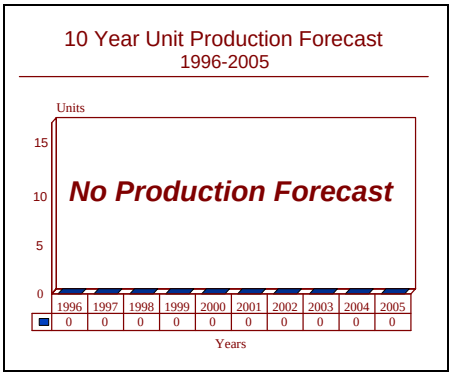
TPS-70(V) - Archived 9/96

Outlook

- In service; on-going logistics support and upgrades
- No significant further production expected
- Five radars to re refurbished for counter-drug operations support in SOUTHCOM



Orientation

Description. A land-based, long-range, transportable 3-D tactical radar. It is the FMS version of the TPS-43/75 radar.

Sponsor

US Air Force
Sacramento Air Logistics Center (SMALC)
McClellan AFB, California 95652-5280
Tel: +1 916-643 6127
(logistics management)

Electronic Systems Center
ESC/PAM
Joint Program Office
Hanscom AFB, Massachusetts 01731-5000
Tel: +1 617 377 5191
(Program Manager, TACS Improvements)

Contractors

Northrop Grumman Corp
Electronic Sensors & Systems Division
PO Box 17319
Baltimore, Maryland 21203-7319
Tel: +1 410 765 1000
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[formerly Westinghouse Electronic Systems Group]

Status. In service, ongoing logistics support and upgrades.

Total Produced. An estimated 213 TPS-43/70 radars have been produced.

Application. Lightweight, air-transportable 3-D radars designed for deployment as part of a tactical air control or similar air control system.

Price Range. Estimated cost for the TPS-70 is $7.9 million.

Technical Data

Dimensions	Metric	US
Weight:		
Shelter module	3310 kg	8000 lb
Antenna module	2050 kg	4520 lb
Antenna:	2.5 X 5.5 m	8.2 X 18 ft

Characteristics

Frequency:	2900-3100 MHz in 16 discrete steps (with pulse-to-pulse agility)	
Power:	3.5 mW peak 6.2 kW average	
Transmitter tube:	Linear beam twystron (Wideband amplifier)	
Pulse duration:	6.5 µsec (4-state phase-coded)	
PRF:	250/275 pps average	
Instrumented range:	444 km	240 nm
Elevation coverage:	0-20^o	
Altitude coverage:	0-99,500 ft (30.3 km)	
Height accuracy:	± 2000 ft (610 m) @ 180 nm	
Data rate:	9.4 s ± 10%	
Track Capacity:	500 simultaneous auto initiate, auto update	
Noise figure:	4.5 dB	
IF Frequency:	32 MHz	
IF Band Width:	1.6 MHz	
Dynamic Range:	90 dB (Receivers & STC)	
STC:		0 to 46.5 dB
A/D Converter:	12 bit, 4 MHz sample rate	
Receiver Channels:	7 with automatic switching and redundancy	
MTI Improvement factor:	50 dB (all beams, full range)	
Small Target Probability of Detection		
1.7 m^2 PD	75%	
P_{FA}	75%	
Range Accuracy:	107 m	350 ft
Antenna Type:	TWT planar array Simultaneous beams 36 waveguides 98 slots per waveguide	
Antenna Gain:		
Transmit:	36 dB	
Receive:	40 dB	
Elevation Angle		
Coverage:	0 to 20^o (transmit) 6 simultaneous beams (receive) 2.3^o to 6.0^o	
Altitude Coverage:	0 to 99,500 ft (30.3 km)	
Azimuth Coverage:	360^o	
Azimuth Sidelobes:	48 dB (one way, principal plane)	
Azimuth Beamwidth:	1.5^o	
Sector Blanking:	Instantaneous	
Sectors adjustable		
Accuracy:		
Range	107 m	350 ft
Bearing	0.22^o	
Height (@100 nm)	± 457 m	✂ 1500 ft
Resolution (2m^2 target):		
Range (50% probability)	490 m	1600 ft
Bearing (50% prob.)	2.4^o	
MTBF:	600 to 1000 hr	
MTTR:	0.5 hr	
Operational availability:	>99%	
Digital Signal Processor:		

Type	Microprocessor controlled Parallel signal processing
Separate in each channel	
MTI processing	4-pulse, I&O in each channel, full range burst mode for anomalous propagation
Automatic Radar Height	Target height simultaneous with detection Unlimited capacity Height in clutter Environmentally adapted height corrections
IFF System:	Interrogator Sidelobe Suppression (ISLS)
Modes	1, 2, 3, C Active/passive decode (UPA-59)
Antenna	Sum-difference
Beam Width	4^o
Prime power:	400 Hz 3-phase 120/208 V
Transport:	Single C-130, two M 35 trucks, two sets of transporters or two helicopter loads
Siting requirements:	6 x 10.5 m clear area on slope of 10% or less
Assembly	< 1 hr (six person crew)
Disassembly	30 min
Wind resistance:	Operate to 52 kts, survive 92 kts (tied down)
Operating temperature:	-40 to 125^o F

Design Features. The TPS-70(V) consists of a receiver, transmitter and monitoring equipment housed in a shelter; the fold-away antenna and mounting pedestal are contained on a pallet. It was designed for long-range, three-dimensional, high-reliability performance in a tactical environment. A low sidelobe antenna and advanced processing provide high probability target detection in a heavy clutter or jamming environment with a low false alarm rate.

It is an export variant of the original TPS-43 tactical radar, employing a fan of multiple receive beams rather than a single "pencil beam". The multiple beams provide elevation data while physical rotation is used for azimuth scanning. This increases target illumination per antenna scan.

The low sidelobe antenna does not use phase shifters. The antenna employs 36 horizontal waveguide sticks; each stick has 94 slots to provide the 1.6^o beamwidth and low sidelobes. These components were originally developed for the AWACS APY-1/2 radar. Twenty-two sticks are illuminated on transmit for an elevation beamwidth of 20^o. Illumination is tapered to provide higher gain at lower elevations. On receive, energy from 36 sticks is combined to provide six simultaneous beams. The elevation beamwidth varies from 2.3^o for the lowest beam to 6^o for the highest.

The digital signal processor is microprocessor-controlled with parallel signal processing in each channel. The simultaneous-beam design provides the time needed per target to perform effective signal processing in a heavy clutter environment. The data output features a CFAR (Constant False Alarm Rate) and can be input directly to automated air defense systems.

The radar employs extensive clutter rejection and ECCM features. The digital Moving Target Indicator (MTI) system features 4-pulse, I&Q in each channel. It can operate full range. There is a 5-pulse sea clutter filter and a burst mode for anomalous propagation. Sector blanking is instantaneous with the sectors adjustable.

ECCM features a low sidelobe antenna to discriminate against standoff jamming and reduce the threat of anti-radiation missiles (ARMs). The transmitted signal is frequency agile (random or programmed) and there is jamming analysis transmission selection (JATS).

The PRF is staggered. The receiver features a Coded Pulse Anti-Clutter System (CPAS). The system features precision jamming strobes for triangulation and a cool antenna to reduce the set's IR signature. Transmission can be silenced instantaneously, including by remote control. The design was created to be especially effective against standoff jamming aircraft.

It uses a sum and difference IFF antenna and features Interrogation Sidelobe Suppression (ISLS).

Operational Characteristics. Tactical radars are used as an airspace control sensor and interface with a tactical air control center to provide threat warning of inbound strike aircraft and operational control of friendly air assets. The TPS-70 is a 3D radar producing azimuth, range, and height information on all targets. Operators can control both air-to-air and air-to-ground operations, allowing commanders to control assigned air forces.

The system moves with the combat force. The radar can be erected in less than one hour and disassembled in 30 minutes. To facilitate air shipment, the system divides into two pallet loads, each of which can be accommodated aboard a C-130 transport. For road travel, each pallet can be loaded onto an M35-size military truck.

The radar is automatically self-calibrating. It was designed to adjust itself to within specified accuracy parameters within six minutes of processor initiation. The system continues self-calibration to ensure accurate operation.

Radar and IFF, range, azimuth, height, and Code IFF information are all extracted digitally and can produce target reports in either plot or track format. The Digital Target Extractor (DTE) performs automatic clutter mapping, radar plot extraction, IFF decoding/ plot extraction, radar/IFF correlation, and clutter filtering. A single correlated range/azimuth report is generated for each target and a forward-tell tracker performs additional scan-to-scan processing on the DTE plot data and automatically initiates and maintains up to 500 simultaneous target tracks. The tracker adds target identity (track number) heading, speed, and track quality information to each target report transmitted to the command and control center.

Height finding is automatic with target height and target detection occurring simultaneously. It has unlimited capacity, provides height information in clutter, and makes environmentally adapted height corrections. Height calibration and alignment is automatic.

Radar data is sent to operations data processors that drive operator displays and can be tailored to the mission at hand. The system uses TAC-90 high-resolution color raster scan displays. Data is continuously updated. All system controls are entered through a touch-sensitive, plasma control terminal. Over 100 user-friendly menus control system operating modes. A BITE system monitors critical functions and features automatic fault isolation. There are two plasma displays. One is located over the radar operator display position (where most mode and parameter changes are made) and one is located in the maintenance shelter.

Until the E-3A AWACS was fielded, the TPS-43/70 family of radars was the prime front-line air control sensor for the US Air Force and many US allies.

Variants/Upgrades

TPS-43 This is the original, basic radar.

TPS-75 This is the advanced US variant of the basic radar.

FPS-700 This variant of the TPS-70 is available for semi-permanent or fixed installation. The FPS-700 can be operated and monitored remotely. In a dualized configuration, the MTBF can be more than 2,000 hours.

Program Review

Background. Westinghouse put the TPS-43 into production in 1966, with initial deliveries in 1970. By 1980, large numbers of the radar had entered service with both American and foreign services. Through a continuous product improvement program, no less than eight generations of the TPS-43 had appeared by 1980, making it one of the most widely used, operationally successful, transportable, tactical surveillance radars in the Western world.

In October 1983, the Royal Australian Air Force (RAAF) contracted with Westinghouse for a rewiring of the RAAF TPS-43 radar sites with fiber-optic cables. This measure increased the allowable distance between the radars and operating shelters from about 15 feet to up to two kilometers, greatly enhancing operator safety, a prime RAAF concern.

On March 5, 1984, Westinghouse received a contract to upgrade the communications shelters and remote display equipment for Saudi Arabia's Radar Defense Complex. In late 1987, the Air Force Electronic Systems Division selected the Westinghouse TPS-70 for the Caribbean Basin Radar Network. The only other bidder was General Electric with the FPS-117.

In FY88, Westinghouse produced and stored 19 ULSA antennas, and began retrofitting the first of the US units. The ULSA antenna and updated electronics package was to be installed only on the US radars, which would become the TPS-75. The Air Force began the test and evaluation of the ARM decoy for the TPS-75.

On April 22, 1994, the Air Force announced its intent to have Westinghouse integrate and refurbish the Honduran-owned and operated TPS-70(V)2 radar and incorporate it into the Air Force Caribbean Basin Radar Network (CBRN) Autotell System at Howard AFB, Panama. As part of the integration and refurbishment effort, Westinghouse's proprietary Autotell system software the will be modified. (Westinghouse Electric Corporation designed and installed the Autotell system). The Government

anticipated award of the contract on or about July 31, 1994.

In 1994, Northrop Grumman acquired Westinghouse Electronic Systems Group, creating the Northrop Grumman Electronic Sensors & Systems Division.

On June 5, 1996, the SOUTHCOM Counter-Drug Support (SCDS) Program Office published a *Commerce Business Daily* notice that it was seeking qualified contractors to provide radar engineering, communications engineering, operations center engineering and integration, site installation, and interim contractor support for SOUTHCOM counterdrug projects. The effort will begin with refurbishing up to five Government-owned TPS-70 radars which would be installed at new radar sites.

The radar refurbishment will include repair and/or replacement of all necessary to make the radars fully operational within specification guidelines. The announcement noted that the Government does not own reprocurement data for the radar, as it is a Northrop Grumman Corporation proprietary product.

Communications engineering would include installing voice communications and Satcom at the sites and providing voice and data connectivity to the Joint Air Operations Center (JAOC) at Howard AFB, Panama.

The projected sites would be at various locations throughout Latin America, with the first site being in Peru. The Government anticipated award of the contract on or about August 1, 1996.

Funding

Funding is from O&M and FMS accounts.

Recent Contracts

(Contracts over $5 million.)

Contractor	Award ($ millions)	Date/Description
Westinghouse	18.0	Sept 1993 - FFP contract for two TPS-70 radar systems for the Peace Pulse FMS program to the Kingdom of Saudi Arabia. Complete Nov 1993 (F09603-93-G-0004)

Timetable

	FY65	Initial study contracts awarded
	FY66	Contract definition phase contracts awarded
	FY66	Prototype production began
	1970	Initial production deliveries
	1977	Foreign sales initiated
	1982	Advanced Tactical Radar (ATR) contract awarded
Apr	1984	USAF terminated efforts on ATR
Nov	1984	ULSA antennas entered production
	1987	TPS-70s ordered for Caribbean Basin radar network
Jun	1990	FMS to Saudi Arabia begins

Worldwide Distribution

Over 200 TPS-43/70 radars have been produced and are in service in 22 nations. Known operators and nations in addition the **US** who have purchased the radar are:

Australia. Westinghouse delivered three TPS-70 radars to Australia for use by the Royal Australian Air Force.

Canada. The Canadian Main Operating Base radar program has purchased two TPS-70 radars through Westinghouse Canada.

Federal Republic of Germany. Known to be a customer.

Honduras. Honduras employs US-manned TPS-70 radars at Tegucigalpa. One may have been replaced by a TPS-63.

Iran. An unknown quantity of TPS-70s were supplied to the Shah in two batches during 1976 and 1977. (Eighteen possible radar sites were surveyed during the early 1970s.) The current status of the radars is unknown, but they are reportedly not operational.

Israel. Known to be a customer. Recent plans for two additional early warning radars consider both the TPS-70 and FPS-117 radars.

Jordan. Amman initiated the purchase of an unknown quantity of TPS-70s in 1980.

Republic of Korea. Known to be a customer.

Mexico. One TPS-70 was delivered in late 1988 for anti-drug surveillance and control.

Morocco. Known to be a customer.

Nigeria. Lagos is thought to have ordered an undisclosed quantity of TPS-70s in 1982.

Pakistan. Known to be a customer.

Saudi Arabia. The Saudis have been the biggest foreign customer of the TPS-43/70, especially for their Peace Pulse program. In 1980, Riyadh signed its first contract for $11.1 million for four TPS-43 radars, support and training. In 1981, a $75 million contract was signed for additional TPS-43Gs, plus the modification of previously-delivered TPS-43s to the 43G standard.

The Saudi radars are used in conjunction with the E-3 AWACS aircraft to form an integrated air-defense network that is principally directed towards the border with Iraq and the Persian Gulf. In was revealed, in 1989, that the Saudis would be buying TPS-70s as part of the Falcon Eye tactical radar system program, Peace Pulse FMS program (agreement signed March 1989). The radars tie into the Peace Shield air defense system.

Singapore. Known to be a customer.

Somalia. In 1982, a $15 million contract for three TPS-70s was signed under FMS for Somalia. Follow-on support, spares and training is believed to have brought the value of this contract to $30 million. Reportedly, this transaction was approved by the USA in return for US base rights at the port and airfield facilities at Berbera.

Spain. The TPS-70 is reportedly the centerpiece of Spain's Combat Grande air defense program. The USA has provided funding for the first two phases of this program which will eventually be linked to NATO's advanced early-warning and quick-reaction defense radar network. The USA may approve funds for the third and fourth program phases.

Sudan. Known to be a customer.

Switzerland. Bern is thought to have signed for an undisclosed quantity of TPS-70 radars during 1982.

Taiwan. A Letter of Offer to Taiwan for an $86 million sale of TPS-43 spares and supplies was followed in 1989 and 1993 by additional spare parts orders.

Thailand. Several TPS-70 radars are in use in the Royal Thai Air Defense System (RTADS). The RTAF is finding, however, that lower frequency radars are better performers during the monsoon season and have opted for FPS-117 equipment for RTADS expansion and upgrades.

United Arab Emirates. An unknown number of TPS-70s were ordered; the first one delivered in 1987.

Yugoslavia. Yugoslavia signed a $39.1 million contract for six TPS-70s in May 1982.

Forecast Rationale

The TPS-43 family of radars has been the baseline for nearly all US tactical radar developments for the past 20 years. It is a proven performer and combat tested. Operational systems in the Persian Gulf were the backbone of an air defense and ground tactical control net for coalition forces. These were supplemented by US radars deployed to the Persian Gulf.

The Persian Gulf War showed how many ground tactical radars will be used in the future. The airborne radar and control system proved to be a successful performer; but AWACS aircraft were deployed immediately and on-scene and operating from the start of hostilities, providing 24-hour threat warning, deconfliction, weapons control, and refueling support. E-3s supported all daily tasking order activity and provided the primary air picture to theater command centers.

Ground-based tactical radars cannot be deployed as rapidly as AWACS, cannot provide wide coverage, and are not as operationally flexible. E-3s can be repositioned very quickly to provide new coverage or support, changing operational requirements. Consequently, when AWACS is available radars such as the TPS-70 will fill secondary, backup, or mission limited roles in future combat. The tactical radars will not be deployed and operated as the primary battlefield sensor. They will be used as gap-fillers or air traffic/flow control and coordination back from the combat front.

Many of the nations which rely on the TPS-70, however, do not have and may not be able to call on AWACS whenever surveillance is needed. In these cases, the TPS-70s will be used in their prime sensor role. This will be true of limited conflicts and situations when larger countries and NATO are not going to support their conflict.

The emerging Eastern European market could eventually become a lucrative opportunity for both US and European radar manufacturers. This radar family has an edge in the tactical/defense market because of its reputation. Affordability, however, is a significant question in these procurement efforts.

Eastern Europe needs to rebuild its air traffic control system more desperately than its defense nets. Northrop Grumman is actively marketing both its defense and ATC systems to Eastern European governments; but ATC-specific systems are attracting more attention.

Most of the nations that needed and could afford the radars have procured them, although the need to fill some gaps in the Gulf Coordination Council protective ring may create a requirement for a few new systems. Much of this requirement, however, may be filled with fixed-station equipment.

Many international users will seek enhancements for their existing operational inventory. Spare parts, upgrades and refurbishment activities will continue beyond the year 2000.

Ten-Year Outlook

No, or very limited, further production expected.

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