# Thomson-CSF ATC Systems - Archived 8/97

## Orientation

Description. An integrated family of air traffic control systems marketed under the generic name **Aircat**. The range includes primary, secondary and surface traffic surveillance radars, navigational and landing aids and systems integration equipment.

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Licensee. The RSM 870 has been co-produced by Tecnasa, Sao Jose dos Campos, Brazil. Thomson-CSF has established a joint venture with British Aerospace Australia Ltd, Sydney, South Australia, that includes production of Thomson-CSF secondary surveillance radar (SSR). The SSR will be marketed through Thomson Radar Australia Corp (TRAC). Other Thomson-CSF ATC equipment is produced by Wilcox Electronics of the USA. Radwar Warsawskie Zaklady Radiowe is producing IFF and military ATC equipment in Poland.

Status. Production and service.

Total Produced. Approximately 50 RSM 870s and 60 RSM 970s were ordered through the end of 1990. More than 30 TR-23L radars are in service or on order. At least 12 ASTRE systems are also installed or on order together with in excess of 70 TA-10 radars. Thomson-CSF has supplied 650 ILS systems, 450 VOR units and 200 DME beacons to a total of 85 countries. In addition, Wilcox has supplied over 1,350 VOR units, 950 VOR-TAC, 500 DME beacons and 1,500 ILS systems. Finally, over 150 Aircat control centers have been supplied of varying types.

Application. The Thomson-CSF range of civilian air traffic control systems is intended to provide a complete, integrated package procurement satisfying all requirements of a modern ATC network.

Price Range. The price of the RSM-970 secondary radar depends upon configuration and installation specifications, with installation on a tower such as the one at Chaumont, France, being much more expensive than the average. An approximate unit cost is US$750,000. ASTRE surface surveillance radar cost around US$2 million while EUROCAT 2000 ATC centers cost approximately US$12 million including ancillary equipment.

## Technical Data

Design Features. The Aircat air traffic control systems are based on the use of high-performance MIV-1000 Cursive or MICV-2000 2,000-line raster displays driven by a triplex central computer system using 32-bit Data

General computers of the MV-10000 family. These are linked by an Ethernet Local Area Network (LAN) in redundant configuration to provide system intercommunication and a bypass capability for information from the computers to be presented directly on the displays. The processing architecture is fully distributed. A consistent technology is used throughout the displays and tracking systems to ensure compatibility and facilitate systems integration. Programming is in advanced Ada with the software structure being modular, highly structured and standardized.

The Aircat 200 is a basic system for use with one or two radar heads and is not initially fitted with a central computer processing capability. The built-in processors are capable of most ATC functions including radar mosaic. The system has built-in provision for growth to the more powerful Aircat 1000 and Aircat 2000 configurations.

The most advanced version of the Aircat system is the Eurocat 2000 introduced in September 1990. This system features software independence from the hardware, the use of a large library of available functions and Ada packages, and 2000x2000 raster displays with EGA graphics, color presentation and multi-windowing. A fast graphics generator has been introduced which takes less than 200 ms to draw a complex operational picture.

Operational Characteristics. The Thomson-CSF Aircat 200, Aircat 1000 and Aircat/Eurocat 2000 systems are designed to integrate the multiradar data acquired and processed from a network of primary and secondary radar stations. Functions performed by the systems include the automated acquisition and processing of flight plans, automatic secondary surveillance radar (SSR) code allocation, radar display of aircraft tracks correlated with the appropriate flight plans, management of flight strips, integrated simulation functions and automatic warning of minimum safe altitudes and conflict detection.

# Variants/Upgrades

TA-10MTD Primary E-Band Radar. This is the standard primary radar for terminal area surveillance and approach control. It has a range of 65 nautical miles against a two-square-meter target and can be configured in either fixed or transportable modes. The system and can also be integrated into military ground-controlled approach systems. The radar data can be displayed in real-time video form on a conventional long persistence phosphor PPI simultaneously with weather outline contours. An extracted plot output can be filtered or tracked in correlation with the associated SSR or IFF responses and used in an automated data processing and display system. Alternatively bright raster scan displays can be provided for radar video and synthetic data, particularly for control tower use.

The radar consists of an AC-316 dual-beam cosecant-squared antenna with polarization switchable from vertical/linear to circular modes. The antenna-turning gear is fitted with dual drive motors to provide reliability and to take account of severe wind conditions. The rotation speed is normally 15 rpm, but can be reduced by half when necessary to compensate for anomalous propagation conditions.

The ER-810SM transmitter uses a magnetron operating in the 2,700-2,900 MHz frequency band. It is entirely solid-state except for the magnetron UHF element. The modulator has 20 submodules and is designed to be fail-safe, with performance degrading gracefully in the presence of progressive failures. Standard pulse width is 1 ms with a peak magnetron power of 600 kW at a PRF of 1,000 Hz. The receiver is comprised of an RF-820S unit acting as a limiter to high-energy UHF signals and as a low-noise amplifier operating in the E-band. An RR-830SM UHF module executes the balancing and switching of high-cover and low-cover signals according to a program generated within the MTD-900 unit. This unit features four independent filter channels which act as a zero-velocity filter, a moving target filter (effectively a triple or quadruple canceler), and two mobile weather clutter rejection filters. The system is based on a Motorola 68020 processor.

TA-10K E-Band Approach Radar. Klystron-powered version of the TA-10MTD generating a peak power of 1900 kW. Maximum range is in excess of 100 nautical miles.

TRAC-2000 D-Band Approach Radar. This primary surveillance radar has an operational range of up to 100 nautical miles. TRAC-2000 operates in the 1,250-1,370 MHz, very low D-band range (Note: this frequency range provides a high potential to detect the stealth F-117A). It utilizes a THD-826 antenna rotated at 12-15 rpm. The transmitter unit is the ER-2000 generating a peak power of 10 kW from 20 individual RF amplifier modules. It is alternately driven by a short pulse (1 ms) and a longer 100 ms pulse. The short pulse is off-set from the long-pulse transmission and ensures short-range detection. Cooling is achieved using a glycol-water mixture to realize the lowest possible transistor temperatures and, correspondingly, the highest equipment reliability potential.

The receiver is duplicated to provide operational diversity and to ensure maximum reliability. Each channel consists of a low-noise RF amplifier preceded by a limiter, a frequency changer element for mechanization of the dual frequency changer technique, and receiver filters for processing the long or short RF pulse received. Automatic gain control is provided as a function of clutter level. The receiver also contains an MTD-900 unit.

RSM 970 Monopulse Secondary Surveillance Radar. This Mode-S compatible radar is derived from the older RSM 870 system which it has largely supplanted. It consists of an AS-909 open array cosecant-squared antenna which may be co-mounted with the antennas of the TA-10 or TRAC-2000m, or operated in stand-alone mode. The uplink frequency is 1,030 MHz and the downlink 1,090 MHz. The system range is up to 250 nautical miles in en route configuration or 200 nautical miles when used in the terminal approach configuration. The interrogator/receiver units are entirely solid state and completely compatible with Mode-S. Transmitter power can be programmed in various azimuth sectors and can be attenuated independently on each of the channels. The receiver processing embodies double phase estimation and offers an unambiguous linear angular deviation measurement. Signal processing is carried out in two units. An ERM-870 monopulse signals extractor carries out the detection and decoding of the elementary receiver replies and degarbles any corrupted responses. The second unit, a TPR-1000 reply processor, carries out the combination of the elementary replies to produce full SSR plots.

LP-23M D-Band Long-range Surveillance Radar. This is a conventional D-band magnetron radar with a range exceeding 220 nautical miles against a two-square-meter target. A klystron-powered derivative, the LP-23K, is also available. This later configuration has a range in excess of 275 nautical miles.

TR-23 D-Band Terminal Area Radar. These radar are derived from the long-range surveillance LP-23 radar, the TR-23M (magnetron-powered, range 120 nautical miles), and TR-23K (klystron-powered, range up to 160 nautical miles). They differ from the LP-23 equivalents only in the antenna assemblies.

ASTRE. The Airfield Surface Traffic Radar Equipment is tasked with providing a clear, accurate complement or substitute for visual ground traffic surveillance. J-band operation has been selected to provide small target detection in rain and other poor operating conditions. Two specific operating modes are provided, one covering runway and taxiway operation while the other covers unpaved areas adjacent to runways. High-resolution 1280-1024 color display units are used. Facilities provided to the operators include eight pre-programmed pictures, picture rotation, two and four fold zoom, off-centering and eight synthetic maps covering crash sites. The radar coverage extends over 8 kilometers in clear weather with processed range limited to 5 kilometers. The range against a two-square-meter target is in excess of 4 kilometers under 16 mm/h rain conditions.

TRS-2310 Precision Approach Radar. The PARS TRS-2310 is a modernized version of existing precision approach radar designed to provide improved performance in the presence of ground clutter and weather returns. It uses a coherent transmitter with a traveling wave tube (TWT) amplifier, a Doppler MTI with four or eight velocity filters and transmission at two or three frequencies in bursts of 6-10 pulses at variable PRF. Signal transmission, reception and processing chains are all duplicated to ensure maximum reliability.

Landing and Navigation Aids. The range of available navigational and landing aids includes the DME-721 directional and omnidirectional distance measuring equipment, VOR-512 conventional and Doppler radio ranging beacons, the MLS-840 microwave landing system, and the ILS-381 and ILS-381T CAT.1 and CAT.2 instrument landing systems.

# Program Review

Background. Thomson-CSF initially entered the civilian ATC market in the late 1950s. It has heavily invested in research and development since that time and has pioneered a number of significant breakthroughs in ATC technology. These include the use of dual beam antennas for primary radar, synthetic or television radar pictures for civilian use, multiradar tracking, the first monopulse secondary surveillance radar and the first integrated ATC systems programmed in Ada.

Thomson-CSF's civilian ATC operations dominate its radar activities and it is to this sector that the company owes its reputation as a leading radar producer. Thomson is unusual in that its civilian ATC radars provided the technology basis from which its military long range surveillance systems have developed. Typically it is the other way around. Significantly, a number of the company's civilian products also have military export serial numbers.

Thomson-CSF has established a firm hold on the monopulse SSR market with its RSM family. These are a step up from previous-generation models in that they are capable of measuring the angle of arrival of a single pulse in the reply from an aircraft transponder. Conventional SSR required a number of signals to achieve a reading. The use of SSR is somewhat comparable to that of a military Identification, Friend-or-Foe (IFF) system in that the ATC system is trying to identify all transponder-equipped aircraft in its area. In these times of increasingly crowded skies, the use of monopulse SSR becomes more and more of an advantage.

The RSM family has garnered significant sales over the last five years and has been installed in Austria, Brazil, Cyprus, Denmark, France, Germany, Kenya, Pakistan, and Sri Lanka. The biggest orders have come from Brazil (21), which has upgraded its national ATC system with RSM 870s manufactured under license; France (19), which is in the process of taking deliveries that will result in a fully integrated national SSR system; and the US Army (15), which has ordered RSM 970s for use in a transportable version.

Besides licensed production in Brazil, Thomson-CSF also signed an agreement in early 1989 with British Aerospace Australia for the codevelopment and production of various ATC products, with coproduction of the RSM 870/970 in Australia for marketing in the Asia/Pacific area. This agreement includes production of the systems ordered by the Australian Civil Aviation Authority. Australia has contracted for 19 RSM 970s and a transportable version of the RSM 970 (with the TA-10M) as the start of a comprehensive upgrade of the Australian ATC system. The Australian order brought total orders up to 107 RSM 870/970s. However, in July 1992 the Australian Government froze contract negotiations with Thomson-CSF following the decision to launch an independent inquiry into the agreement.

In July 1991, the Greek government awarded Thomson-CSF a contract for a fully automated fixed tele-communications network and integrated ATC system. This included installing a TA-10K and RSM-970 radar at Athens International (work completed in July 1992) and the provision of a primary air traffic control center. This contract was followed, in December 1991, by a Czech contract with Thomson-CSF for the supply of a complete turnkey ATC system. This includes the provision of two Eurocat 2000 ATC centers for Prague and Bratislava and three secondary monopulse RSM-970 radars. Two additional primary radars and an ASTRE surface surveillance radar plus full navigational equipment are also to be installed.

The already strong position held by France in the Middle East was reinforced when Thomson-CSF won a contract to supply an integrated ATC system for the new King Fahd International Airport. This success was quickly followed when, after an international request for proposals, the European air traffic control safety agency, Eurocontrol, awarded Thomson-CSF the lead company contract for the Aeronautical Telecommunication NETWORK (ATN). This will optimize the efficiency of different datalinks (VHF radio, Mode-S radars and satellite) to form a fully integrated network. Thomson-CSF will be concentrating on the VHF and Mode-S sectors while Siemens-Plessey will be a primary subcontractor dealing with the satellite network.

ATN will tie in various aeronautical communications systems to provide a single international network between control centers and aircraft, thus significantly enhancing the integration of navigational and surveillance systems. ATN will automate numerous air traffic control and management functions and convey data between aircraft and the ground stations in all flight phases, regardless of aircraft position. The objective of ATN is to bring end-to-end continuity to air traffic control and improve the flow of aircraft movements.

Thomson-CSF has also been awarded a contract to supply and install an air traffic control system at Da Nang Airport in Vietnam, which is being developed as a civilian field, with the goal of enhancing the country's tourist trade. The contract covers the delivery of a TRAC-2000 primary radar and an RSM-970 secondary radar at Da Nang, as well as a second RSM-970 at Quynhon airport. Under the terms of an existing contract, Thomson-CSF is supplying a TRAC-2000 and an RSM-970 radar for Tan Son Nhat Airport (this was known as Tan Son Nhut during the Vietnam War due to a regrettable US Army clerical error in 1963, but has now reverted to its correct name). The new order also includes a Eurocat-2000 control system to be installed at Tan Son Nhat to coordinate the operations of the three new radar systems.

Since that time, Thomson-CSF has continued to reinforce its hold on the European ATC system, winning the contracts for its further development either in its own right or in partnership with other companies such as Siemens-Plessey or GEC-Marconi. These include a significant volume of work in Central Europe, bringing the ATC systems of the Czech Republic and Hungary in particular up to Western European standards. However, these successes have been partially offset by problems with the Australian ATC contract which has led to pressure to have the system rebid.

In May 1993, the Warsaw-based Radwar Warsawskie Zaklady Radiowe and Thomson-CSF signed an agreement for the assembly in Poland of IFF equipment for the Polish armed forces and for the adoption of Thomson-CSF designed Polish military ATC equipment.

## Funding

The development of the product range was funded as a private venture using corporate resources. Thomson-CSF is, however, a state-run enterprise with needed resources ultimately provided as part of French government contracts.

## Recent Contracts

| Contractor | Award ($ millions) | Date/Description |
|---|---|---|
| Wilcox | 7.0 | Aug 1988 - Contract for two TA-10M and two RSM 970 radars (DAAB07-88-D-M146, 0001). |
| Thomson-CSF | 56.0 | Oct 1988 - New Zealand integrated ATC system contract. |
| Thomson-CSF | | Sept 1990 - Contract for the supply of TXM-4400 Voice Communications Control Systems to the UK Civil Aviation Authority for use at Manchester International Airport. |
| Thomson-CSF | | Sept 1990 - Belgian ATC radar upgrade contract. |
| Thomson-CSF | | Sept 1990 - Denmark ordered Thomson-CSF terminal control radars. |
| Thomson-CSF | | April 1991 - Mexico ordered Aircat 200 integrated system for Cancun International Airport. |
| Thomson-CSF | | Dec 1991 - Czech contract for turnkey ATC system to replace Soviet-designed installation. |
| Thomson-CSF | 2.6 | June 1992 - Russian contract to provide technical and training plan for Russian ATC system. |
| Thomson-CSF | | Jan 1993 - Saudi Arabian contract to supply an integrated ATC system to King Fahd Airport. Contract covers a TRAC-2100 and a RSM-970 radar and an AIRCAT-2000 control center. |
| Thomson-CSF | | May 1993 - Eurocontrol lead company contract for the Aeronautical Telecommunication NETWORK (ATN). This will optimize the efficiency of different datalinks (VHF radio, Mode-S radar and satellite) to form a fully integrated network. Thomson-CSF will be concentrating on the VHF and Mode-S sectors while Siemens-Plessey will be a primary subcontractor dealing with the satellite network. |
| Thomson-CSF | | May 1993 - Vietnamese contract to supply and install an air traffic control system at Da Nang Airport. The contract covers the delivery of a TRAC-2000 solid state primary radar and an RSM-970 secondary radar at Da Nang and a second RSM-970 at Quynhon airport. Under the terms of an existing contract, Thomson-CSF is supplying a TRAC-2000 and an RSM-970 radar for Tan Son Nhat Airport. The new order also includes a Eurocat-2000 control system to be installed at Tan Son Nhat to coordinate the operations of the three new radar systems. |

## Timetable

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|---|---|---|
| Dec | 1984 | First RSM 870 became operational at Linz in Austria |
| Apr | 1985 | Order for six RSM 870s received from Pakistan |
| Oct | 1985 | RSM 870 installed on Mount Kiona on Cyprus. RSM 870 orders received from Kenya (4), and Austria (1). |
| Jun | 1986 | Second Austrian RSM 870 became operational (Vienna's Schwechat airport) |
| Oct | 1986 | French order received for 19 RSM 870s |
| Feb | 1987 | Third RSM 870 order received from Austria |
| Apr | 1987 | Order for four RSM 870s received from Indonesia |
| Sep | 1988 | Order from US Army for ATC equipment including 15 RSM 970s |

| | | |
|---|---|---|
| Oct | 1988 | Order from New Zealand for various ATC equipment including six RSM 970s |
| Spring | 1989 | First French RSM 870 installation operational |
| May | 1989 | Irish contract for ATC equipment including four RSM 970s |
| Aug | 1989 | Australians ordered 20 RSM 970s for the start of a comprehensive ATC upgrade |
| | 1990 | Germany signed with Thomson-CSF/Selenia consortium for extensive upgrade of German ATC |
| Sep | | Belgian contract for ATC radar upgrade |
| Apr | 1991 | New Zealand contract completed |
| | | Mexico orders Aircat 200 |
| Jul | | Greek order for ATC system |
| Dec | | Czech contract for integrated ATC system |
| | 1992 | French contract completed |
| | 1993 | Scheduled completion of Australian contract |
| Jan | | Saudi order for integrated ATC system |
| May | | Eurocontrol contract for ATC communications system |
| | | Vietnamese contract for integrated ATC system |
| | | Polish licensed production agreement signed |
| | 1995 | Full-scale replacement of New Zealand navigational aid system completed |

# Worldwide Distribution

At the last count Thomson-CSF was supplying major civilian ATC services to a total of 85 countries. Some of the more significant recent installations are as follows:

**Abu Dhabi.** In 1982 a new Abu Dhabi International Airport was supplied on a turnkey basis. This included an Aircat 200 control center, an approach control system with primary and secondary radars, an ASTRE airfield surface movement radar, two CAT.III ILS systems and associated navigational aids, and a complete automated communications system.

**Australia**. Australia's Civil Aviation Authority awarded a contract in August 1989 to Thomson Radar Australia Corporation for the production of 19 RSM 970s, as well as a transportable version of the RSM 970 in a similar configuration to those being provided by Wilcox to the US Army. Installation of the radars was completed in 1993 covering the south and east of Australia from Cairns and Adelaide, as well as the southwest part of the country. The priority sites at Cairns and Coolangatta had their radar installed by early 1990. Current work is upgrading Melbourne airport with the replacement of existing SSR and upgrading support facilities. Australian production is being performed in concert with partners British Aerospace Australia and Adacel.

**Austria**. Three RSM 870s have been installed in Austria at Linz, Salzburg, and Vienna (Schwechat) airports. All three operate in conjunction with TA-10M primary radar. A fourth RSM 870 was scheduled to become operational before the end of 1989 at Graz airport.

**Belgium**. Complete upgrade of ATC system including installation of one RSM 970 radar and upgrading of two others with new antennas. The work was completed in August 1992 and the system was declared operational in March 1993.

**Brazil**. Brazil has installed a total of 21 RSM 870s as part of a major upgrade of the country's ATC system in the DACTA I, II, III, and AMAZONIA programs. Eleven of the RSM 870s are installed with TRS-2230 radar in co-located sites at Cangacu, Santiago, Morro da Igreja, Catanduvas, Sao Roque, Tanabi, Jaraguari, Couto, Tres Marias, Gama, Aragarcas, and Chapada dos Guimaraes. Nine RSM 870s have been installed, along with LP-23Ms, at Porto Seguro, Bom Jesus da Lapa, Salvador, Maceio, Natal, Fortaleza, Alcantara, Belem, and Manaus. A single RSM 870 is installed on the island of Fernando de Noronha.

**China**. The completed interlocking ATC system for the Beijing/Shanghai air traffic region includes six long-range radars for en route surveillance, three airport surveillance radars, two main and three air traffic control centers, three terminal control centers and an automated ground-air communications center.

**Cyprus**. An RSM 870, along with an LP-23K, is installed on Mount Kiona.

**Czechoslovakia** Complete Eurocat 2000 ATC system with 3 RSM-970 radars and navigational equipment.

**Denmark**. Automated control centers have been installed at Copenhagen, Billund and Aalborg with TA-10 radars at those sites. A total of six primary radar have been supplied. Two RSM 870s were ordered in 1986 for installation at Copenhagen and Esbjerg airports where they operate in stand-alone configurations. A TA-10MTD and an RSM 970 radar were supplied to Aarhus/Tirstrup airport.

**Egypt**. A complete en-route and terminal approach system with primary and secondary radars has been supplied for Cairo International Airport together with an ATC simulator and a fully integrated and automated communications system.

**Eurocontrol**. Thomson-CSF has been the basic supplier of Eurocontrol's requirements since the system was inaugurated in 1963. This includes ATC simulator units, SSR stations in Ireland, Germany and The Netherlands and en route primary radar sites.

**Finland**. Thomson-CSF has supplied 10 ILS systems, two airport automated control centers with both primary and secondary radar, and training/simulation facilities.

**France**. In 1986 the French civil aviation authority (Direction de la Navigation Aerienne) placed an order with Thomson-CSF for a fully integrated ATC system for France, designated CAUTRA IV. This system consisted of six long-range en route surveillance stations supplemented by six terminal approach radar stations and three SSR stations shared with other users. A total of 19 RSM 870 unmanned stations are planned all over France. The first station (at Chaumont) became operational by the spring of 1989. The contract called for deliveries stretching from 1988 to 1992.

**Germany**. In 1990 the German Government placed orders with a consortium made up of Thomson-CSF and Selenia for the upgrade and re-equipment of the then West German air traffic control system. The contract covers the installation of numerous Thomson-CSF SSR radar and the refurbishment of the existing air traffic control centers. It is believed that the new system is specifically designed to facilitate integration of the new East German ATC system with that of West Germany following reunification.

**Greece**. Integrated air traffic control system including two TA-10K primary radar, five RSM-970 secondary radar and a major air traffic control center.

**Indonesia**. In a follow-on to earlier ATC contracts (that included orders for 12 SSR), Indonesia ordered four RSM 870s in 1977 for installation at Ambon, Kupang, Manado, and Wainpagu.

**Ireland**. The Irish signed a contract in May 1989 for four RSM 970s, with the first scheduled to become operational before the end of 1989 (Dublin airport), and the rest to be delivered over the following 25 months.

**Kenya**. Kenya has installed four RSM 870s, which operate in conjunction with one LP-23K, two TR-23Ks, and one TR-23MA.

**Mexico**. An Aircat 200 control center has been installed at Cancun International Airport incorporating a TA-10MTD primary surveillance radar and an RSM 970 SSR. The system became fully operational in 1992. As part of the same contract an ASTRE radar has been installed at Mexico City International Airport. Other Thomson-CSF ASTC centers have already been installed at Mexico City, Veracruz, Monterey, Santa Eulalia and Meridia for en-route control and at Guadalajara, Puerto Vallarta and Cancun for approach control.

**New Zealand**. New Zealand placed an order in 1988 for an integrated ATC system from Thomson-CSF that includes six RSM 970s, of which three operate in conjunction with TRAC-2000s. The whole system is linked to three Aircat 2000 control centers. System was completed in April 1991 with navigational aids replacement to be completed by 1995.

**Netherlands**. Two RSM-970 radar at the Herwijnen radars station operated by the Dutch Civil Aviation Authority.

**Pakistan**. The Pakistanis placed an order in 1985 for three RSM 870s (along with TA-10K primary radars) at Islamabad, Karachi, and Lahore airports, as well as three more RSM 870s in stand-alone configurations for en route ATC.

**Saudi Arabia**. Turnkey ATC system for King Fahd International Airport. Includes a TRAC-2100 primary radar and a RSM-970 secondary radar coordinated by an AIRCAT-2000 center.

**Sri Lanka**. No other information is available other than the fact that an RSM 870 was ordered in the 1986 time-frame, possibly for installation at Colombo airport.

**Switzerland**. Landing approach system including seven ILS-321, 10 VOR and six DME units supplied to Sion (Valais) Airport.

**UK**. Digital communications systems supplied to Manchester International Airport. ASTRE surface movement radars supplied to London, Heathrow.

**US**. In 1988 the US Army ordered from Thompson- CSF's American subsidiary, Wilcox Electric, a total of 15 sets of TA-10Ms/RSM 970s combined into a transportable shelterized configuration in a system which has been given the title TPSRS (Terminal Primary and Secondary Radar Systems). The systems apparently were designated to be installed in the continental US and in overseas locations such as Heidelberg (FRG) and Kwajelein Atoll (Pacific).

**Vietnam**. Complete, integrated ATC system including two TRAC-2100s, three RSM-970 radars, and an AIRCAT-2000 control center.

# Forecast Rationale

The past several years have seen Thomson-CSF continue to further strengthen its market domination of the ATC sector. The company has recorded significant successes in all the major growth areas of the ATC industry: Western Europe, Eastern Europe, the Middle East and the Far East.

In addition to virtually monopolizing the market for integrated, turnkey ATC systems, the company has recorded numerous successes with small, unit replacement or upgrade contracts. Thus, Thomson CSF ATC operations have the rare distinction of dominating both the broad-brush and niche market sectors.

In Eastern Europe, Thomson has been awarded a contract for the complete restructuring and re-equipment of the Czech ATC system to bring that up to Western European standards. Our suggestion that the company was well placed to win similar contracts from Hungary has been confirmed. Thomson-CSF, in partnership with Alenia, recently won a major contract for the refurbishment of the German ATC system. It is very likely that the same consortium has won the contract for a similar refurbishment of the former East German ATC network and its eventual integration with the unified German system. This will be a task of major proportions, effectively meaning the complete reconstruction of the East German system and the retraining of its personnel in Western procedures and standards. In most ex-Warsaw Pact countries the civilian ATC system is in a sad state of disrepair and decay, exacerbated by the Russian withdrawal of much of its equipment for its own use.

In Russia itself, Thomson has faced, and ultimately worked out relationships with, several potentially significant rivals. Alenia set up a partnership (Buran) with the former Soviet Union to supply systems to this major market. In the first three years after Buran was formed, the consortium won contracts worth more than US$200 million, mainly in connection with enhancing ATC facilities for the trans-Siberian air routes. Meanwhile Westinghouse, also recognizing the vast potential of the Eastern European/former USSR market, moved quickly to supply ATC equipment to Poland and used this as a base to bid for the massive Russian contracts which are expected to have a total value in excess of US$10 billion by the year 2000.

The economically strapped Commonwealth of Independent States (CIS) lacked the resources to fully fund the identified much needed major ATC procurements. The CIS was also astute enough to recognize that individual corporations also lacked the resources (or were willing to take the risk) to underwrite the early phases of these programs. In an inspired strategic move, the CIS forged a new consortium, Raduga (Russian for Rainbow), which combined the resources of three major competitors (i.e., Buran, Westinghouse and Thomson-CSF) in a single company. Future contracts will be carried out by this joint venture, creating a reasonable probability that other suppliers will be shut out from this lucrative market. By means of this alliance Thomson-CSF has assured itself of a continuing significant presence in this major market.

Thomson-CSF has achieved a dominant position as the major non-US supplier of air traffic control equipment by providing a complete fully integrated package of ATC systems which can be assembled to meet virtually any requirement. The long-range surveillance radars employed are very widely used and (although Thomson-CSF denies it) have provided the basis for its military ADGE surveillance radar. In the secondary surveillance radar field, the RSM 870/970 family has steadily gained the commercial advantage over Cossor's SSR 950/955 product line. A key advantage of the RSM 870/970 family over the equivalent Cossor systems seems to be that it has been fully Mode-S compatible from the beginning, while only the Cossor SSR 955 can be readily adapted to S Mode. Mode-S is the next-generation aircraft identification system. It will result in the availability of more accurate positional information as well as minimizing interference.

Thomson-CSF has targeted the Asia/Pacific region as being very important to the current export drive. Unlike most corporate sales predictions, we consider this market prediction to be quite realistic. Southeast Asia will be upgrading many of its airports over the next decade to cope with the explosive growth of regional and puddle-hopping air traffic. Many of the airports scheduled for development lack all but the most rudimentary ATC systems, a factor which has already caused one major accident. The recent contracts with Vietnam are a strong pointer to Thomson's growing success in this region, although they can be explained by the long historical relationship between France and its ex-colonies in Indo-China.

The Middle East also offers a good potential market for Thomson-CSF ATC products. France is well established as a radar supplier to this area and is very likely to receive the contract to rebuild the Kuwaiti ATC system. Thomson-CSF is already supplying the ATC facilities for Saudi Arabia and is building rapidly on this relationship. Presumably, the Iraqi ATC system will be rebuilt at some time, but any attempt to determine a schedule under current circumstances is an exercise in futility.

Finally, it should be noted that early in 1995 Thomson-CSF withstood a potential global challenge to its existing ATC product market which should assure retention of its leadership position into the 21st century. In late 1994 the FAA/USAF elected to terminate its beleaguered microwave landing system development program in favor of a GPS based technology for next-generation ATC systems in the US. Canada subsequently followed suit.

This situation created obvious concern among European ATC suppliers, including Thomson-CSF, who had focused product developments on an MLS approach. Their perception was that US suppliers were more advanced in the development of GPS systems and would gain a strategic advantage and penetrate the markets they had worked to develop.

Pressure was put on the International Civil Aviation Organization (ICAO) to provide a policy statement defining the ATC technology to be used in future systems. Significant pressure was applied from both sides. The ICAO, at an April 1995 COM-OPS 95 meeting held in Montreal, failed to produce the desired decision but instead issued a non-binding recommendation that nations provide a five-year warning before decommissioning existing ATC systems. This has had the effect of holding the door open for individual countries to pursue their preferred approaches and, correspondingly, for suppliers worldwide to continue to promote their existing and/or developmental products well into the future. Thomson is certain to use this non-decision to its advantage across its broad ATC international product base.

The following forecast is based on the known historical production of Thomson-CSF civilian ATC systems. The total numbers produced to date have been modified to reflect upgrades, replacements and modernizations of existing T-CSF equipment to later standards. In assessing future requirements, we believe that the mid-term will see major sales in the Far East while the long-term forecast reflects a very steep increase as the countries of Eastern Europe upgrade their ATC facilities to Western European standards. In most cases this will constitute modernization by complete replacement, a process for which Thomson-CSF's product range is ideally suited. This process has already started with the Czech contract while the Polish agreement provides a military ATC counterpart. Major sales in the CIS are likely to follow as well through Thomson's Raduga participation.

# Ten-Year Outlook

**ESTIMATED CALENDAR YEAR PRODUCTION**

| | | | High Confidence Level | | | | Good Confidence Level | | | Speculative | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Designation | Application | thru 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | 05 | 06 | Total 97-06 |
| THOMSON-CSF ATC SYSTEMS | ATC DISPLAYS (UNSPECIFIED) | 3640 | 100 | 120 | 120 | 120 | 150 | 150 | 180 | 150 | 150 | 150 | 1390 |
| THOMSON-CSF ATC SYSTEMS | ATC LANDING AIDS (UNSPECIFIED) | 350 | 30 | 50 | 50 | 50 | 100 | 100 | 100 | 100 | 100 | 100 | 780 |
| THOMSON-CSF ATC SYSTEMS | ATC NAVAIDS (UNSPECIFIED) | 1495 | 90 | 120 | 120 | 120 | 150 | 150 | 150 | 150 | 150 | 150 | 1350 |
| THOMSON-CSF ATC SYSTEMS | ATC RADARS (UNSPECIFIED) | 865 | 30 | 45 | 45 | 45 | 50 | 50 | 50 | 50 | 50 | 50 | 465 |
| Total Production | | 6350 | 250 | 335 | 335 | 335 | 450 | 450 | 480 | 450 | 450 | 450 | 3985 |