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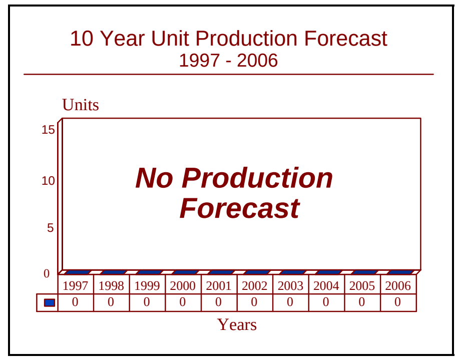
TPS-63/65 - Archived 9/98

Outlook

- Production complete; backbone of many radar nets
- Good heavy rain performance suits radar for Pacific Rim
- Heavy use, spares/repair support required through turn of century
- Replacement sources sought, announcement released



Orientation

Description. A land-based/2-D, me dium-range tactical radar used to provide low-altitude coverage.

Sponsor

US Navy

Space & Naval Warfare Systems Command (SPAWAR)
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Arlington, Virginia (VA) 22202
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Contractors

Northrop Grumman Corp

Electronic Sensors & Systems Division
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USA
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Licensee

Benha Company for Electronic Systems Center
Cairo, Egypt

Status. The TPS-63(V) and LASS are in production. Production of the TPS-65 has been completed.

Total Produced. An estimated 97 units have been delivered.

Application. Tactical surveillance radar the detection of low-flying aircraft. Provides area surveil lance as part of an overall tactical air defense or tactical air operations system. The LASS balloon-borne version provides low-level surveillance and detection of low-flying aircraft.

Price Range. Estimated unit cost is approximately US$4.6 million.

Technical Data

Dimensions	**Metric**	**US**
System weight:	3,400 kg	7,497 lb
Antenna:	6.7 X 5.5 m	21.9 X 5.5 ft
Characteristics		
Transmit frequency:	1.25 to 1.35 GHz	
Selectable frequencies:	51	
Pulsewidth:	41 F sec, dual-frequency (selectable from 21 frequencies, dual diversity)	
Characteristics		
PRF:	774 avg., fixed or staggered	
Peak Power:	100 kW	
Average Power:	3 kW	
Range:	9.25 to 148 km	5 nm to 80 nm
Extended Ranges	222 to 296 km	120 nm and 160 nm
Range Resolution:	0.1 nm	
Range Accuracy:	150 m	
Azimuth Coverage:	360^o	
Scan rate:	6, 12, 15 rpm	
Azimuth Resolution:	2.7^o	
Azimuth Accuracy:	0.35^o	
Height Coverage:	0 to 40,000 ft, to 40^o elevation angle	
Probability of Detection:	90 percent (1 m^2 target to 80 nm (150 km)	
Probability of False Alarm:	10^{-7}	
MTI Improvement:	60 dB	
MTBF:		
TPS-63	884 h	
TPS-65	3,000 h	
MTTR:	0.5 hr	
Availability:	99.9 percent	
Set-up time:	60 min	
March Time (for disassembly):	30 min	
Prime Power:	50 or 60 Hz 20 kW	
Display:	UYQ-27(V)1	
Outputs:	Radar Videos	
Number of receiver channels:	2 (dual-frequency)	
Tuning of receiver:	Electronic	
Dynamic Range of receiver:	123 dB	
ECCM:	Coded Pulse Anti-Clutter Frequency agility PRF Stagger	

Design Features. The TPS-63 2-D, tactical radar detects small, low-flying aircraft in clutter, electronic interference and heavy rainfall. Incorporating features of ITT's TPS-46/47/61 radars, it replaced the UPS-1 radar and features improved flight control, surveillance capability, system reliability and maintainability.

One immediately recog nizable characteristic is the radar's parabolic cylinder antenna, a low-cost means of combining electronic and physical steering. The antenna uses a line source feed, extending in front of the reflector. The system fits into a single shelter

The Moving Target Indicator (MTI) has a 90-percent probability of detecting a one-square-meter target out to the fully instrumented range. Using a four-pulse canceler with variable time intervals between pulses, the digital MTI distinguishes moving aircraft from ground returns while eliminating MTI blind speeds. There is a digital three-pulse MTI weather/chaff canceler false alarm (CFAR) to 10^7. Dual frequency operation is normal.

The system uses TAC-90 color raster scan displays presenting high-resolution data and text. System control inputs are entered through a touch-sensitive, plasma control terminal. Over 100 user-friendly menus allow operator control of radar operating modes.

The standard antenna is sectional and can be stowed in the shelter during transport. It was designed to be erected in approximately one hour or disassembled for transport in half that time.

The system features a dual channel solid state IFF system. High system availability is made possible by the extensive use of microwave integrated circuits, solid-state com ponents, and digital signal processing.

Options offered with all TPS-63(V)s include ASP with tracker capability; an Ultra-Low Sidelobe Antenna (ULSA); solid state transmitter; Mobile Short Range Radar (MSRR) with a range to 40 km while retaining other TPS-63(V) features; and operation with redundant, tower-mounted, antennas. With the increase in range, the radar can operate as a long-range primary radar or gapfiller.

Operational Characteristics. The TPS-63(V) is mobile and can be operational within one hour of arriving at a new site. The electronic subsystems (including dualization where needed) can be installed in fixed structures. This makes for easy maintenance when there is long-term operation of a radar at a fixed site.

During operations in bad terrain and weather conditions, the radar can pull targets out of heavy clutter and interference with a 90-percent detection probability of a $1m^2$ fluctuating target with a low probability of false alarm.

The TPS-63 can be used for air defense, as part of a multi-radar network, independently, for airport surveillance, and as a tactical gap filler. For integrated air defense operations, it can interface with any operations center computer, even from remote locations, providing frequent updates on high-velocity targets.

For autonomous focal point air defense operation, the TPS-63 can cover areas inaccessible to larger stationary radars. It provides tracking for air traffic control, giving constant and frequent target reports to computers and precision landing systems.

As a gap-filler, the TPS-63 can support requirements for air surveillance in remote areas or likely areas of approach for hostile aircraft.

Variants/Upgrades

TPS-63A(V). The TPS-63A(V) is an updated version that offers extended range with a capability of 80/120/ 160 nautical miles. It features remote control and monitoring of key radar functions, and an Array Signal Processor (ASP) for digital target reports via narrow-band channels.

W-630. The W-630 is a commercial version of the TPS-63(V).

TPS-65. The TPS-65 has the same basic features as the TPS-63(V), except that it is dualized with redundant units, and is tailored to be the primary airfield surveillance radar sensor for the Marine Corps Air Traffic Control and Landing System.

The TPS-65's mission is to provide automated and manual control information for landings at expeditionary airfields. This dualized version of the basic TPS-63(V) uses a single antenna on a 20-foot shelter which houses dual subsystems. The antenna can be separated from the shelter for mounting on a building, for example, for fixed-location use.

Low Altitude Surveillance Radar (LASS). TECOM Inc is offering the LASS system aerostat equipped with a modified TPS-63(V) as a unique low-cost sensor whose primary mission is to detect low-flying aircraft. A single LASS can detect fighter-sized aircraft as far away as 260 kilome ters and allows surveillance of an area more than 210,000 square kilometers in size.

The LASS system has an advantage over ground-based radars in that it avoids range limitations due to the Earth's curvature. Low-flying hostile aircraft become visible to ground-based radar only when they are ap proximately 32 kilometers from the ground-based radar site.

The operational altitude of LASS not only increases detection range, but allows line-of-sight (LOS) radar data transmission directly to an air defense control system Sector Operations Center up to 200 kilometers away via an air-to-ground radio relay. This eliminates the need for cable or multiple relay terrestrial microwave systems.

LASS systems can remain on-station for 30 days at a time, limited only by avionics reliability and the helium permeability of the aerostat. There have been complaints about the overall availability of balloons along the US anti-drug fence in the Southwestern US. Weather and the need for balloon maintenance has limited the operational surveillance possible from balloon-mounted radars, in some instances.

The TPS-63(V) carried by the LASS has undergone minimal modifications to take full advantage of the ongoing production, maintenance, logistics, and training support for the radar. These modifications include replacing the original antenna with a 12’ x 25’ parabolic reflector mounted behind the radar avionics and incorporating a previously developed radar processing range extension.

The radar and its antenna are enclosed within a ventral bubble that can be opened to allow full access by technicians who use a cherry picker on the mooring tower and a work platform integral to the radar. The TPS-63(V) is mounted on a stabilized gimbal with its own North reference.

LASS radar features include the following:

A high, 60 dB clutter rejection capability which allows small target detection even when severe ground clutter is encountered;

When over water, the ability to detect small targets even with sea state 4 surface reflections interfering;

Rejection of unwanted ground and sea reflections due to a full frequency coherent design;

Rejection of reflections coming from beyond the radar's instrumented range through the use of advanced signal processing;

A high probability of target detection in only one antenna scan with excellent performance even when multi-path and other propagation anomalies are present.

Aerostat-mounted VHF and UHF transceivers are used by operation center controllers for direct communication with friendly interceptor aircraft operating inside the aerostat radar's detection range. There is simultaneous radar data transmission to a site maintenance ground center so as to supply ground-based personnel with continuous data to support system performance evalu ation and preventive maintenance planning.

LASS marketing continues with IR/EO sensors added to expand the potential uses for the system. The UK and other users are interested in the balloons with different radars, including APS-134, APS-137, or APG-66 variants.

Low Sidelobe Antenna (LSA). A slightly wider version of the original antenna, but only about half as high. The mechanical system is enhanced and the dipole radiating elements are arranged in 32 inter- changeable columns. It reportedly gives a 100-to-1 improvement in ECCM performance against standoff jammers. It also provides an internal sum-and-difference monopulse or conventional Secondary Surveillance Radar.

Program Review

Background. The Navy released solicitations for the TPS-63 in September 1971. The pre-production con tract was awarded to Westinghouse in June 1974 and a three-year phased procurement to replace the 15-year-old UPS-1 radar set began in 1976.

A pre-production TPS-63 radar completed developmen tal testing in September 1976 and was shipped to the USMC base at Kaneoha Bay, HI, for operational evaluation. Full-scale production began in 1978. A 1979/80 sale of eight radars to Morocco was the first foreign sale of the radar. Negotiations for a sale of eight radars each to Egypt, Yugoslavia, and Korea were completed in September 1980. In June 1981, Westinghouse received US$50 million to design and build twelve fully automated TSQ-143 Operation Centers for the Egyptian Air Defense Command. An FMS sale to Jordan of five radars took place in FY81.

The US Marine Corps procurement of the TPS-63 terminated after FY81, a year earlier than originally planned, due to FY82 budget cuts. Foreign sales continued, including 1982/84 sales of two radars to Venezuela, two radars to Taiwan, and two dual-band TPS-65 systems to Korea.

In 1983, Egypt held a competition between Westing house and Thomson-CSF for the purchase of air defense radars. The Westinghouse TPS-63 radar won over Thomson's Tiger 2100 Gap-Filler radar.

In 1984, Westinghouse delivered 12 mobile automated TSQ-143 operations centers to Egypt. Eight centers link to the TPS-63 radars, while four link to TPS-59 radars. In

Marine Corps Upgrade. In FY85, the Marine Corps initiated a product improvement program for the TPS-63(V) to upgrade reliability and maintainability. In FY87, it designed a new ultra-low sidelobe antenna for operation in a high threat environ ment.

In FY88, engineers started developing a solid state transmitter for the radar, replacing the TWT with solid state drivers. The RFP called for the development of an engineering development model, with options for 22 to 28 production modification kits. A contract for an engineering development model of the solid state driver stage was issued in March 1988.

There has been a continuing program to develop, produce and field ECCM enhancements to the TPS-63. Designers have been working on upgrading the TPS-63/Tactical Air Operating Module (TAOM) Interface kits with contracts for this application were issued in early 1988.

In August 1985, Egypt signed a co-production agreement with Westinghouse. The agreement called for the Egyptian firm Benha Company for Electronic Industries of Cairo, Egypt, and Westinghouse to produce 34 TPS-63E radars between 1985 and 1992. The agreement was reportedly worth approximately US$190 million.

The Egyptian Air Defense Command took delivery of the first co-produced radar in 1988. During the final phase of the US$156 million program, 90 percent of the production work took place in Benha Company facili ties outside Cairo.

The US Customs Service was one of the first users of LASS, operating one balloon in the Bahamas since March 1985. It has provided coverage of the islands and the Florida Keys in a drug smug gling interdiction role. That aerostat reportedly had a 97 percent availability and was tested in late 1986 and early 1987 by the USAF Electronic Systems Divi sion. The LASS exceeded 10,000 hours of operating time in late 1987.

It is part of Project CARIBALL and operates from a site on Grand Bahamas Island. Other aerostats are being deployed at Georgetown and Grand Turk Islands under the project, but these use the L-88 radar.

Another LASS was procured for service along the Mexican border, based at Fort Huachuca in Arizona. The radar was given credit for leading to a seizure of a half-ton of cocaine in late 1993. In February 1992, Westinghouse received a US$100 million contract from the US Customs Service to produce four Tethered Aerostat Radar System (TARS) sites for drug interdiction and surveillance in to southern US and Bahamas. Eleven had already been put in drug service along the southern border of the US, using improved LASS radars.

The upgraded sensor has an improved data processor and an enhanced beacon target extraction system. The new radar uses an agile frequency generator and radio frequency receiver.

There have been major complaints, however, that the overall operational rate for the aerostat line was about 60 percent. This includes down time due to weather and maintenance of the balloon. There continue to be radar holes along the southern US border, and the overall US drug interdiction effort is not as efficient as many would like.

A US$12.6 million contract in 1986 provided for a demonstration to the Royal Saudi Air Force of a radar-equipped aerostat. Westinghouse demonstrated the system for 90 days in the hope that the Saudis would buy some of the radars to supplement their AWACS fleet. The system consisted of a 365,000 ft^3-capacity System 365 aerostat equipped with a modified TPS-63(V). The contract called for the installation of the aerostat, radar, mooring system and support equipment in Saudi Arabia and the perfor mance of checkout and flight tests.

A purchase of four to six radars was considered possible, with deployment on the coast facing Iran. But only one LASS has apparently been purchased.

In January 1988, (then) Westinghouse was awarded an US$11 million contract for a LASS plus associated training, technical services, data, and spares to be provided to Kuwait under the FMS program. Work was to be completed in August 1989; however, a US$13.7 million contract modification awarded in late 1988 pushed the completion date out to August 1990.

The contract would have a value of US$28 million if all the options are exercised. The LASS mission was to provide total air surveillance over Kuwait and portions of the Arabian Gulf. Reports indicated that the Ku waiti LASS radars were among the first systems to detect the August 2nd invasion by Iraq. Because of the damage done to Kuwait by the Iraqi forces, re placement sensors are needed and Kuwaiti defense officials are exploring a variety of ways to upgrade and strengthen their early warning sensor lines.

The USMC and the USAF developed a tactical air operations center (TAOC-85), which uses the TPS-63 radar along with TPS-32 and TPS-59 radars. A Litton air traffic control system coordinates a full complement of air defense weapons, including fighter aircraft and surface-to-air missiles such as Hawk and Stinger. With TAOC, the USMC should be able to control all air, anti-air warfare, and air defense operations within a 100- to 300-nm sector. Command and control data are linked to friendly aircraft and air defense sites over UHF and HF networks.

The Marine Corps uses the TLQ-23(V)1 for its TAOC. By the end of 1994, an estimated 34 TYQ-23(V)1s had been produced, with an estimated eight more being acquired by the Marines.

The Marine Corps is retrofitting existing TPS-63 radars with a Digital Target Extractor (DTE) modification kit that allows the transmission of full radar data over narrow-band datalinks, eliminating much of the equipment and system complexity previously required. The DTEs will provide digital target reports, correlated with IFF data on all targets within TPS-63's coverage envelope.

The USAF uses the TPS-63 for range safety purposes.

In August 1995, The Marine Corps Systems Command announced that it intended to enter into a Sole Source contract with Westinghouse Electric Corporation (now Northrop Grumman ESSG), for one Solid State Transmitter (SSTX), Frequency Agility (FA) Upgrade Kit and associated parts and materials, to be integrated into a TPS-63 Radar System. The Upgrade Kit includes parts and materials designed to correct reliability and maintainability deficiencies found in the existing transmitter and associated circuitry.

In addition to the Upgrade Kit, training, interim spare parts, and red-lined changes to the engineering drawings and technical manuals would be procured. Delivery of the upgraded radar system would be by June 1997.

Replacement Radar. In February 1996, the Marine Corps published a sources sought announcement in the *Commerce Business Daily* seeking information on potential sources of a replacement for the TPS-63 and TPS-73 radars. The new radar would have to be capable of detecting tactical aircraft to 150 nm and 100,000 ft, medium range Tactical Ballistic Missiles out to 200 nm and 500,000 ft, and low observable (0.01 m^2 targets) to the radar horizon. The system would have to have a 90% probability of detection. Additionally, the system would have to be able to initiate a "search and track" on information obtained from either a Cooperative Engagement (CEC) Net or Tactical Digital Information link J (Tadil J) and have low probability of intercept (LPI) transmission characteristics.

The radar would also have to be highly mobile, able to be moved by a single 5 Ton truck with a set up time of 10 minutes or less.

The Marine Corps took pains to note that the announcement was only to survey the industry to determine the level of interest and capability available. Responses were required by March 1996.

Funding

Current funding is from Operations and Maintenance accounts. Previous R&D efforts are complete.

Recent Contracts

No recent DoD contracts over US$5 million recorded.

Timetable

	1977	Develop ment completed on TPS-63(V)
Feb	1978	Series production announced
	FY81	Foreign Military Sales (FMS) production com menced
	1981	Egypt purchased eight TPS -63(V)s
Fall	1983	700-hour reliability test of TPS-63(V) by Egypt completed in-country
Feb	1984	Egypt decided to co-produce the TPS-63(V) with Westin ghouse
	1984	Israel purchased five Low Altitude Surveil lance Systems (LASS) radars
	FY85	Modifi cation program for TPS-63(V) com menced
	1985	Egypt chose TPS-63(V) for its Air Defense Command
Mar	1985	US Cus toms Service LASS began operations in Bahamas
	FY86	Continued TPS-63(V) product improvement of solid state transmitter components to achieve improved reliability and maintainability
	1986	Saudi Arabian LASS tested
	FY87	Plan for design of a new ultra-low sidelobe antenna for operation in a high threat environment by the TPS-63(V). Continued development of solid state transmitter components
Jan	1988	Contract issued for LASS system for Kuwait. Scheduled operation date for first of US Customs Service SOWRBALL program LASSs
Mar	1988	Contract issued for EDM of a solid state driver stage for the TPS-63
Nov	1988	Egyptians accepted the first TPS-63 to be jointly produced by Wes ting house and Benha
Dec	1988	First W-630 of Mexican order delivered
	FY89	Began development of a solid state transmitter for the TPS-63(V)
Aug	1995	SSTX FA - Upgrade Kit sole source announcement
Feb	1996	Replacement radar sources sought announcement
Jun	1997	Delivery of SSTX FA upgraded radar

Worldwide Distribution

Egypt. The Egyptians are the single biggest foreign customer for the TPS-63(V), and have license-produced the radar. Originally, the Egyptians purchased eight of the radars, ordered in November 1979. Under the licensed-production agreement, the Egyptians produce at least 34 TPS-63(V)s, with varying degrees of local produc tion, leading up to 90 percent in the final phase of the program. Of the total of 34 radars, six would be the LASS configuration.

Israel. The country has purchased at least five LASS systems.

Jordan. Jordan fielded five TPS-63(V)s, which were ordered in 1981.

Republic of Korea. South Korea employs two ver sions of the TPS-63: a dualized TPS-65 version which com bines two TPS-63 radars in one system and a dual-band radar version which combines the technology of the TPS-43 and TPS-63 radars. The South Koreans have purchased aerostats, so there is a possibility that some of the TPS-63(V)s are mounted on them.

Kuwait. The Kuwaitis operated three LASS systems.

Mexico. Mexico ordered two W-630s, the first of which was delivered in late 1988.

Morocco. As the first FMS client for the TPS-63, Morocco received eight radars for a complete air defense system.

Saudi Arabia. The Saudis have apparently procured a number of TPS-63(V)s, and have evaluated a LASS system. While they were supposed to procure produc tion versions of the LASS, apparently only one system was ordered.

Taiwan. Two TPS-63 radars have been sold to Taiwan.

Turkey. Operates an unknown number of the radars.

US. The Air Force and the Marine Corps have both been customers for the TPS-63, and the Marine Corps is the only known customer for the TPS-65. Both radars were originally designed to fill Marine Corps requirements. The US Customs Service fields five LASSs, located at Grand Bahamas Island and George Town in the Bahamas, Deming (NM), as well as Fort Huachuca and Yuma (AZ).

The **United Arab Emirates** ordered two LASS sys tems for its new air defense and air traffic control system.

Yugoslavia. The country fielded eight TPS-63(V)s, four for ATC applications and four for military ap plications.

Venezuela. Venezuela fielded two TPS-63(V)s, delivered in 1984.

Forecast Rationale

The TPS-63 has a solid technological foundation, and the radar can be upgraded with new processing and similar technology to upgrade its capabilities. This is common to long-range surveillance radars. Generational changes come slowly and major upgrades tend to be in the area of processor improvements and software upgrades.

The role of tactical ground radars, however, is now different from when they were originally fielded. During the Persian Gulf War, AWACS aircraft were deployed immediately and were 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 pro viding the primary air picture to theater command centers. A network of aircraft provided a real-time picture of the Persian Gulf theater of operations and was an effective part of a multi-asset data-sharing network that included Rivet Joint EC-135s, Airborne Battle Command and Control Centers, Tactical Air Control Centers, and Navy E-2C Hawkeyes.

In the future, ground-based tactical radars will be deployed in a backup, or mission-limited role. They cannot be deployed as rapidly as AWACS, cannot provide the area of coverage, and are not as operationally flexible. E-3s can be repositioned quick ly to provide new coverage or support changing operational requirements.

Radars such as the TPS-63 are no longer the primary battlefield sensors. They are now assigned to gap-filler or air traffic/flow control and coordination roles back from the combat front. AWACS is now the prime theater sensor.

The TPS-63 continues to be an integral part of the Marine Amphibious Force and can be expected to see uses in some situations where AWACS is not deployed or is covering other parts of the theater. The replacement sources sought announcement indicates that there is little interest in procuring more of the older radars. The time has come to look at replacing the veteran radar with newer technology. Advanced in component manufacture results in things like better frequency stability and more reliability. Improved processors and mature algorithms make it possible to extract more detailed data from radar returns. Upgrades can only go so far in improving these older systems.

Northrop Grumman continues to market the radar internationally, and at least one South Ameri can, one or two South Asian, and a Middle Eastern nation reportedly are interested in the system. The better, lower frequency performance in heavy rain and monsoon weather makes it a good system for some Pacific Rim applications. But tight budgets are hurting sales chances, as has heavy and successful European competition. Thomson-CSF has recently announced the availability of new lower frequency radars on the market.

In addition to limited FMS sales and production, a steady spare and repair parts market will be needed through the turn of the century to support the radars operational in the field.

Ten-Year Outlook

No further significant production anticipated beyond spare/repair parts support.

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