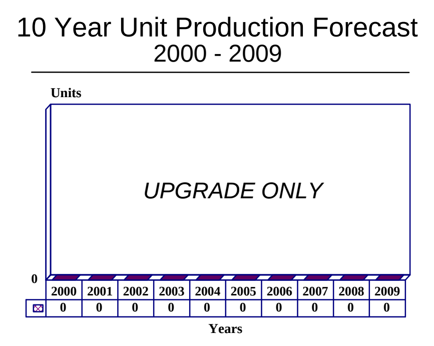
TPS-70(V) Archived 9/2001

Outlook

- In service, ongoing support
- No significant further production expected, but significant logistics support and upgrades will continue
- ARSR-70 commissioned in Rwanda



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)

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(Logistics management)

Electronic Systems Center

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Joint Program Office

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Contractors

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Electronic Sensors & Systems Division

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Status. In service, ongoing logistics support and upgrades.

Total Produced. An estimated 213 TPS-43/70/75 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(V) is US$7.9 million.

Technical Data

	Metric	US
Dimensions		
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

	Metric	US
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	
Elevation coverage:	240 nm	
Altitude coverage:	0-20^o	
Height accuracy:	0-99,500 ft (30.3 km)	
Data rate:	± 2000 ft (610 m) @ 180 nm	
Track capacity:	9.4 s ± 10%	
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 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) 2.3^o to 6.0^o (receive) 6 simultaneous beams	
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	

Characteristics	Metric	US
Sector blanking:	Instantaneous	
Sectors adjustable		
Accuracy		
Range:	107 m	350 ft
Bearing:	0.22°	
Height (@100 nm):	± 457 m	± 1500 ft
Resolution ($2m^2$ target)		
Range (50% probability):	490 m	1600 ft
Bearing (50% prob.):	2.4°	
MTBF:	600 to 1,000 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	
ECCM:	Low sidelobe antenna Coded pulse anti-clutter system (CPAS) Frequency agility (programmed/random) Jamming analysis transmission selection (JATS) PRF stagger Precision jam sidelobes for triangulation Cool antenna to reduce IR signature Enhanced ARM resistance Instantaneous radar silence – remote control available	
IFF system:	Interrogator sidelobe suppression (ISLS)	
Modes:	1, 2, 3, C Active/passive decode (UPA-59)	
Antenna:	Sum-difference	
Beam width:	4°	
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 kt, survive 92 kts (tied down)	
Operating temperature:	-40 to 125° F	

Design Features. The TPS-70(V) has 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 version of the original TPS-43(V) 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. It uses 36 horizontal waveguide sticks; each stick has 94 slots to provide the 1.6° beamwidth and low sidelobes. These components were originally developed for the AWACS APY-1/2(V) radar. Twenty-two sticks are illuminated on transmit for an elevation beamwidth of 20°. 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 degrees for the lowest beam to 6 degrees 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 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 four-pulse, I&Q in each channel. It can operate full range. A five-pulse sea clutter filter and a burst mode are for anomalous propagation. Sector blanking is instantaneous with the sectors adjustable.

ECCM features a low sidelobe antenna to discriminate against stand-off 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 cooled 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 stand-off jamming aircraft.

It uses a sum and difference IFF antenna and features interrogation sidelobe suppression (ISLS).

Operational Characteristics. Tactical radars are designed 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(V) is a 3-D radar that produces 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. 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 are also automatic.

Radar data are sent to operations data processors that drive operator displays and can be tailored to the mission at hand. The system uses UYQ-509(V) color raster scan displays (formerly known as TAC-90). Data/text on these high-resolution displays are 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(V) family of radars was the prime front-line air control sensor for the US Air Force and many US allies.

Variants/Upgrades

TPS-43(V). This is the original, basic radar.

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

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

TBM. A tactical ballistic missile upgrade is one of the changes being implemented on TPS-70/75(V) radars.

ARSR-70. This is a dual-use, air traffic control and surveillance radar based on the TPS-70(V) tactical system. It is being made available in 240 nm and 60 to 90 nm versions. They are designed in either mobile or fixed-site configurations. TPS-70(V) performance combines with reliability improvements based on a transmitter similar to the one developed for the ASR-12 ATC radar. MTBF is over 2000 hours.

An optional Missile Launch Warning System (MLWS), similar to that capability deployed in the TPS-75(V) battlefield radar, is being made available.

Program Review

Background. The original TPS-43(V) went into production in 1966; initial deliveries began in 1970. By 1980, large numbers of the radar were operational with both American and foreign services. Through a continuous product improvement program, no less than eight generations of the TPS-43(V) 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 for a rewiring of the RAAF TPS-43(V) radar sites with fiber-optic cables. This increased the allowable distance between the radars and operating shelters from about 15 feet to up to 2 kilometers.

On March 5, 1984, (then) 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(V) for the Caribbean Basin Radar Network.

In FY88, designers produced and stored 19 Ultra-Low Sidelobe Antennas (ULSAs), and began retrofitting the first of the US units. The ULSAs and updated electronics package were to be installed only on US radars, which would become the TPS-75(V).

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

The projected sites would be at various locations throughout Latin America; the first one in Peru. The contract was awarded September 27, 1996, and had an August 1997 completion date. Services for four of the nine sites are currently provided under the Caribbean Basin Radar Network (CBRN) contract.

CSCS is a network of radar and communications sites, designated Host Nation Command Centers (HNCC), located in Florida and Central and South America which provides air surveillance data to the Joint Air Operations Center (JAOC) and the Caribbean Regional Operation Center (CARIBROC) located at Key West Naval Air Station (NAS), Florida. The CSCS mission is to support the United States and Allied Nations counter-drug efforts and the support of air sovereignty, search and rescue, and regional cooperation missions throughout Central and South America and the Caribbean.

Each CSCS radar site has a radar, communications and support facilities. The radar segment consists of either a commercial TPS-70(V) or a military TPS-43E/TPS-75(V) three-dimensional, long-range ground radar. The communications are: 1) Long-haul commercial SATCOM earth terminals; 2) radio communications, to include UHF, VHF and HF; and 3) on-site communications, to include telephones, switch panels and multiplexers.

The facilities include storage tanks or bladders, a security fence, security lighting, personnel quarters where provided by the government, and the roads and grounds within the site perimeter. The CSCS network also features Command Center equipment including radar data processing and display equipment, secure and non-secure communications control equipment for CSCS site radios, and a TADIL processing and display capability.

At the 1999 Paris Air Show, officials announced that the government of Rwanda procured the ARSR-70, along with the associated installation and logistics support. Contract terms were not released. Delivery took place within months and the system was operational by the end of the year. It was commissioned in May, 2000.

A March 28, 2000, *Commerce Business Daily* announcement from the Counterdrug Surveillance and Control System (CSCS) Program Office, ESC, Hanscom AFB, Massachusetts, said officials were seeking potential sources to design, develop, fabricate, integrate, install, and test Digital Weather Intelligence Data (DWID) systems which will extract weather data from existing CSCS TPS-70(V) ground-based radars. It would allow enhanced sortie generation of airborne early warning (AEW) systems, tracker aircraft, and interdiction assets for USSOUTHCOM counternarcotics missions in Central and South America. DWID will provide weather information to enable the capability to reposition all air assets based on near real-time weather data; significantly increasing US and Allied sortie success and productivity.

This system will be used as an Intelligence source, as it can identify areas where suspects are most likely *not* flying due to inclement weather conditions. The government requires digital weather extractors that can be readily integrated with existing TPS-70(V) radars to provide weather data in the USSOUTHCOM Area of Responsibility (AOR). It also requires hardware and software to fuse DWID from multiple TPS-70(V) radars and provide access to fused data via a server on the SIPRNET and NIPRNET.

Use of Commercial-Off-The-Shelf technology was encouraged. Near real-time DWID is key to improved forecast reliability in the zero-to-six hour time-frame; three to four hours is the mission endurance for most trackers and all participating nation interdiction assets.

A response was due April 14, 2000.

Funding

Funding is from O&M and FMS accounts.

Recent Contracts

No recent contracts over $5 million recorded.

Timetable

Month	Year	Major Development
	FY65	Initial study contracts awarded
	FY66	Contract definition phase contracts awarded
	FY66	Prototype production begins
	1970	Initial production deliveries
	1977	Foreign sales initiated
	1982	Advanced Tactical Radar (ATR) contract awarded
Apr	1984	USAF terminates efforts on ATR
Nov	1984	ULSAs enter production
	1987	TPS-70s ordered for Caribbean Basin radar network
Jun	1990	FMS to Saudi Arabia begins
Sep	1996	SOUTHCOM refurbishment contract awarded

Month	Year	Major Development
Aug	1997	SOUTHCOM refurbishment contract complete, OM&S services source sought announcement
Jun	1999	Rwanda selects ARSR-70 for surveillance & ATC use
May	2000	Rwanda ARSR-70 commissioned

Worldwide Distribution

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

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

Canada. The Canadian Main Operating Base radar program has purchased two TPS-70(V) radars.

Federal Republic of Germany. Known to be a customer.

Honduras. Honduras employs US-manned TPS-70(V) radars at Tegucigalpa.

Iran. An unknown quantity of TPS-70s was 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.

Israel. Known to be a customer. Plans were for two additional early warning radars, with both the TPS-70(V) and FPS-117(V) radars under consideration.

Jordan. Amman purchased of an unknown number of TPS-70(V)s in 1980.

Mexico. One TPS-70(V) 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-70(V)s in 1982.

Pakistan. Known to be a customer.

Republic of Korea. Known to be a customer.

Rwanda. Installed ARSR-70.

Saudi Arabia. The Saudis have been the biggest foreign customer of the TPS-43/70(V), especially for their Peace Pulse program. In 1980, Riyadh signed its first contract for four TPS-43(V) radars, support and training. In 1981, a contract was signed for additional TPS-43Gs, plus the modification of previously delivered TPS-43(V)s 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 toward the border with Iraq and the Persian Gulf. In was revealed in 1989 that the Saudis would be buying TPS-70(V)s 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, bought three TPS-70(V)s under FMS. Reportedly, the USA approved this transaction in return for US base rights at the port and airfield facilities at Berbera.

Spain. The TPS-70(V) 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 would be linked to NATO's advanced early-warning and quick-reaction defense radar network. The US was expected to fund a third and fourth program phase.

Sudan. Known to be a customer.

Switzerland. Bern bought an undisclosed quantity of TPS-70(V) radars in 1982.

Taiwan. Acquired TPS-43(V) radars and has been actively supporting them.

Thailand. Several TPS-70(V) 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 they have opted for FPS-117 equipment for RTADS expansion and upgrades.

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

Yugoslavia. Yugoslavia acquired six TPS-70(V)s in May 1982.

Forecast Rationale

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

How ground-based radars are being used is changing. AWACS aircraft can be deployed immediately; on-scene and operating from the start of hostilities; providing 24-hour threat warning, weapons control and refueling support. E-3s will directly support daily tasking order activity and provide the primary air picture to theater command centers.

Ground-based tactical radars cannot be deployed as rapidly as AWACS. They do not provide the same wide coverage and are not as operationally flexible. E-3s can reposition to provide new coverage or support, changing mission requirements. Consequently, when AWACS is available, radars such as the TPS-70(V) fill secondary, backup, or mission-limited roles in future combat. The tactical radars will no longer be deployed and operated as the primary battlefield sensor, but used as gap-fillers or air traffic/flow control and coordination back from the combat front.

Still, many of the nations which rely on the TPS-70(V) do not have, or may not be able to call on, AWACS whenever surveillance is needed. In these cases, the TPS-70s will be used as their prime sensor. This will be true of limited conflicts and situations when larger countries and NATO are not supporting their efforts.

These nations need to rebuild their air traffic control system more desperately than they need extensive air defense nets. Northrop Grumman is actively marketing both its defense and ATC systems to East European governments, but new ATC-specific systems are attracting more attention. Contracts for radars and control systems have begun to flow, some going to Northrop Grumman for its ATC equipment. The ARSR-70 combines a proven radar with a new transmitter and is being marketed as a combined ATC and Surveillance sensor. Northrop Grumman's worldwide reputation will prompt many users to acquire the system to meet their dual-use needs.

A good number of international users will seek enhancements for their existing operational inventory. Spare parts, upgrades and refurbishment activities will therefore continue.

Ten-Year Outlook

Very limited production, if any.

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