ARCHIVED REPORT

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ARSR-3 LRR - Archived 8/96

Orientation

Description. The ARSR-3 LRR (long-range radar) is a D-band surveillance radar.

Sponsor

Department of Transportation (DOT
Federal Aviation Administration (FAA)
Washington, DC

Contractors

Westinghouse Electric Corp
Electronic Systems Group
Baltimore-Washington Int'l Airport
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Status. In operational service in USA, Canada, and Switzerland. Production completed.

Total Produced. Thirty-six total (including ASR-30 version) to three customers.

Application. Surveillance radar used jointly by the FAA for en route air traffic control and by the USAF for air defense. Implemented to improve coverage and accuracy, and to reduce operational and maintenance costs of earlier systems.

Price Range. Approximately US$1.6 million per system.

Technical Data

Design Features. In the early 1970s the ARSR-3 was the first new en route radar acquired by the FAA in 20 years. As such it represented a major step forward from its predecessor, the ARSR-2, built by Raytheon. Today, it is in the sunset years of its application and is being replaced by the solid state digital ARSR-4.

ARSR-3 performance characteristics include a coverage volume for a two square meter target of 240 nm in the duplex mode (193 nm in the simplex mode) to an altitude of 100,000 ft. The D-band (1.25 to 1.35 GHz) radar operates at a peak power of 5,000 kW, with an average power of 3.5 kW, at a PRF of 310 to 365 pulses per second. The modified parabola, dual beam antenna has an integral SSR beacon; maximum elevation is 44 degrees, rotation rate is 5 rpm. Azimuth and range resolution, the ability to distinguish between two targets, are 2 degrees and 0.25 nautical miles, respectively. Digital signal processing techniques include windowing, MTI (Moving Target Indicator), CFAR (Constant False Alarm Rate), RAG (Range Azimuth Gating), and STC (Sensitivity Time Control). All or any combination of these ARSR-3 processing techniques can be used in sequence to overcome sitting difficulties or clutter problems. Either circular (clockwise or counterclockwise) or linear (vertical or horizontal) polarization can be selected; polarization diversity allows weather and target information to be displayed simultaneously.

In operational field usage, the radar demonstrated reliability performance which substantially bettered the specified MTBF (Mean Time Between Failure) of 750 hours in the duplex mode. The MTTR (Mean Time To Repair) is 30 minutes, and maximum repair time is 2 hours for a main antenna bearing. Availability is 99.6 percent in the full duplex mode.

Using state-of-the-art design and manufacturing technology of the day, solid-state control panels eliminated approximately 95 percent of the mechanical switches and all of the incandescent bulbs utilized in previous similar equipment. Switching control of the solid state panel is provided by an infrared emitting diode; LEDs replaced the incandescent bulbs. Automatic machine wiring of IC boards and components cut wiring assembly time by a factor of 40, and automatic testing reduced testing time by a factor of 6 from earlier radar. Built In Test (BIT) and automatic reconfiguration are used extensively in the ARSR-3.

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Variants/Upgrades

The ASR-30 is a mobile dual-channel version of the ARSR-3 with a detection range out to 120 nm for small aircraft (2.0 M^2 radar cross section).

Program Review

Background. Air traffic control and air defense missions both require detection, location, identification, and tracking of aircraft operating within and near US airspace. Two basic types of ground-based surveillance radar are used to accomplish this. Primary radar rely on reflected energy from targets illuminated by ground radar beams. Secondary Surveillance Radar (SSR) rely on energy transmitted, in response to ground radar interrogations, by radar beacons on board the aircraft, such as ATCRBS (Air Traffic Control Radar Beacon System) and the Mode S beacon system which is replacing it. Beacon responses can include encoded information; for example, Mode C beacons automatically transmit aircraft pressure altitude.

The FAA divides its surveillance mission into terminal and en route segments. Under the FAA Aviation System Capital Investment Plan (CIP), these will be consolidated in ACFs (Area Control Facilities), supported by a real time, interactive Advanced Automation System (AAS), which is scheduled for completion in the late 1990s. Modern terminal surveillance radar carry an ASR (Airport Surveillance Radar) designation, such as the newest ASR-9s. En route radar carry the designation ARSR (Air Route Surveillance System). The ARSR-4 is the newest generation of this equipment.

The FAA Aviation System Capital Investment Plan as currently defined is a coordinated, three element effort to improve the en route radar network. The first element of this program was to extend the life of obsolescent equipment, replace selected portions of 76 vacuum tube radar with solid state devices, repair and refurbish other portions, improve tolerance to power fluctuations, and provide limited remote control.

The second element, conducted in conjunction with the USAF, is to procure 39 new ARSR-4 radar to replace all JSS radar and provide an additional system for field support and training.

The third element is to leapfrog 10 ARSR-3 radar currently at JSS sites to replace older equipment at other locations, provide Remote Maintenance Monitoring (RMM) for all ARSR-3 facilities, and relocate other long range radar (LRR), as required.

In 1968 the FAA LRR network provided continuous surveillance for approximately 60 percent of all IFR traffic in the airspace system. Expansion of the network was approved that year, with the goal of providing surveillance for 90 percent of all IFR traffic and nearly 100 percent of high altitude traffic. By 1973, the FAA had a growing network of 85 LRR serving the 20 ARTCC (Air Route Traffic Control Centers) in the continental USA. In February 1973 the FAA awarded a US$3.5 million contract to Westinghouse Electric Corp for one prototype advanced LRR. The new radar, designated ARSR-3, was to incorporate state-of-the-art technology to increase coverage, improve target detection and reduce clutter. Administratively, the program encountered difficulties. When plans to proceed directly from development to production were thwarted by the Department of Transportation (DOT), the FAA abruptly terminated the contract but subsequently solicited bids on a production system. (See further discussion, below).

An RFP for 10 ARSR-3s, plus 2 MERFs (Mobil En Route Radar Facilities) with associated documentation and options, was issued in May 1974. Four firms, including Texas Instruments, Bendix, and Westinghouse were finalists. Westinghouse appeared the winner in March 1975 with a bid of US$41.7 million. But the contract was delayed while the Government Accounting Office (GAO) ruled on a protest by Bendix. The GAO denied the protest and in July 1975 the FAA awarded Westinghouse a US$30.2 million contract for 16 radar, with an option for 10 more. Initial deliveries were scheduled for 1977. The FAA indicated that it would utilize its own staff to provide training under terms of the contract.

In September 1975, the Westinghouse Electric Command and Controls Division forecast a five-year global market of US$1 billion for fixed air surveillance radar and announced their intention to increase the one-third share of that market claimed by the US based on its FAA ARSR-3 contract. In December 1975 the FAA announced the exercise of an US$11.2 million option for 10 additional ARSR-3s.

1977 passed without deliveries of the ARSR-3; and FAA acquisition practices were severely criticized. With specific respect to the ARSR-3 program, the GAO deputy director for procurement and systems acquisition said that the "FAA, in our opinion, permitted a buy-in by the contractor." According to GAO, the prototype contract was awarded even though the radar technology was not new, and it was obvious that the award could not cover Westinghouse expenses. After Westinghouse reported cost over-runs in excess of 100 percent, the FAA paid an additional US$4.4 million and terminated the contract. Westinghouse later received the award for a production version of the radar, according to GAO, largely as a result of the work done on the prototype.

Delivery of the first ARSR-3s to the FAA Aeronautical Center in Oklahoma City, took place in July 1978. Plans at the time called for 23 fixed installations in the US, plus four mobile units which could temporarily replace damaged fixed based units. Also in 1978, Westinghouse reported the sale of seven ARS-30s to Canada and two to Switzerland.

The first operational ARSR-3 was commissioned at Arlington, IA, in June 1979. The FAA reported delivery of other units to Kenai, AK; Binns Hall; VA, Nashwauk, MN; and Finley, ND; in addition to the training unit delivered to Oklahoma City in 1978. The FAA announced plans to commission one a month over the next two years; the negotiated price for the 23 fixed and four mobile ARSR-3s was US$44 million.

With development of the new Capital Investment Plan (then National Airspace Plan - NAS) in FY82, the FAA began to look beyond the ARSR-3 system and related upgrades. The most urgent order of business was to reduce maintenance costs and improve the reliability of the older vacuum tube radar still in the network. In FY85 a contract to upgrade 64 tube type en route radar was awarded to then United Technologies/Norden Systems. A draft RFP was issued in FY86 for the ARSR-4, a new long range, three-dimensional radar to replace diverse existing JSS sensors (FPS-20/60 series, ARSR-1, and ARSR-2 primary radar; and FPS-6/90/116 height finders) around the coastal US, Hawaii, and Guam, with a common, high performance, unattended radar.

The ARSR-4 is a long-range primary surveillance radar used for combined tracking of aircraft and weather by emitting radio signals that are reflected by all the aircraft and weather conditions present in the area covered by the system. (Please refer to Forecast International's **ARSR-4** report for the design and performance characteristics of this new generation radar).

The FAA is planning to deploy 39 ARSR-4 units in a program jointly funded by the Department of Defense. These radar will be placed along the perimeter of the United States and will assist in en route navigation, air defense, and drug interdiction. One additional radar will be used for field support and training.

Ten of the 39 ARSR-4s will be used to replace ARSR-3s, which will then be moved to the interior of the United States as part of the ARSR-3 Leapfrog Program. Five of these transplanted ARSR-3s will replace older radar systems, such as the ARSR-2, while the other five will be placed at new locations.

Funding

No specific funding can be identified.

Recent Contracts

No recent contracts can be identified.

Timetable

FY68	Expansion of LRR coverage approved
FY73	ARSR-3 prototype contract awarded
FY74	ARSR-3 procurement RFP issued
FY75	ARSR-3 production contract award
FY78	First ARSR-3 delivered
FY79	First operational ARSR-3 commissioned
FY80	Final ARSR-3 delivered
FY85	Tube Type Upgrade contract awarded
1988	Tube Type Upgrade implementation began

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Early	1992	Tube Type Upgrade implementation completed
	1994	ARSR-3 Leapfrog begins
	1996	ARSR-3 Leapfrog to be completed

Worldwide Distribution

The ASR-30 mobile variant of the ARSR-3 has been sold to **Canada** (7) and **Switzerland** (2).

Forecast Rationale

The ARSR-3 is no longer in production and the enhancements, modifications, and upgrades currently in progress to support the FAA leapfrog program are scheduled for completion in 1996.

Technologically, the future of the ARSR-3 is limited. The system is incompatible with the new generation of digital systems which are emerging and being integrated to form the sophisticated, highly automated systems to track and control air traffic in the 21st

century. Our forecast for the ARSR-3 program is for a limited period of maintenance and logistics activity only. We further anticipate that the rate of decrease in this activity is likely to be accelerated as the result of the spare parts pool formed as ARSR-3 units are decommissioned due to incompatibility with the new, fully digital, integrated ATC systems.

This forecast includes only maintenance funding and the remaining estimated cost associated with the leapfrog program.

Unless a significant change in program direction is experienced, the ARSR-3 report will be eliminated from future Forecast International publications.

Ten-Year Outlook

FORECAST FUNDING LEVELS
(FY94 US $ Millions)

				High Confidence Level			Good Confidence Level			Speculative			
Designation	Application	thru 94	95	96	97	98	99	00	01	02	03	04	Total 95-04
ARSR-3 LRR	SURVEILLANCE RADAR (FAA)	54.00	1.00	0.50	0.50	0.50	0.30	0.20	0.20	0.20	0.20	0.20	3.80