

# ARCHIVED REPORT

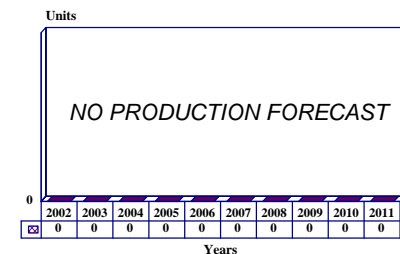
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## Tornado ECR - Archived 03/2003

### Outlook

- Italian ECR retrofit completed in 2000
- No future production or retrofits anticipated
- This report will be archived in the near future if no further activity is detected

10 Year Unit Production Forecast  
2002 - 2011



### Orientation

**Description.** Electronic warfare and reconnaissance aircraft.

#### Sponsor

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Web site: [www.raytheon.com](http://www.raytheon.com)  
(ELS and channelized receiver)

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(Infrared linescanner for German version)

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 (Infrared linescanner for German version)

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 (Radar warning system for Italian version)

**Licensee.** None identified.

**Status.** In service.

**Total Produced.** The German Air Force purchased 35 Tornado ECR aircraft. The Italian Air Force acquired 16 Tornado ECRs by converting Tornado IDS airframes.

**Application.** Based on the Tornado IDS airframe, the ECR variant is optimized for reconnaissance and electronic warfare. The aircraft is tasked with penetrative tactical air reconnaissance in all weather conditions, day and night. Missions include the suppression of enemy air defenses by disrupting and destroying the radar networks and countering enemy C<sup>4</sup>I systems. Tornado ECR aircraft are also tasked with determining low-risk penetrative routing for other attack aircraft. Datalink transmission facilities are provided to transmit reconnaissance and targeting information to already-airborne follow-on attack aircraft. A significant electronic intelligence-gathering capability is also included in the capability profile.

**Price Range.** The ECR version of the Tornado has an estimated value of US\$38 million in 1998 dollars.

## Technical Data

For technical data concerning the Tornado ECR aircraft, see the "Panavia Tornado" report in Forecast International's *Aircraft Forecast*, *Military Aircraft Forecast* and *Airborne Retrofit & Modernization Forecast* binders. The aircraft's avionics are described in the **Design Features** section below.

**Design Features.** The key component of the Tornado ECR avionics suite is the Raytheon Systems Company (originally Texas Instruments, and more recently Raytheon TI Systems) Emitter Location System (ELS), designed to allow the passive autonomous acquisition and precise location (angle and range) of radiating threats. The ELS operates using a high probability of intercept receiver (HPIR) system. It features multi-octave radar frequency coverage, phase interferometric antenna arrays for precision direction-finding and passive ranging, channelized receivers, and multiple 1750A digital processors. The system operates across the RF spectrum for all primary surface-to-air and airborne threats. Data acquired by the system are transmitted via an MIL-STD 1553B databus to both the pilot and the weapons systems operator (WSO). Threat assessments can then be made by the crew, and the appropriate countermeasures initiated.

The channelizer provides a cued analyzer with contiguous high-signal selectivity across a wide instantaneous bandwidth. The basic channelizer design consists of multiple surface acoustic wave (SAW)

channelizer filter banks, each with multiple signal channels. The system utilizes a SAW in a cued analysis receiver configuration. The delay lines allow the channelizer to measure the frequency of the incoming signal and then, using a fast-settling local oscillator (FSLO), tune and cue up the correct narrowband receiver for subsequent analysis and pulse report generation. Once the signals are detected, steering logic sets the FSLO tuning analysis receiver. An adaptable dwell schedule detects delayed pulse trains and forwards emitter information to the processor.

The burden on the computing speed and throughput of the digital data processors is reduced by the use of a specialized hardware presorter and multiple MIL-STD-1750A CPUs (central processing units) to handle the required signal processing and analysis. Signal clustering, de-interleaving, sorting, library file operations, and executive control are tailored and distributed among these multiple processors.

The ELS installation within the Tornado ECR consists of eight individual line-replaceable units. The two

antenna/RF converter LRUs are placed within conformal mountings in the left and right wing ribs. The remaining LRUs are distributed within the spine, the shoulder and the gun bays. Operator control and interface is provided by the ELS control panel and the Tornado's TV-TABS display. Unit-level communication and control and BIT facilities are accommodated through serial communications links. System-level communications between the ELS and other aircraft avionics/defensive systems are via MIL-STD-1553B buses.

To fulfill the Recce Attack Interface (RAIN) and pathfinder missions, the Tornado ECR is equipped with the Operational Data Interface (ODIN) digital datalink made by Siemens-Plessey Systems. This system uses the UHF/VHF and HF frequencies for the transmission of near-real-time reconnaissance data to attack aircraft and to group command posts. The system converts signals from analogue to digital and vice versa. ODIN messages are automatically transferred for display to the crew via the avionics bus. Message formats on the WSO TV-TAB screens are used for preparing transmissions. Received and transmitted data can be recorded in the mission data-transfer system. Voice communication is not inhibited by operation of the datalink facility.

The Tornado ECR Infrared Imaging System (IIS) has a horizon-to-horizon capability which allows area and point reconnaissance. It provides a near-real-time onboard display of the recorded image on the WSO's TV-TABS. The IIS consists of the Honeywell/STN Atlas IR linescanner; electronic components for power distribution, formatting, processing and amplification; electromechanical components for film recording and developing; and the control panel. It provides video images to the displays via the computer symbol generator. The IIS is further used to record Emitter Location System electronic intelligence data.

Other systems carried aboard the aircraft include a Zeiss-Eltro Optronics PAMIR-N infrared targeting sight; a ground-mapping radar; a terrain-following radar; a Thomson-CSF AHV 9 TLP radar altimeter; an autonomous, highly accurate navigation and weapons delivery system; and a fly-by-wire flight control system.

**Operational Characteristics.** The internal space available within the Tornado IDS airframe allows the extensive ECR electronic suite to be installed with only minimum reductions in weaponry. To accommodate the necessary systems, the two nose-mounted 27 mm Mauser cannon have been deleted. The normal weapons load will be two HARM anti-radiation missiles and two AIM-9L Sidewinder air-to-air missiles.

## Variants/Upgrades

The Italian version of the Tornado ECR does not possess the linescanner used in the German models. It also differs in that it video-records data instead of using

dry silver film, and it operates an Elettronica radar warning system and SMS-90 stores management system.

## Program Review

**Background.** The Panavia Tornado was developed in response to a tri-national requirement for a multirole combat aircraft to equip the air forces of Great Britain, Italy and West Germany, as well as the West German Navy. Go-ahead for the development of the Tornado ECR version was given in June 1986, with an order for 35 aircraft for the West German Air Force being included in the seventh production batch. Texas Instruments (now Raytheon Systems Company) received a contract for the development and production of the Emitter Location System at about this time.

The first prototype Tornado ECR, a converted pre-production IDS, was delivered to the MBB facility at Manching, Germany, in August 1988. Following initial flight trials and technology demonstrations, the first production aircraft for the West German Air Force were delivered in 1990. At that point, the program was

running approximately five months late because of integration problems with the electronics suite. By mid-1991, 18 aircraft had been delivered. The final (35th) Tornado ECR airframe was delivered in January 1992, although all the delivered aircraft initially lacked the Emitter Location System and were therefore not fully operational. Without the ELS, the aircraft were unable to locate and classify hostile radars or use HARM anti-radar missiles. Initial deliveries of the ELS were made in February 1993; the German Tornado ECRs became fully operational the following April.

The Italian Air Force placed an order for 16 Tornado ECRs in early 1990. This order was canceled in July 1990 after work on the airframes had commenced. However, the project was revived during 1991 when the Air Force decided to acquire a fleet of 16 Tornado ECR aircraft by converting 16 Tornado IDS airframes.

In July 1989, two German Air Force Tornado IDS attack aircraft visited the headquarters of the US Air Force Tactical Air Command. This was part of Rockwell's campaign to promote the Tornado ECR as a replacement for the F-4G Wild Weasel. Under the terms of Rockwell's agreement with Panavia, surcharges for the basic development of the Tornado ECR would be waived. The US Air Force Tornado ECR would be built at Palmdale, California, using Panavia-built major subassemblies such as wings, tails and (subject to negotiations) fuselage components. About 50 percent of the aircraft would be derived from US sources. In 1990, however, US funding for the ECR follow-on to Wild Weasel was deleted and the program effectively died.

In 1991, the South Korean Air Force declared an interest in acquiring a fleet of 50 Tornado ECR aircraft. However, technical problems with the Tornado ECR program seriously delayed this deal, and discussions on acquisition of the aircraft did not resume until July 1993. The proposed buy was reduced to 24 aircraft, which would be new-production airframes derived from the Tornado GR.1. To date, no progress regarding this program has been detected. All Panavia Tornado production ended in 1998, and a South Korean buy is not forecast.

In 1992, the Royal Saudi Air Force initiated studies on converting its existing force of 24 Tornado F.3 aircraft

from the air superiority to the electronic combat and reconnaissance role. This followed the poor performance of the Tornado F.3 during the Persian Gulf War and an urgent desire by the Royal Saudi Air Force to replace its Tornado F.3 fighters. The Tornado F.3 problems were related to the shortcomings of the Foxhunter radar and to the lack of maneuverability of the aircraft when used in the fighter role. An initial study made by British Aerospace examined a number of options, including packaging the Tornado ECR avionics into the Tornado F.3 airframe, but a Saudi purchase of conversions to the ECR standard never materialized.

In February 1994, the Tornado ECR failed electromagnetic compatibility tests. The aircraft was reportedly unable to meet specifications during a series of trials carried out at the DASA High Energy Radiating Facility (HERF) at Manching. These problems apparently were resolved by early 1995, as Tornado ECR aircraft were then readied for operations in support of UN initiatives in Bosnia. These preparations included live firings of AGM-88 HARM missiles. The aircraft are said to have supported the NATO air offensive in late 1995.

The first Italian Tornado ECR prototype was manufactured (through conversion of Tornado IDS) in March 1992. Conversions of an additional 15 for Italy began in 1996 and ended in 2000.

## Funding

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Development funding for Tornado ECR was provided by the German government; specific amounts have not been identified.

## Recent Contracts

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Since 1996, no known contracts have been awarded for the ECR program.

## Timetable

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<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Mar	1992	First Italian Tornado ECR prototype manufactured
Feb	1993	Initial deliveries of ELS for German Tornado ECR aircraft
Apr	1993	German Tornado ECR aircraft fully operational
	1995	German Tornado ECRs deployed to Bosnia
	1996	Deliveries of 15 Tornado ECR conversions for Italy begin
	2000	Tornado ECR conversions completed

## Worldwide Distribution

The Tornado ECR has been purchased by **Germany** (35 new productions) and **Italy** (16 converted from Tornado IDS).

## Forecast Rationale

The Electronic Warfare and Reconnaissance (ECR) variant of the Tornado was developed as a replacement for the RF-4E. The Tornado ECR was equipped with an Emitter Locator System, a forward-looking infrared (FLIR) system, and an ODIN system. The Tornado ECR is designed to suppress enemy air defenses by disrupting and destroying the radar networks and countering enemy C<sup>4</sup>I systems. Tornado ECR aircraft are also tasked with determining low-risk penetrative routing for other attack aircraft.

Using a modified IDS Tornado airframe, only 35 Tornado ECR aircraft were build for the German Air

Force. Italy had 16 Tornado IDS airframes converted to ECR standards. Beyond these two sales, there has not been any new activity. Attempts to market the Tornado ECR on the international market in the late 1990s were unsuccessful.

With production of the Tornado having ended in 1998, any future ECR sales are restricted retrofits. Considering the lack of interest in the Tornado ECR, no production or retrofits are being forecast. If no new activity is detected in the near future, this report will be archived next year.

## Ten-Year Outlook

### ESTIMATED CALENDAR YEAR PRODUCTION

Designation	Application	Thru 01	High Confidence Level				Good Confidence Level				Speculative		Total 02-11	
			02	03	04	05	06	07	08	09	10	11		
TORNADO ECR	Prior Prod'n:	51	0	0	0	0	0	0	0	0	0	0	0	0