be fed to a computer-based, tactical fire-control system.

The TPQ-47(V) is designed to handle dense barrage fire automatically. The heart of the system is a high-speed computer that controls beam placement, stores data from each radar return, and then carries out the trajectory-fitting calculation that pinpoints the hostile weapon location. The radar’s built-in “censoring”

feature adapts it to high-density environments and ensures that the radar is tracking projectiles from newly located weapons rather than repeating data on the same one.

Fault-detection constantly monitors the performance of each subsystem, providing system status information to the operator. Built-in test equipment isolates problems and indicates their location.

The TPQ-47(V) is designed to detect tactical ballistic missiles at ranges out to 300 kilometers and interface with tactical ballistic missile systems.

It is to be fully integrated into the targeting structure by interfacing with the Advanced Field Artillery Tactical Data System (AFATDS) and designed so it can be driven on and off a C-130 transport aircraft, providing high mobility, ease of transport, and high survivability. The new design features improved automation, allowing for a reduction in crew size. It can be operated by six people.

The design doubled FIREFINDER detection range for mortar, artillery, and rocket fire. It would have had an added ability to interface with a Theater Missile Defense System, and rapid counterfire would be made possible by incorporating AFATDS software. The upgrade design planned to reduce the false alarm rate from one per hour to less than one in 12 hours. Because

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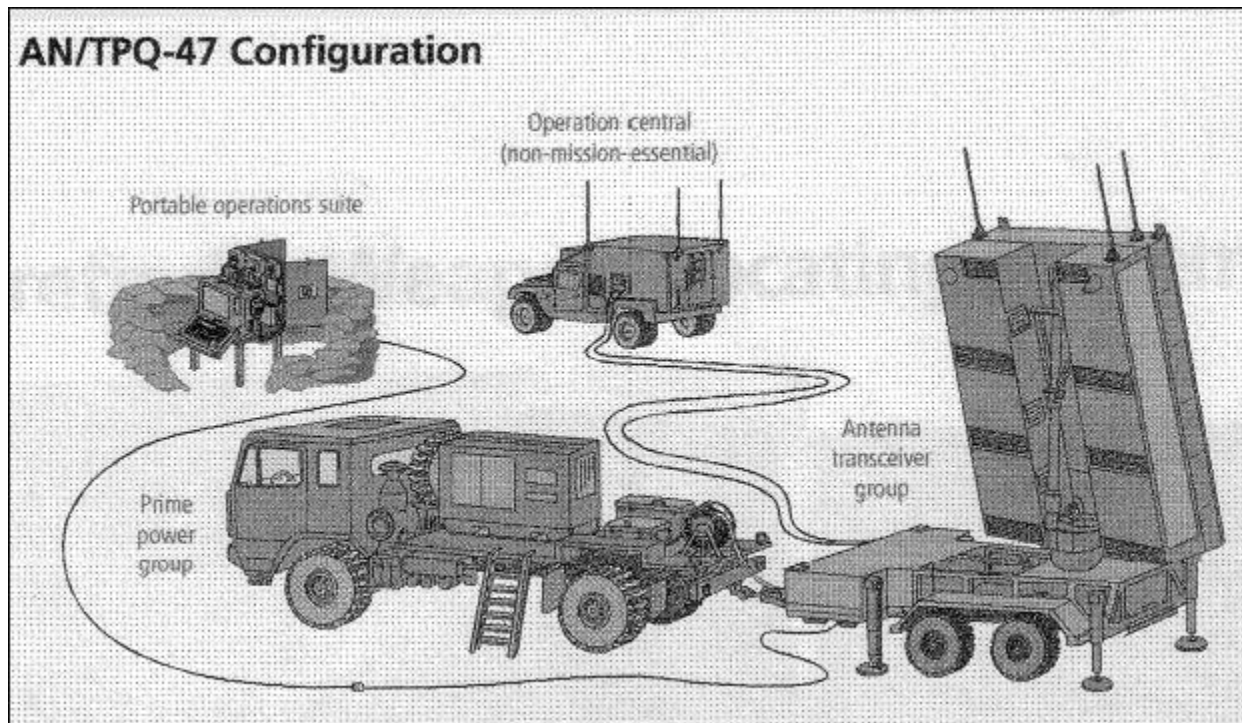
of FIREFINDER's modular, field-repairable design, downtime is minimized and most maintenance tasks would be performed at unit level. An auto-calibration algorithm allows for re-calibration of the antenna in the field after repair.

Operational Characteristics. FIREFINDER is used to adjust friendly fire on hostile emplacements and had usually been deployed 3.2 to 4.3 nautical miles (6 to 8 km) behind the forward edge of the battle area (FEBA). The increased range performance of the TPQ-47(V) would have allowed for a different placement of the system. The 60-kilometer artillery and 150- to 300-kilometer missile and rocket detection was to accommodate a completely new tactical planning matrix. PBS2 would be able to provide better coverage from farther back than the TPQ-37(V) does. PBS2 features first-round target detection and has a 50-target-per-minute throughput. It would classify weapons by caliber and identify boosting projectiles. By filtering all detections through a series of processing steps, the false location rate is reduced.

The system would offer 90-degree sector coverage and automatic height correction using digital terrain maps. It can predict the impact points of hostile projectiles, and offers significant improvements in man-machine interfaces for ease of operation and maintenance.

The Pentagon Battlefield Operational Concept for FIREFINDER focused on an end-to-end system for destroying mobile missile transporter-erector-launchers (TELs), using all possible surveillance and reconnaissance assets. The TPQ-37(V) FIREFINDER was used successfully in the Precision/Rapid Counter-Multiple Rocket Launcher advanced technology demonstration (ATD), as discussed in the 1997 *Emerging Operational Concept Report*.

FIREFINDER was considered part of the Rapid Targeting System being developed and implemented. It joins sensors like JSTARS, the U-2, and UAVs as inputs to the battlefield command and control system.

TPQ-47(V)

Source: Raytheon Systems Co

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Variants/Upgrades

The program planned to leverage the TPQ-36(V)8 electronics upgrade by using the Operations Control Shelter currently fielded.

Program Review

A Need for Upgraded FIREFINDER Radar

In 1991, the Army began upgrading to a TPQ-36(V)8 variant, including electronics upgrades to the HMMWV model radar. A 1992 contract was awarded for the design and synthesis of one pre-production system, along with program plans and long-lead support for upgrading seven TPQ-36(V)7 radar into the TPQ-36(V)8 variant.

In December 1992, (then) Grumman Aerospace received a contract to upgrade seven Operations Control Groups to the enhanced configuration. The improvements increased range, reduced false alarms, and helped identify the projectiles detected. The first contract was for eight prototypes. Designers installed SKYbolt computers for the processor upgrade.

An October 1997 *Commerce Business Daily* announcement from the CECOM Acquisition Center formally introduced the replanned Product Improvement Block II effort.

This effort called for the design, development, test, and delivery of three EDM systems for technical and operational testing prior to a production decision. In its transport configuration, the new system was transportable (drive-on/drive-off) by C-130 and larger military cargo aircraft, and able to be lifted by a CH-47 or UH-60 helicopter.

The TPQ-37(V) Block II program replaced the antenna transceiver group with a new antenna subsystem, including an upgraded or new signal processor with reuse/new software. It interfaced the new antenna subsystem with an existing Operations Central (OC) shelter from the TPQ-36(V)8 system. A contract for the 42-month effort was awarded in early 1998.

System Given New Designation

The Army awarded Raytheon Systems a \$73,687,517 cost-plus-incentive-fee contract for EDM of a next-generation FIREFINDER weapon location radar. The FIREFINDER Block II was designated the TPQ-47(V).

In May 1998, the Army Communications-Electronics Command called for Raytheon to deliver three EDM

radar systems during the initial development phase of the program, to be followed by a 69-unit production program. The Army later changed its requirement for the three EDM systems to enhance the reporting capability of the TPQ-47(V) to better track tactical ballistic missiles (TBMs).

Further Improvements

The Army also contracted with Raytheon to define efforts to enhance the processing, display, and reporting of TBMs by the TPQ-47(V) on the battlefield. Both hardware and software changes were required.

The work would include the following sole-source efforts:

1. TBM Early Warning and Cueing. This effort would supplement the current radio and communications suite/devices/paths of both hardware and software to ensure timely and accurate transfer of digital data containing the TBM data parameters.
2. TBM Simulation. The contractor would develop and integrate a High Level Architecture (HLA) capability into the TPQ-47(V) system.

An April 2001 contract was awarded for enhancements to make the TPQ-47(V) capable of detecting and tracking TBMs. A robust communications suite would enhance the system's ability to process and report TBM data in a timely manner.

Other work would be related to the design, development, fabrication, and testing of the TPQ-47(V) Radar Environment Simulator System (RESS).

The TPQ-47 Sees an Early End

The TPQ-47(V), popularly called the Phoenix Battlefield Sensor System (PBS2), was restructured in FY05. The problems with the FIREFINDER system that arose in Iraq demonstrated future problems in the TPQ-47, since the system is based on TPQ-37 currently in service. The TPQ-37 does not perform well in urban environments, and therefore the Army is spending resources on a completely different system that will overcome these shortcomings. Therefore, the program will conclude with a demonstration to characterize radar

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performance and a final report. The Contracting Officer issued a Stop Work Order September 24, 2004. A Termination Letter was issued October 18, 2004.

Funding

	U.S. FUNDING							
	FY05 QTY	FY05 AMT	FY06 QTY	FY06 AMT	FY07 QTY	FY07 AMT	FY08 QTY	FY08 AMT
RDT&E (U.S. Army) PE#0604823A L85 TPQ-47	-	10.3	-	0.0	-	0.0	-	0.0

All \$ are in millions.

Contracts / Orders & Options

(Contracts over \$5 million.)

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Raytheon	9.6	Apr 2001 – Award of a \$3,226,000 increment as part of a CPFF contract for enhancements to the FIREFINDER TPQ-47(V) associated with processing, display, and reporting of tactical ballistic missiles. Completed May 2003. (DAAB07-01-C-H201)

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Feb	1983	FIREFINDER IOC
Oct	1990	Fielding by U.S. Army completed
Sep	1996	P ³ I MNS approved
2Q	FY98	P ³ I solicitation release
May	1998	EDM contract awarded (TPQ-47)
1Q	FY99	Milestone II approved
4Q	FY99	Contract start
4Q	FY00	PDR
1Q	FY01	V&V of the RESS
3Q	FY01	CDR
3Q	FY03	Milestone B for FCS
1Q-4Q	FY04-05	Developmental Testing (DT) planned
4Q	FY05	Milestone C for LRIP
Sep	2004	Stop Work Order
Oct	2004	Termination Letter

Worldwide Distribution / Inventories

This is initially a U.S.-only effort.

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Forecast Rationale

TPQ-47 Followed President Bush's Transformation Plan

The TPQ-47 PBS2 program was to be a replacement for the TPQ-37. The PBS2 development was in keeping with the Transformation Plan of the Bush administration. Rather than creating new equipment, developers would enhance the capabilities of successful systems to meet the needs of the future. This new sensor was considered well suited to the operational concept of a seamless, multisensor missile defense over the battlefield. Congress approved funding for development of added capabilities and hardware improvements.

However, combat operations in Iraq and Afghanistan have revealed a problem with the FIREFINDER radars. According to Army operators and company sources, Iraqi insurgents have learned to take advantage of the system's 90-degree coverage. They observe the radar secretly to find out what direction it is facing. They then launch mortar shells at Army units from angles that

the radar cannot detect. Since the TPQ-47 is based on the FIREFINDER, it would have similar problems.

Army to Use New Technology to Replace FIREFINDER

The Army has already begun fielding the Lightweight Counter Mortar Radar that will give 360-degree coverage and perhaps be more adaptable to urban environments. It will cover a range of 500 meters to 10 kilometers and register observed fires from friendly units. O-LCMR shall be a digitally connected, day/night mortar, cannon, and rocket locating system. The O-LCMR will be a spiral enhancement to the existing LCMR. The LCMR was originally designed to operate as a stand-alone capability for Special Forces, and is man-portable when disassembled. This capability has been fielded to OIF as a Limited Procurement Urgent (LPU) capability. The U.S. Army has also begun an effort to develop a new radar system, dubbed the EQ-36.

Ten-Year Outlook

No further production. The program was terminated. This report will be archived next year (2007).

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