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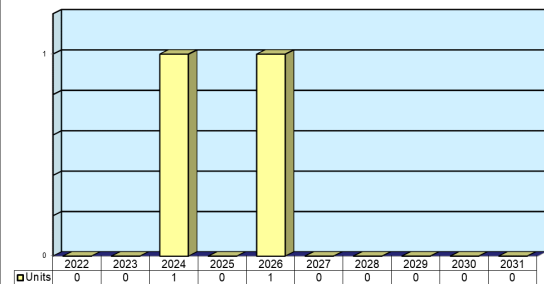
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TPS-78

Outlook

- The U.S. Air Force's pursuit of a next-generation air surveillance radar (3DELRR program) marked the beginning of the end for the TPS-78
- Only procurement from second-tier international customers is forecast; these orders would come from the Asian, Latin American, and Middle Eastern markets
- Any further orders are highly speculative, and the TPS-78 may exit production without winning any new customers

Unit Production Forecast
2022-2031



Orientation

Description. The TPS-78 is a rotating, land-based, long-range, air surveillance radar operating in the S-band with a solid-state, electronically scanned architecture. The radar can be mounted on a trailer or truck in its mobile configuration, and installed in a permanent or semi-permanent configuration. It has IFF capability.

Sponsor

U.S. Air Force Materiel Command
 OO-ALC
 6038 Aspen Ave B1289NE
 Hill AFB, Utah 84056-5805
 United States

Licensee. PT Industri Telekomunikasi Indonesia (PT INTI) is the designated licensee for the Indonesian market.

Dalma Tech² provides program management, life support, maintenance, oversight, and other services for the Saudi Arabian market.

MAC Aerospace Corp has advertised that it provides TPS-78 support services.

Status. In production and service.

Application. The TPS-78 is a vehicle- or pallet-mounted radar for ATC and air defense missions.

Price Range. As of December 2021, Forecast International estimated the price of a TPS-78 to range between \$18.0 million and \$24.0 million.

Contractors

Prime

Northrop Grumman Mission Systems	http://www.northropgrumman.com , 7323 Aviation Blvd, Baltimore, MD 21240-2001 United States, Tel: + 1 (410) 765-1000, Email: ES_Communications@ngc.com , Prime
Dalma Tech2	http://www.dalmatech2.com , Al Saif Group Bldg, South Twr, Olaya Rd, 4th Floor Office 404, Riyadh, Saudi Arabia, Tel: + 966 112791025, Fax: + 966 14660412, Logistics Support

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MAC Aerospace Corp	http://www.macaerospace.com , 14558 Lee Rd, Chantilly, VA 20151-1632 United States, Tel: + 1 (703) 502-8300, Fax: + 1 (703) 502-8303, Email: info@macaerospace.com , Program Participant (TPS-78 Support)
PT Industri Telekomunikasi Indonesia (Persero), PT INTI (Persero)	http://www.inti.co.id , Jl. Moch. Toha No 77, Bandung, Indonesia, Tel: + 62 225201501, Fax: + 62 225202444, Licensee

Subcontractor

Kratos C5ISR Systems	http://www.kratosdefense.com , 490 E Locust St, Dallastown, PA 17313 United States, Tel: + 1 (877) 520-1773 (TPS-78 Components)
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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data**TPS-78**

	<u>Metric</u>	<u>U.S.</u>
Characteristics		
Radar type	Solid-state electronically scanned	
Transmitter semiconductor type	SiGe	
Operating frequency	2.8-3.1 GHz, E-/F-band	S-band
Jamming avoidance range	300 MHz	
Beam width	360° rotating	
Elevation	0-20°	
Height coverage	30.5-152.4 km	16.4-82.3 nm
Display type	Flat panel liquid crystal	
Data refresh rate	10 sec	
Prime power	50 kW @ 50 or 60 Hz	
Cooling type	Air	
MTBCF	>2,000 hr	
Instrumented range	445 km	240 nm
Max targets	1,000	
Moving target indicator (MTI) sensitivity	≥50 dB	
System weight	8,150 kg	17,968 lb
Antenna size		
Height	2.5 m	8.3 ft
Width	5.5 m	17.9 ft
Shelter/Pallet	4.3 m ISO compliant	14 ft ISO compliant

Design Features. The TPS-78 is a technological enhancement over the preceding TPS-70 and TPS-75 long-range air surveillance radars. It utilizes a solid-state architecture to allow stacked beam scanning in the S-band for full-time, full-volume coverage of targets. This allows the simultaneous detection of high-altitude and low-altitude targets in heavy ground and sea clutter.

Beyond general air surveillance, the TPS-78 also gives operators air traffic control (ATC), moving target indicator (MTI), moving target detection (MTD), and identification friend or foe (IFF) modes.

The system utilizes solid-state transmitters that include the use of silicon germanium power transistors. Before

installation in the antenna, the transmitters are inserted into identical, interchangeable power panels. In this setup, Northrop Grumman claims that the TPS-78 can maintain advertised performance even with the normal rate of failing transistors.

For electronic counter-countermeasures (ECCM), the TPS-78 utilizes a flexible bandwidth growth of 200 to 300 MHz. Additionally, the electronic components are enclosed in an environmentally controlled 14-foot ISO shelter for protection from landscape and weather elements, and from detection. Operational interruption resistance is also enhanced by the system's antenna profile. Northrop Grumman says that the low-sidelobe

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antenna will filter out most sidelobe jamming prior to the signals entering the system.

The TPS-78 is made up of nine different line-replaceable units (LRUs), which Northrop Grumman claims is 80 percent fewer than in previous generations. These units include fully interchangeable pre-amplifiers, power panels, and radio frequency panel power amplifier modules. Meanwhile, the processing architecture of the TPS-78 is claimed to reduce the

number of processor LRU types by 90 percent, with the system using only two basic circuit card styles for signal and data processing.

The system's ISO-compliant 14-foot (4.3-m) shelter / pallet is transportable by a single C-130 aircraft. Once the radar is onsite, the TPS-78 can be set up for operation by four people in approximately 30 minutes. The operators then obtain the radar's data through liquid crystal or flat-panel displays, or via remote control.



A TPS-78 antenna is deployed on its pallet, with shelter visible in the background.

Source: Northrop Grumman

Variants/Upgrades

TPS-70SS. The TPS-78 was at one time known as the TPS-70SS, with the "SS" standing for solid-state. This designation is a clear demonstration of the close links between systems in Northrop Grumman's air surveillance radar family: the TPS-70, TPS-75, TPS-78, and TPS-703.

TPS-70 Vigilant. The TPS-70 is the original radar in Northrop Grumman's long-range, air surveillance series leading up to the TPS-78. The system became operational in U.S. service in 1970. It utilizes a tube-powered architecture.

TPS-75. The TPS-75 is the intermediary radar in the evolution from the TPS-70 into the TPS-78. It provides enhanced performance over the TPS-70, but still uses a pencil-beam scanning technique.

The TPS-75 was the USAF's standard long-range air surveillance/control radar by the mid-1990s.

TPS-78. In the 2000s, the TPS-78 was developed to add solid-state, electronically scanned capability and reliability to the USAF's air surveillance radars.

TPS-78 Advanced Capability (ADCAP). The TPS-78 ADCAP improves on the base TPS-78, including an advanced small target UAS and Maritime tracking subsystem with integrated automatic detection and tracking. The radar is optimized to detect and track slow air and maritime moving targets.

The ADCAP features modernized, COTS signal and data processors, as well as SiGe solid-state transmitters.

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TPS-78 Advanced Capability Multi-Mode Radar (ADCAP MMR). The TPS-78 ADCAP MMR is a long-range (240 nm / 444 km) S-band 3D radar. It includes 10-second and 5-second scan rates and is suited for the Ground Control Intercept Mission (which requires faster target update rates), as well as long-range air surveillance, including tactical ballistic missile tracking.

As indicated above, the ADCAP MMR features modernized, COTS signal and data processors, as well as SiGe solid-state transmitters.

TPS-703. The TPS-703 is a downgraded version of the TPS-78. It is optimized for mid-range detection, with an instrumented maximum range of 75 nautical miles (137 km).

Program Review

Background. The TPS-78 grew out of an air surveillance lineage that includes the USAF's TPS-70 and TPS-75 radars. The original radar in the series, the TPS-70, was brought into operational service in 1970, and was the standard Air Force air surveillance radar for many years.

By the mid-1990s, the TPS-75 had superseded the TPS-70. The radar featured many refinements and enhancements to capabilities.

The final TPS-70 was sold to Rwanda in 2000, marking the completion of the TPS-75's accession. By December of that year, 50 TPS-75s were in service with the U.S. Air Force.

However, even at that time, the TPS-75's tube-powered technology was beginning to become outmoded. Solid-state, electronically scanned radars were beginning to be developed, and their capability and reliability overshadowed the performance of the earlier analog models.

Northrop Grumman used the TPS-70/-75 as a base and developed the solid-state TPS-78. The new radar featured stacked-beam scanning for a fuller, more updated picture of the surveilled space. As of 2002, Northrop Grumman reported 30 orders for the type. The U.S. Air Force had developed plans to upgrade its existing TPS-75s to the new solid-state configuration.

Future Opportunities and the Tie-Up with PT Industri Telekomunikasi Indonesia

By 2012, the TPS-78 had become a well-proven system. It had been fielded by a host of international customers and was a main component of the strategies of its sponsor, the U.S. Air Force. However, the platform was aging.

At that time, Northrop Grumman had already developed the G/ATOR next-generation AESA air surveillance radar and was competing for the USAF's 3DELRR

award. The TPS-78 was soon to lose its most important customer, as the 3DELRR (Three-Dimensional Expeditionary Long-Range Radar) was scheduled to replace the older radar as the USAF's standard long-range air surveillance/control radar.

With the impending arrival of the 3DELRR, Northrop Grumman began to look for new opportunities for the TPS-78, such as customers that may originally have been unable to afford the system.

Among the opportunities that Northrop Grumman was pursuing strongly were those in the Asia-Pacific region. Thailand had already purchased the TPS-78, and its neighbors were launching their own long-range air surveillance competitions.

To better align itself for Indonesia's air surveillance radar requirement, in April 2012 Northrop Grumman allied with local manufacturer PT Industri Telekomunikasi Indonesia and the Research Centre for Electronics and Telecommunications of the Indonesian Institute of Sciences. Northrop Grumman signed a Memorandum of Understanding (MoU) with the organizations to facilitate collaboration on ground-based radars in Indonesia. The particular radar specified for the requirement was the TPS-78.

However, Indonesia ultimately decided to pursue the TPS-77 radar bid from competitor Lockheed Martin – which also paired with PT Industri Telekomunikasi Indonesia.

Latin America and the TPS-78

In the 2010s, the TPS-78 found a growing customer base in Latin America.

Among the region's recipients of the system are Colombia and Mexico. Peru awarded a contract for the TPS-78 in 2012, but the deal was reported as canceled only a month after the deal's announcement.

Funding

U.S. FUNDING

As of FY16, the U.S. includes no special funding allowance for the TPS-78 in its defense budget.

Contracts/Orders & Options

<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Raytheon Technical Services	11.54	Aug 2004 – Time and material contract for engineering services to provide assistance for and resolve system deficiencies in the TPS-75 during its sustainment phase. Support included but was not limited to providing technical, administrative, and engineering assistance in the areas of program management, engineering, and engineering analysis. Work was completed by Sep 2009. (FA8217-04-D-0003)
Communications and Power Industries	9.75	Jul 2007 – IDIQ, FFP contract for services to repair a maximum of 150 electronics tubes (Twyston) over a five-year period. Services included disassembling the tubes into component parts that would be reworked, rehabilitated, altered, and/or replaced while inspecting them, repairing them as necessary, and upgrading, reassembling, aligning, and testing them. The Twyston is a final-stage, high-power RF amplifier using a hybrid TWT and klystron technology for the TPS-75 radar. (FA8217-07-D-0001)
Raytheon	0.95	Jan 2008 – FFP contract for TPS-75 radar items for the USAF.
Raytheon	6.79	Jan 2009 – FFP contract for TPS-75 radar items for the USAF.
Raytheon	5.67	Jan 2010 – FFP contract for TPS-75 radar items for the USAF.
Raytheon	3.78	Jan 2010 – FFP contract for TPS-75 radar items for the USANG.
Raytheon	0.79	Jan 2010 – FFP contract for one TPS-75 SLEP unit for the USAF.
Raytheon	1.20	Mar 2010 – FFP contract for 15 TPS-75 ECU/pallet upgrades for the USAF.
Raytheon	3.70	Jul 2010 – FFP contract for one TPS-75 SLEP unit for the USAF.
Raytheon	1.60	Aug 2010 – FFP contract for one TPS-75 pallet upgrade for the USAF.
Raytheon	6.71	Mar 2011 – FFP contract for eight TPS-75 SLEP units for the USAF.
Raytheon	1.48	Mar 2011 – FFP contract for 25 TPS-75 ECU/pallet upgrades for the USAF.
Raytheon	1.99	Jun 2011 – FFP contract for 20 TPS-75 pallet upgrades for the USAF.
Raytheon	4.97	Jul 2011 – FFP for eight TPS-75 SLEP units for the USAF.
Raytheon	4.97	Oct 2011 – FFP for nine TPS-75 SLEP units for the USAF.
Raytheon	1.22	Jun 2012 – FFP for 14 TPS-75 pallet upgrades for the USAF.
Raytheon Technical Services	9.06	Feb 2013 – FFP contract for eight TPS-75 SSM mod kits for the USAF.

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<u>Contractor</u>	<u>Award (\$ millions)</u>	<u>Date/Description</u>
Raytheon Technical Services	4.11	Sep 2013 – FFP contract for eight TPS-75 SSM mod kits for the USAF.
Raytheon Technical Services	4.20	Mar 2014 – FFP contract for eight TPS-75 SSM mod kits for the USAF.



Truck-Mounted TPS-78 Radar

Source: Northrop Grumman

Worldwide Distribution/Inventories

Algeria, Colombia, Latvia, Mexico, Pakistan, Saudi Arabia, Thailand, the United Arab Emirates, and the United States are all believed to be among the current or future operators of the TPS-78. Including the TPS-70 and TPS-75, a far wider number of countries have operated the radars over the course of their production.

As of October 2020, Northrop Grumman was advertising that over 75 TPS-78 units had been produced and fielded.

Forecast Rationale

The TPS-78 and its predecessors, the TPS-70 and TPS-75, have long served as some of the U.S. Air Force's most prominent air surveillance radars. However, in the early 2010s, the Air Force began the process of replacing its TPS-75s/TPS-78s, launching the 3DELRR radar program.

While the 3DELRR program was complicated by numerous delays, and a cancellation of its initial contract with program lead Raytheon Technologies, the Air Force still pursued a next-generation TPS-75/TPS-78 alternative. This resulted in Lockheed Martin earning the prime contractor position in 2022 with its TPY-4 3DELRR. More information can be found in Forecast International's "TPY-4 3DELRR" report.

Faced with losing one of its most valuable TPS-78 customers (the USAF), Northrop Grumman began to actively pursue international sales. The system has been sold to several countries in Latin America, including Colombia and Mexico. In Asia, the system has been procured by Thailand and has competed for an award in Indonesia. In the Middle East, the TPS-78 was reportedly under consideration by Kuwait.

This selection of countries exhibits what could be the TPS-78's primary market going forward: second-tier militaries that wish to operate a proven, cost-effective, and yet still highly functional air surveillance radar. The Asian, Latin American, and Middle Eastern markets provide the primary pool for potential TPS-78 sales.

TPS-78 production is forecast into the mid-2020s, and its prospective customers will be operators that were previously unable to obtain the system, whether because of trade barriers or the system's previously higher expense. However, even with lowered costs, the TPS-78 is still an expensive item that requires well-funded customers. The radar also faces competition from more modern systems, such as the Thales GM400, the radar that usurped a second sale to Mexico.

Given the dearth in sales rumors and the radar family's low profile in Northrop Grumman's advertising, all forecast TPS-78 production is speculative. There is a strong likelihood that the TPS-78 will exit production with no further orders.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program		High Confidence				Good Confidence			Speculative			
	Thru 2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Northrop Grumman Mission Systems												
TPS-78 <> Worldwide <> Armed Services												
Note: Ongoing Production is Speculative												
	44	0	0	1	0	1	0	0	0	0	0	2
Total	44	0	0	1	0	1	0	0	0	0	0	2