**Surveillance Functional Projects**

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| S01 | Airport Surface Detection Equipment (ASDE) Radar and Airport Movement Area Safety System (AMASS) | 24-14, 62-23 | Surveillance-3 |
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| S09 | Runway Incursion Reduction Program (RIRP) | New (includes A12) | Surveillance-9 |
| S10 | Automatic Dependent Surveillance Broadcast (ADS-B)<br>• Ohio Valley initiative/Safe Flight 21 | New<br>New | Surveillance-11 |

## S01–Airport Surface Detection Equipment (ASDE) Radar and Airport Movement Area Safety System (AMASS)

**Program Description:** Airport traffic control tower (ATCT) controllers cannot see aircraft or other vehicles on the airport surface during low-visibility conditions such as fog, rain, and snow. Additionally, controllers do not have an automated system to alert them when an aircraft or vehicle "blunders" onto an active runway or taxiway (i.e., a runway incursion). Consequently, to ensure safety, surface traffic movement efficiency is reduced under these conditions.

This program consists of two projects: airport surface detection equipment radar (ASDE-3) and airport movement and safety system (AMASS).

***ASDE-3.*** This project acquires and installs the ASDE-3 radar system at 34 high-activity airports. ASDE-3 detects and displays aircraft and vehicle movement on the airport surface, allowing controllers to effectively manage airport surface operations during low-visibility conditions, such as rain, fog, and night operations. The ASDE antenna may be located atop the ATCT or remotely on its own tower. Installation on existing ATCT's may require structural modifications.

***AMASS.*** This is an ASDE-3 enhancement that provides controllers with visual and aural alerts of potential runway incursions and surface movement conflicts. The system uses the ASDE-3 radar as the display/entry device, requiring no additional displays or entry devices in the tower. Controller entries are required for each change in runway configuration or operating condition. This will require defining the human/machine interfaces and air traffic control procedures.

**Products:**

- 40 ASDE-3 systems
- 40 AMASS units.

**Accomplishments (1/97–9/98):**

- Commissioned ASDE-3 systems at Memphis, Tenn.; Dallas-Fort Worth, Tex.; and Chantilly, Va.
- Delivered ASDE-3 systems to Chantilly, Va.; Ronald Reagan Washington National; St. Louis, Mo.; Andrews AFB, Md., Salt Lake City, Utah; Newark, N.J.; and Louisville, Ky.
- Installed new slipring assemblies at 30 sites
- Updated bearing cartridge specifications
- Repaired four bearing cartridges
- Accepted ASDE-3 Mosaic System at Houston
- Delivered full-scale development AMASS units to Detroit and St. Louis Airports
- Awarded contract and option for production of 36 AMASS systems
- Delivered Dimension International Terminal Automation Interface Units to Detroit, Mich.; St. Louis, Mo.; Atlanta, Ga.; and San Francisco, Calif.

**Sponsor Organization:**

- ARS-1, Air Traffic System Requirements Service.

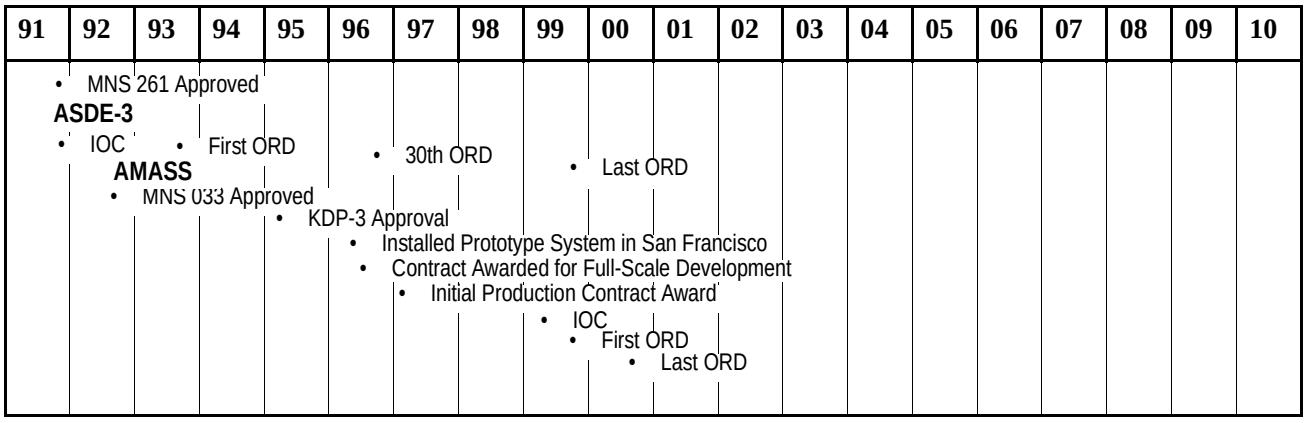
**Performing Organization:**

- AND-410, Surface Products Team, IPT for Surveillance/Weather.

**Contractors:**

- Northrop Grumman Norden Systems
  Norwalk, Conn.
- Dimensions International
  Alexandria, Va.

**Schedule: S01 - ASDE and AMASS**



**S02–Secondary Surveillance**

**Program Description:** Air traffic control radar surveillance of aircraft by ground-based equipment will be required well into the next century. The secondary surveillance radars (SSR) enhance controller capabilities by providing aircraft position, altitude, and identification information. The older SSR's (Air Traffic Control Beacon Interrogator (ATCBI)) are beyond their engineered lifespans, requiring the manufacture of selected parts to remain operational. The ATCBI-4 systems (1971 transistor technology) and the ATCBI-5 systems (1976 integrated circuit technology), at the end of their 20-year cycle, will be replaced by the ATCBI-6 radar.

***Mode S.*** Mode S improves the surveillance capability of the air traffic control secondary surveillance system. This is done by providing more accurate positional information and minimizing interference, through discrete interrogation of each Mode S transponder-equipped aircraft and improved processing of aircraft replies. Mode S also provides the medium for a digital data link used to exchange information between aircraft and various air traffic control functions and weather data bases.

144 Mode S systems have been installed at terminal and en route radar sites. Another four have been allocated to support and research facilities. These systems will provide coverage down to the ground at 108 major airports and down to 12,500 feet above mean sea level (MSL) in en route areas.

Mode S has remote maintenance monitor capabilities, reducing periodic maintenance workload. Less capable radar beacon system antennas have been replaced and additional antennas procured where increased data rates are required.

***ATCBI Relocation.*** Under the ATCBI relocation project, 123 ATCBI-4/5 systems are being relocated to replace ATCBI-3 and support new facilities until the ATCBI-6 radar and the ASR-11 radar can be installed. The ATCBI-3 equipment will be removed for disposal.

***ATCBI Replacement.*** The ATCBI-6 project will acquire 124 radars, replacing ATCBI-4/-5 systems. Three more systems will be procured for ATCBI-6 system support. The ATCBI-6 can selectively interrogate aircraft equipped with Mode S transponders. Data link capability (traffic information service (TIS) and obtaining the contents of GICB registers) can be added as an ATCBI-6 upgrade. The ATCBI-6 project will also provide selected en route sites with open array antennas and rotary joints.

**Products:**

- 127 ATCBI-6 SSR radars
- 148 Mode S systems
- Relocation of 123 ATCBI-4/5 systems
- 56 Mode S back-to-back monopulse antennas for en route surveillance sites
- 13 equipment shelters.

**Accomplishments (1/97–9/98):**

- Installed six Mode S systems
- Commissioned 35 Mode S systems
- Removed 32 ATCBI-4/5's
- Installed 27 ATCBI-4/5's
- Decommissioned 28 ATCBI-3's
- Installed Mode S en route software at 10 sites
- Completed ATCBI investment analysis and achieved JRC investment decision
- Completed ATCBI-6 operational capabilities test on competitive systems
- Awarded ATCBI-6 contract.

**Sponsor Organizations:**

- AAT-1, Air Traffic Service
- AAF-1, Airway Facilities Service.

**Performing Organization:**

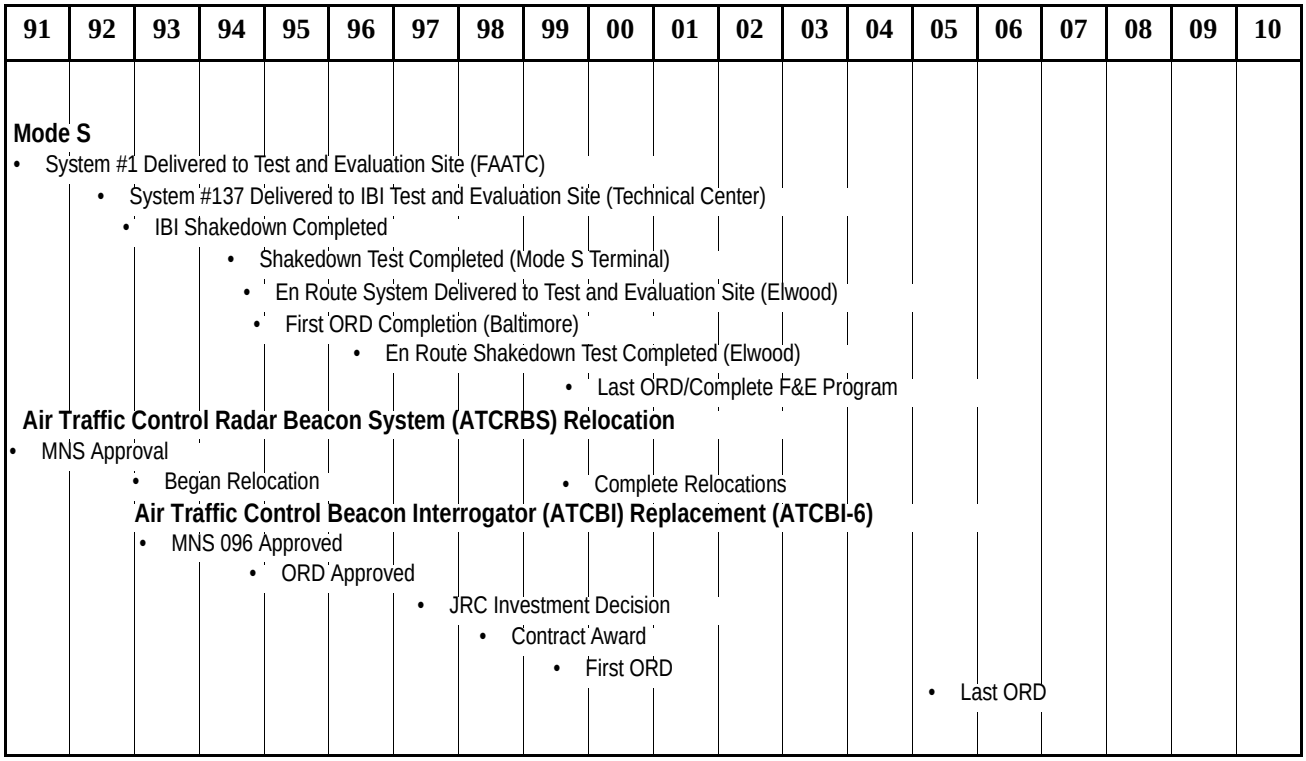
- AND-450, Secondary Surveillance Product Team, IPT for Surveillance/Weather.

**Contractors:**

- Northrop Grumman Corporation
  Linthicum, Md.
- Lockheed Martin Air Traffic Management
  Paoli, Pa.
  - Wilcox Electronics
    Kansas City, Mo.
- Raytheon Service Company
  Rosemont, Ill.
- Radiation Systems Incorporated
  Sterling, Va.
  - Kevlin Microwave Corporation
    Wilmington, Mass.

– Raytheon Systems Company
Marlboro, Mass

**Schedule: S02 - Secondary Surveillance**




**S03–Terminal Radar (ASR) Program**

**Program Description:** The FAA needs radar surveillance systems in the terminal area to provide separation services. The older terminal radar systems do not meet air traffic requirements for coverage and capacity. Also, they are logistically unsupportable and are incompatible with the new terminal automation system, which requires digital surveillance inputs.

***ASR-9.*** This project replaced airport surveillance radar (ASR)-4/-5/-6 with ASR-7/-8/-9, established new ASR-9 sites, and provided DOD terminal radar systems.

***ASR-11.*** After completing the ASR-9 project, many terminal areas still have aging analog ASR-7/-8 radars and inadequate weather detection capabilities. The ASR-7/-8 radars also will not provide digitized radar data suitable for use with the standard terminal automated radar system (STARS) equipment.

The ASR-11 Terminal Radar Program will replace ASR-7's and ASR-8's. The ASR-11 is a nondevelopmental digital terminal radar system with an integrated monopulse secondary surveillance radar system. It will be acquired through a joint acquisition with DOD. The system will provide digitized radar data and weather data. The program will also provide, on an as-needed basis, interim digitizers to ASR-8 sites, which will receive STARS in advance of the ASR-11.

***Sustain/Relocate ASR.*** This ongoing project relocates and refurbishes existing terminal radars. Relocation is necessary wherever new construction interferes with required radar coverage or because of changes in air traffic volume. Regions provide candidates for relocation, and FAA Headquarters validates the priorities and funds the relocations through the annual budget process.

**Products:**

- 134 ASR-9 radars, replacement and new establishments
  - 41 ASR-4/-5/-6 locations
  - 55 ASR-7/-8 locations
  - 28 new establishments
  - 10 DOD systems
- Replacement of ASR-4/-5/-6 vacuum-tube radars with ASR-7/-8

  - Leapfrog eight ASR-7's to ASR-4/-5/-6 sites
  - Leapfrog 38ASR-8's to ASR-4/-5/-6 sites
  - Leapfrog two ASR-8's to ASR-7 sites
  - Establish three new ASR-8 sites
- Relocation of ASR's and raising of antennas where required
- 112 ASR-11 digital integrated primary and secondary radars
- Interim digitizers for ASR-7/-8 sites.

**Accomplishments (1/97–9/98):**

- Obtained JRC decision to replace all ASR-7 and ASR-8 radars with ASR-11 radars for a total of 112 systems
- Completed site selection for installation of the initial ASR-11 radar
- Delivered ASR-9 radars to Newark, N.J; Washington, D.C.; Martinsburg, W.Va.; Islip, N.Y.; White Plains, N.Y.; transportable to Phoenix, Ariz.; and relocate to Miami #2
- Commissioned ASR-9 radars at Columbia, Mo.; Roswell, N.M.; Fayetteville, N.C., Newark, N.J.; Phoenix, Ariz.; and Ronal Reagan Washington National
- Commissioned ASR-8 radars at Colorado Springs, Colo.; Duluth, Minn.; and Myrtle Beach, N.C.
- Replaced ASR-4/-5/-6 radars with ASR-7/-8/-9 radars at Fayetteville, N.C.; Sioux Falls, S.D.; Colorado Springs, Colo.; Myrtle Beach, S.C.; and Palm Springs, Calif.
- Delivered ASR-8 antenna to the FAA Technical Center for ASR-8 Interim Digitizer Testing
- Awarded contract modification for transportable ASR-9 radar
- Completed final design review of full-scale development 9-Processor Augmentation Card (PAC)
- Awarded contract for production of 9-PAC
- Commenced testing of 9-PAC full-scale development boards.

**Sponsor Organizations:**

- AAT-1, Air Traffic Service
- AAF-1, Airway Facilities Service.

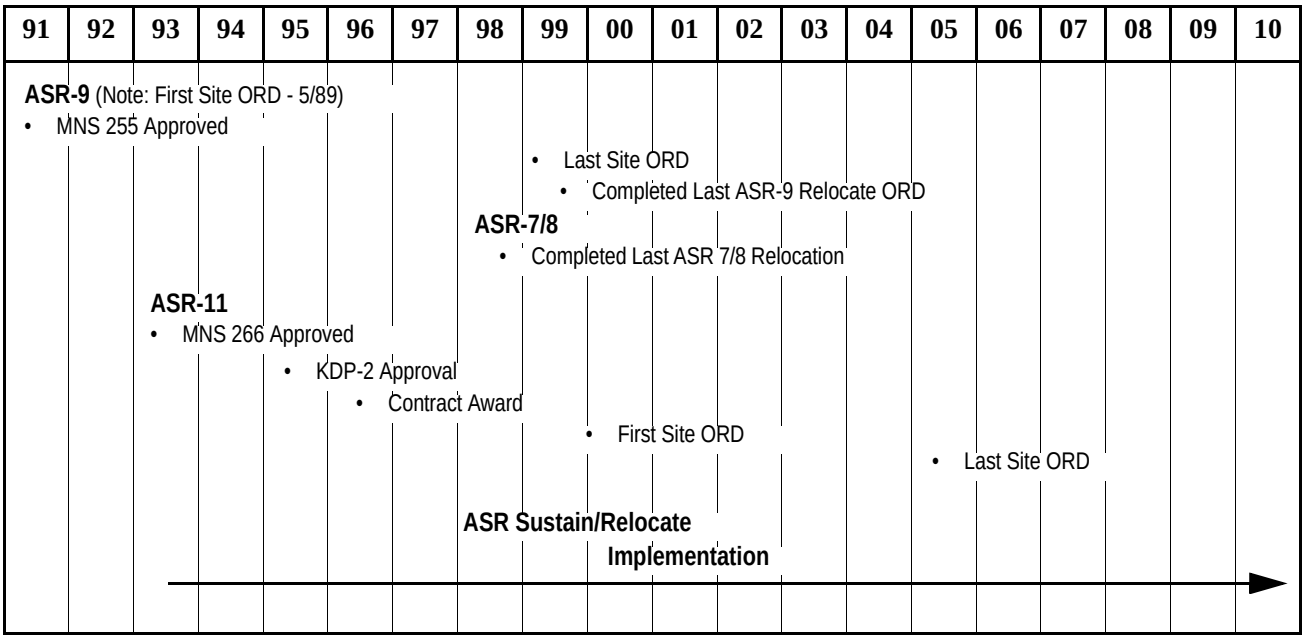
**Performing Organizations:**

- AND-410, Terminal Surveillance Product Team, IPT for Surveillance
- AND-440, En Route Surveillance Product Team, IPT for Surveillance.

**Contractors:**

- Northrop Grumman Corporation
  Linthicum, Md.
- Raytheon Electronic Systems
  Marlborough, Mass.

**Schedule: S03 - Terminal Radar (ASR) Program**



**S04–Long-Range Radar Program**

**Program Description:** The FAA is replacing the majority of joint-use surveillance system radars with Air Route Surveillance Radar, Model 4's (ARSR-4).

The FAA is also preparing to deactivate its inventory of long-range radars (these are not joint-use radars) once NEXRAD weather products are made available to the air traffic controllers (mid-CY 2000). Current FAA thinking is that the need for primary en route radars is drawing to an end. The majority of these existing radars have exceeded their planned life-cycle by as much as 25 years.

As the FAA shares the radar data with several other entities, plans will need to be developed on how, or if, to transfer maintenance and financial responsibility.

These aging systems are also experiencing lower reliability rates and increased maintenance requirements. Therefore, availability rates are decreasing, which has a direct impact on air traffic control operations and the flying public.

The sustainment activity is directed primarily at the infrastructure upgrades necessary to sustain the facility. The program is intended to improve the national radar surveillance network. The program has two major projects: air route surveillance radar (ARSR-4) and long-range radar sustainment, until deactivation can begin, and then the deactivation itself.

***ARSR-4.*** ARSR-4 is a multiyear project funded jointly by the FAA and Air Force, per a 1994 interagency agreement. The agreement provides solid-state ARSR-4 radars as replacements for older joint-use surveillance system radars at 43 operational facilities around the U.S. perimeter, Hawaii, Guam, and Guantanamo Bay. One additional radar will be used for training at the FAA Academy.

The all solid-state ARSR-4 is a 3-dimensional radar with enhanced azimuth and range resolution and extended range to 250 nautical miles. The ARSR-4 has full remote maintenance monitoring capability and greatly increased reliability, which decrease maintenance workload and logistics costs.

***Long-Range Radar Sustainment/Deactivation.*** The FAA has decided not to continue en route primary radar surveillance. A transition to a beacon-only surveillance system will be developed and implemented. The transition will address disposal of the primary radars, physical plant changes, and equipment modifications for use with Mode S or other beacon surveillance radars, such as the air traffic control beacon interrogator.

Action taken as a result of Title VI of the Omnibus Budget Reconciliation Act of 1993 required that 235 megahertz (MHz) of Federal Government radio frequency spectrum be transferred to the private sector. The reallocation of the 1385–1400 MHz band in January 1999 will impact long-range radar, including the new ARSR-4. Wave guide filters for FAA long-range radars must be added and the ARSR-4 reengineered to operate in the reduced spectrum.

**Products:**

- Acquisition of 44 ARSR-4 radars, including one for field support/training
- Sustain en route radars until deactivation occurs
- Deactivate primary en route radars after NEXRAD availability
- Radar relocations as required.

**Accomplishments (1/97–9/98):**

- Installed and accepted 11 ARSR-4 systems (43 total to date)
- Commissioned 25 ARSR-4 systems (for a total of 37).

**Sponsor Organization:**

- ATS-1, Air Traffic Services.

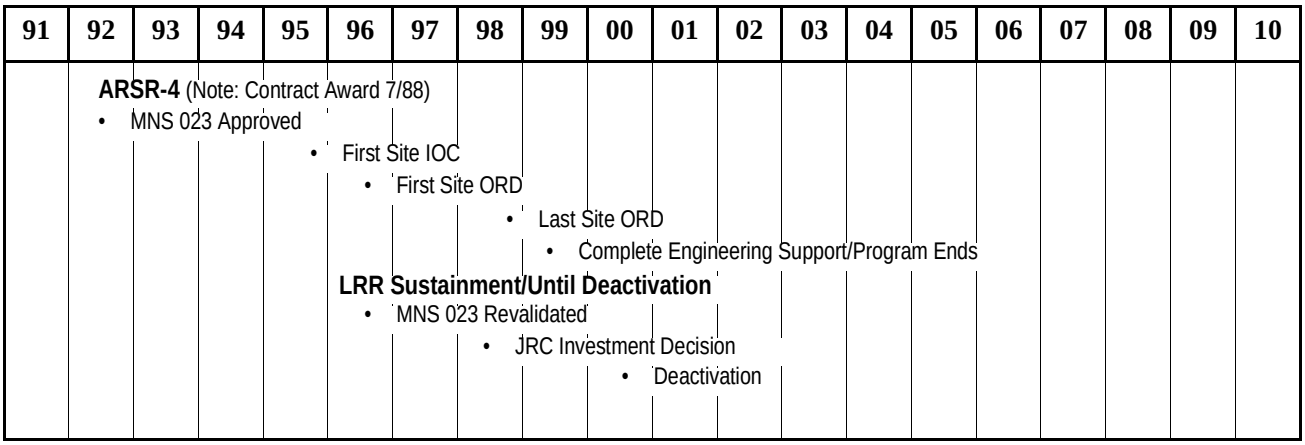
**Performing Organization:**

- AND-440, En Route Products Team, IPT for Surveillance.

**Contractors:**

- Northrop Grumman Corporation
  Baltimore, Md.

**Schedule: S04 - Long-Range Radar Program**




**S05–Long-Range Radar (LRR) Radome Replacement**

**Program Description:** Most long-range radar radomes are 25 to 30 years old and have exceeded their expected service life. Also, the current radomes are incompatible with the Mode S monopulse antenna system, because they are too small for the Mode S antenna. Additionally, the metal frames in the existing radomes block or skew the Mode S signal.

This program procures and installs replacement radomes that are compatible with the Mode S antenna system and are more weather resistant, resulting in reduced maintenance costs.

**Products:**

- 96 radomes
- Radar tower modifications as necessary.

**Accomplishments (1/97–9/98):**

- Program completed
- Installed 35 radomes (for a total of 96).

**Sponsor Organization:**

- AAF-1, Airway Facilities Service

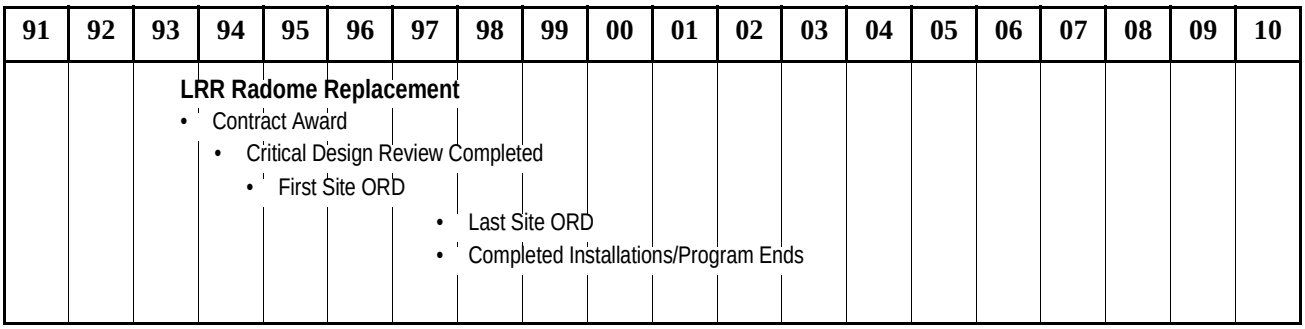
**Performing Organization:**

- AND-440, En Route Products Team, IPT for Surveillance

**Contractors:**

- Electronic Space Systems Corporation (ESSCO) Concord, Mass.

**Schedule: S05 - Long-Range Radar Radome Replacement**




**S08–Precision Runway Monitor (PRM)**

**Program Description:** During instrument meteorological conditions (IMC), airports with parallel runways spaced less than 4,300 feet apart cannot conduct independent simultaneous operations due to existing equipment limitations. This results in decreased capacity during inclement weather. Congress mandated that FAA procure and install five precision runway monitor systems (PRM) to address this issue at qualifying airports.

This project resulted in the development of a high-update-rate radar and computer predictive displays that enable controllers to monitor simultaneous independent operations during IFR/IMC to dual and triple parallel runways spaced less than 4,300 feet apart.

The PRM electronically scanned antenna system provides a faster update rate than conventional radars because it uses a computer-controlled electronic scanning sensor beam. The required update rate requirement for parallel runways spaced 3,400 feet apart is 2.4 seconds or less. The five production systems procured under a sole-source contract include a 1.0 second update rate with a capacity of 35 aircraft tracks.

The FAA has awarded a sole-source contract for five limited production electronically scanned units. These systems have a 1.0 second update rate with capacity of 35 aircraft tracks, which will enable airports to maintain capacity, avoid or reduce delays, and save fuel during reduced visibility. The FAA has determined that Minneapolis-St. Paul, St. Louis, JFK, Philadelphia, and Atlanta airports qualify for a PRM system. Installations at Philadelphia and Atlanta airports are contingent on each completing a new runway.

Development and simulation of air traffic control procedures for independent approaches to dual parallel runways spaced 3,000 feet apart have been completed. Results of the real-time simulations showed that PRM will support and benefit these approaches if one of the approaches contains a localizer offset of at least 2.5 degrees.

Future alternatives to the E-Scan PRM system may include automatic dependent surveillance broadcast (ADS-B) or multilateration systems or a combination of both. Analysis and simulations of these alternatives will be performed in their respective projects. No further analysis will be performed under this project.

**Products:**

- Five electronically scanned PRM systems and associated site and depot spares
- Air traffic procedures for conducting independent instrument operations at airports with parallel runways spaced less than 4,300 feet.

**Accomplishments (1/97–9/98):**

- Commissioned Minneapolis-St. Paul PRM.
- Began installation at St. Louis and JFK International Airport.

**Sponsor Organization:**

- AAT-1, Air Traffic Service.

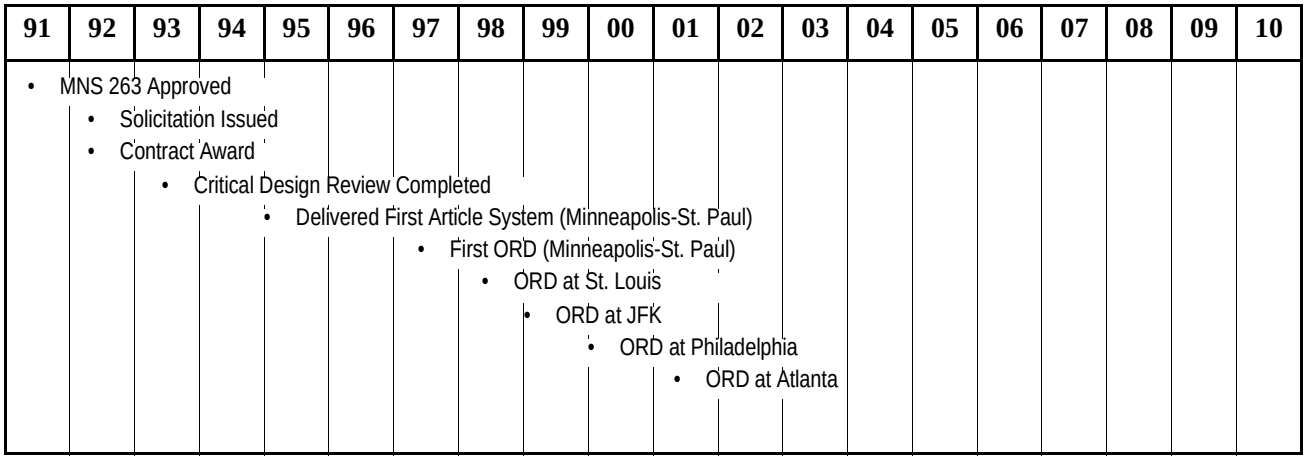
**Performing Organization:**

- AND-450, Secondary Surveillance Product Team, IPT for Surveillance.

**Contractors:**

- Raytheon Systems
  Marlboro, Mass.
- Lincoln Laboratories
  Bedford, Mass.

**Schedule: S08 - Precision Runway Monitor (PRM)**




**S09–Runway Incursion Reduction Program (RIRP)**

**Program Description:** Per FAA and the National Transportation Safety Board, runway incursions are a problem requiring priority attention. The FAA needs to develop technological and procedural solutions to reduce incidents and accidents caused by runway incursions and to provide methods of detecting and preventing potential incursions.

This project will reduce the number of incidents and accidents attributable to runway incursions by pro-

viding surface coverage, conflict alerting, and positive identification of aircraft and vehicles on the airport surface. It will improve general situational awareness by providing surface traffic information to air traffic controllers, pilots, vehicle operators, and emergency units.

The project proposes both technological and procedural solutions for the runway incursion problem. Potential technological solutions include low-cost airport surface detection equipment (ASDE) with conflict alert, automatic dependent surveillance/multilateration, data fusion, and loop detection. These modular developed solutions are scalable to any airport. Non-technological solutions include runway incursion action team meetings, education and training programs, and procedure changes.

Technological proposals will be demonstrated/evaluated in FY 1999 at Dallas-Ft. Worth (DFW) International Airport. Test results will be integrated into NASA's Low Visibility Landing and Surface Operations program for a joint DEM/VAL in FY 2000.

The project will develop technical and operational specifications, then proceed through developmental testing into full-scale development. The low-cost ASDE project will likely be the first technological solution to begin full-scale development (FY 2000). Other technological solutions will enter testing and full-scale development in FY 2001. Non-technological solutions are currently being implemented and will continue throughout the project's life cycle.

**Products:**

- One full-scale development low-cost ASDE
- One prototype automatic dependent surveillance broadcast (ADS-B)/multilateration system
- One prototype data fusion server
- Education and Training materials
- Procedure changes.

**Accomplishments (1/97–9/98):**

- Conducted joint FAA/NASA surface operations demonstration in Atlanta
- Installed and evaluated Phase I of Loop Detection system at Long Beach
- Completed installation of Phase II of Loop Detection system at Long Beach
- Awarded airport surface target identification system (ATIDS) contract
- Conducted runway incursion action team meetings
- Installed vehicle ADS-B system at DFW.

**Sponsor Organization:**

- ATO-102, Runway Incursion Program Office.

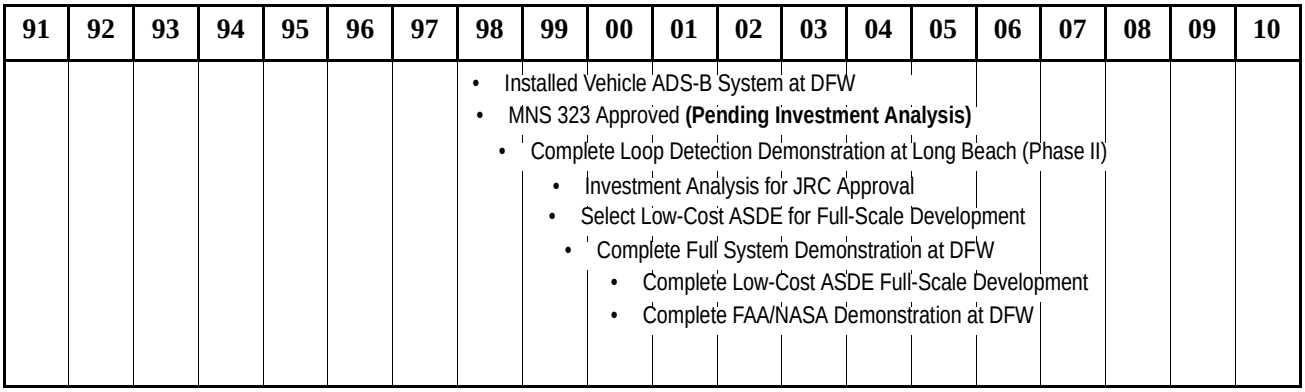
**Performing Organization:**

- AND-410, Surface Products Team, IPT for Surveillance.

**Contractors:**

- Sensis Corporation
  Rochester, N.Y.
- Orincon, Inc.
  San Diego, Calif.
- Raytheon Corporation
  Marlborough, Mass.
- Dassault Electronique
  St. Cloud, France
- Volpe National Transportation Systems Center
  Cambridge, Mass.

**Schedule: S09 - Runway Incursion Reduction Program (RIRP)**



## S10–Automatic Dependent Surveillance Broadcast (ADS-B)

ADS-B is a technique for reporting aircraft position information from an onboard global navigation satellite system (GNSS) receiver or other backup source of navigation data. Aircraft identity, altitude, velocity, and position are broadcast directly to ground receivers and to nearby aircraft. Transmitted ADS-B messages received by nearby aircraft are processed, displayed on an airborne cockpit display of traffic information (CDTI), and used for situational awareness, conflict detection, and Free Flight capabilities.

Accurate and timely reports from ADS-B minimize runway incursions and improve safety by increasing pilot situational awareness of nearby aircraft and improve efficiency and airspace capacity by potentially reducing current separation standards.

ADS-B's modular design and cooperative nature offer a low-cost alternative for surveillance coverage in existing nonradar areas and potentially, in the long term, in some areas currently served by radars. ADS-B has been identified by both the FAA and the aviation industry as an enabling technology for Free Flight.

This project will develop standards for ADS-B avionics, CDTI, and transponders. Future efforts will include procurement specifications for ground systems, deployment of system prototypes, and revised operational procedures.

***Ohio Valley Initiative/Safe Flight 21.*** The Safe Flight 21 program is a government and industry cooperative effort to develop and demonstrate a set of enhanced Free-Flight capabilities derived from evolving communications, navigation, and surveillance (CNS) technologies. The program will replace the earlier Flight 2000 program and is the result of user recommendations to focus on specific needed operational capabilities. These capabilities will allow real-time information sharing between pilot and controller. Key new technologies for the program include GPS, ADS-B, and digital data link systems, which will be integrated into enhanced pilot and controller information displays.

Safe Flight 21 is the test ground for many of the expected Free Flight enhancements. This effort is closely coordinated with complementary activities being planned by the Cargo Airlines Association (CAA) for the Ohio Valley and the Alaska Capstone Initiatives (M36). Safe Flight 21 will complement Free Flight Phase 1 activities. The Ohio Valley project will test three candidate avionics/data link technologies for air-air surveillance. They are the universal access transceiver (UAT), the self-organizing time division multiple access (STDMA) radio (also known as VHF data link-Mode-4, or VDL-4), and the Mode-S (1090 MHz) squitter.

The Ohio Valley project will help test avionics, which periodically broadcasts the aircraft position (i.e., ADS-B), derived from the Wide Area Augmentation System (WAAS). These tests will occur in the terminal areas, which support cargo aircraft operations at Memphis, Wilmington, Louisville, Scott AFB, and Nashville. ADS-B-equipped aircraft will be able to receive the broadcast and display the position of other ADS-B-equipped aircraft CDTI.

The Ohio Valley project will also use GPS Local Area Augmentation (LAAS) avionics and the CDTI display with a moving map feature to help pilots taxi on the airport surface during reduced visibility conditions. GPS LAAS avionics will provide the precise navigation position required for arrival and surface operations. Vehicles that operate on the airport movement area will also be equipped with comparable equipment.

**Products:**

***ADS-B***

- ADS-B avionics standards in conjunction with RTCA (i.e., minimum aviation system performance standards and minimum operational performance standards (MOPS))
- ICAO standards and recommended practices (SARP's)
- Draft cockpit and ATC operational procedures
- Deployment and evaluation of system prototypes
- Technical specification for ground systems.

***Ohio Valley Initiative/Safe Flight 2*1**

- Provision of weather and other information to controllers
- Affordable means of reducing controlled flight into terrain
- Improved capacity for approaches in low-visibility conditions
- Greater situational awareness
- Increased self-separation capability
- Improved ability for pilots to navigate airport taxiways

- Enhanced surface traffic management capability for controllers
- Surveillance coverage of airspace not covered by radar
- Reduced separation standards.

**Accomplishments (1998)**

Not applicable because ADS-B is a new start in FY 1999.

**Program Coordinator (ADS-B):**

ASD-1, System Architecture and Investment Analysis

**Sponsor organizations:**

- ATO-400, Operations Planning Division
- AFS-400, Technical Programs Division.

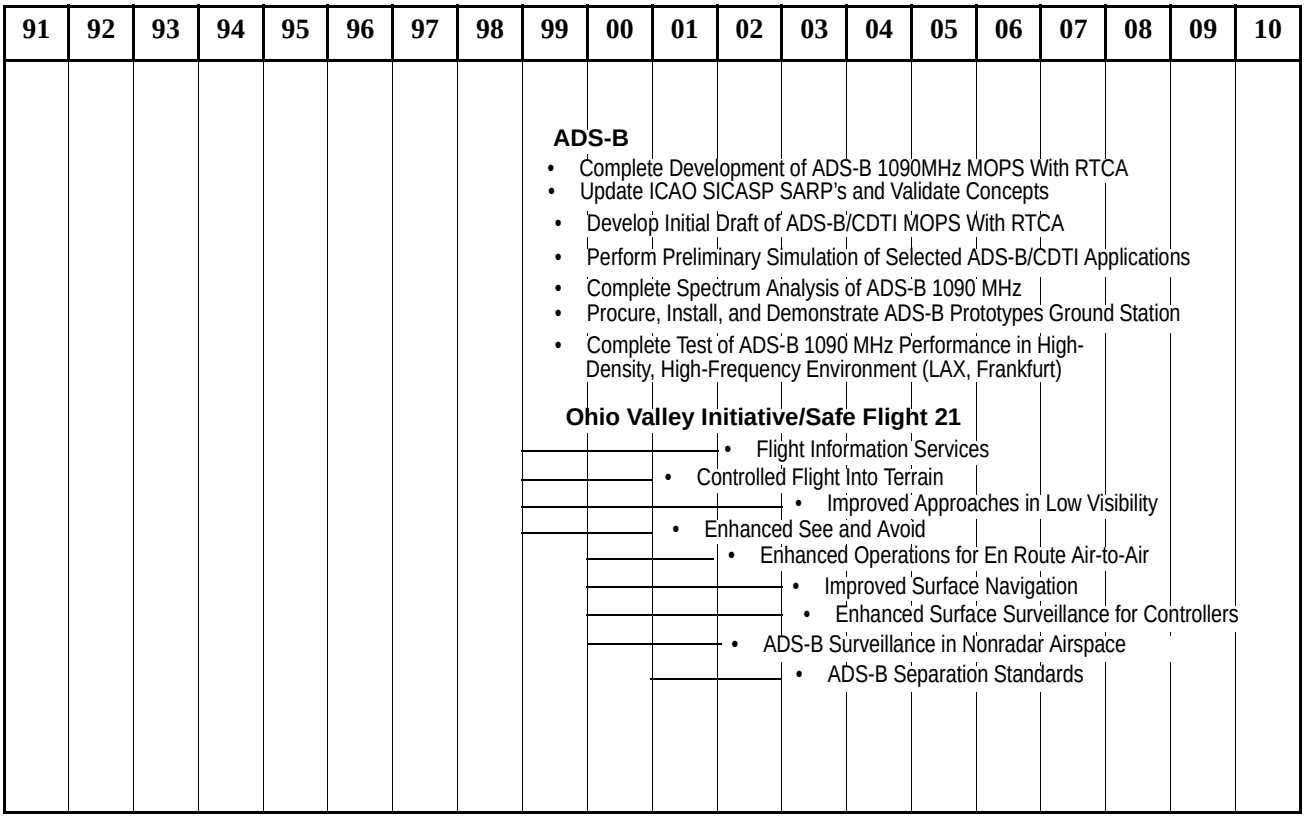
**Performing Organization:**

- AND-470, Safe Flight 21 Product Team.

**Contractors**

- Lincoln Laboratory
  Lexington, Mass.
- MITRE CAASD
  McLean, Va.
- Volpe
  Cambridge, Mass.

**Schedule: S10 - Automatic Dependent Surveillance Broadcast**




**New Surveillance Mission Needs (2001–2004)**

Surveillance plans to be funded over the next 5 years include:

- Decommissioning legacy surveillance systems (e.g., ARSR-1/-2/-3)
- Upgrading or extending the service life of more recent surveillance systems (e.g., ASR-9, ASR-11, ASDE-3, and ATCBI-6)
- Adding the ASTERIX surveillance format capability to ASR-11.

Actual requirements will be addressed through the Acquisition Management System.