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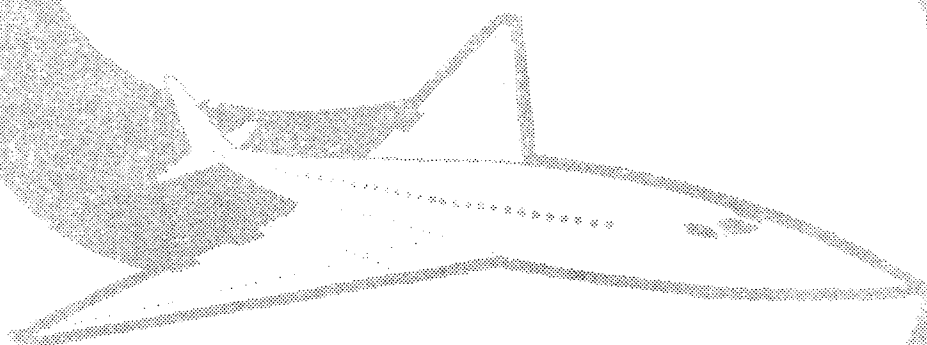


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Limited Production Precision Runway Monitor (PRM) Master Test Plan

Thomas Bratton

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16. Abstract This Master Test Plan (MTP) establishes the basic framework to guide and direct the Limited Production (LP) Precision Runway Monitor (PRM) test program. This MTP explains the relationship between all test phases. It concerns the LP PRM system's readiness to be integrated into the National Airspace System (NAS). Sufficient detail is provided to define and direct the development of the next lower level of documentation. The MTP addresses the responsibilities of the LP PRM contractor and the Federal Aviation Administration (FAA).					
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EXECUTIVE SUMMARY

This Master Test Plan (MTP) establishes the basic framework to guide and direct the test program for the limited production Precision Runway Monitor (PRM) procurement.

It addresses the responsibilities of the PRM contractors and the Federal Aviation Administration (FAA). The contractors testing responsibilities are addressed through the Development Test and Evaluation (DT&E) and Production Acceptance Test and Evaluation (PAT&E) test effort.

The FAA testing responsibilities are addressed through the Operational Test and Evaluation (OT&E) Integration, OT&E Operational testing, and OT&E Shakedown test effort.

The MTP provides sufficient detail to show the rationale for the kind, amount, and schedules of the testing planned. It relates the T&E effort to technical risks; operational issues and concepts; systems performance; reliability, availability, maintainability and logistic requirements; and major decision points. Sufficient detail is provided to define and direct the development of the next lower level of test planning documentation.

The MTP explains the relationship of all test phases and addresses all the PRM T&E efforts to be accomplished prior to the Operational Readiness Demonstration (ORD).

The contractor DT&E on-site acceptance testing and FAA OT&E Integration and OT&E Operational testing of the PRM system will be accomplished at the first FAA field site.

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1. PURPOSE.

The purpose of this Master Test Plan (MTP) is to establish a Test and Evaluation (T&E) program for the limited production (LP) Precision Runway Monitor (PRM) systems. The MTP defines a T&E framework to guide and direct the PRM test program. The MTP relates test objectives to required system characteristics. It identifies responsibilities, necessary resources, and schedules for the T&E effort.

The MTP establishes confidence in the PRM system's readiness to proceed into the next test phase by addressing the responsibilities of the PRM contractors and the Federal Aviation Administration (FAA). The contractors testing responsibilities are addressed through the Development Test and Evaluation (DT&E) and Production Acceptance Test and Evaluation (PAT&E) test effort. The FAA testing responsibilities are addressed through the Operational Test and Evaluation (OT&E) Integration, Operational, and Shakedown test effort.

The MTP will ensure that all PRM system requirements are verified prior to becoming part of the National Airspace System (NAS).

The PRM system is a major subsystem acquisition (MSA) of the NAS. Currently, there are no NAS requirements defined in the NAS-SS-1000 documents. This MTP document is prepared in accordance with FAA-STD-024A and adheres to the T&E program established in FAA Order 1810.4B. All test terms and definitions are per NAS-MD-110.

2. REFERENCE DOCUMENTS.

FAA-STD-024A	Preparation of Test and Evaluation Documentation
NAS-MD-110	Test Terms and Definitions for the National Airspace Systems
FAA Order 1810.4B	FAA NAS Test and Evaluation Policy
FAA Order 1010.51A	US National Standard for the Mark X (SIF) Air Traffic Control Radar Beacon System (ATCRBS) Characteristics
FAA Order 1800.58A	National Airspace Integrated Logistics Support Policy Air Traffic Operational Requirements for a PRM System
FAA-E-XXXX	LP PRM Specification

3. DESCRIPTION.

3.1 MISSION.

The FAA has initiated a program to improve airport capacity. The implementation of the PRM system will achieve significant capacity gains where closely spaced parallel runways exist. It will provide air traffic control (ATC) with arrival and departure rates that more closely approximate those in visual conditions during instrument weather conditions. There will be five LP electronically scanned (E-Scan) PRM systems developed for commissioning into the NAS. One system will replace the Upgrade system at Raleigh-Durham (RDU) airport. The remaining systems will be located at Memphis, TN; Minneapolis, MN; Baltimore, MD; and Atlanta, GA.

3.2 SYSTEM.

The PRM systems consist of an improved monopulse antenna system that provides higher azimuth and range accuracy and higher data rates than the current terminal Airport Surveillance Radar (ASR) radars. The E-Scan PRM utilizes a stationary cylindrical array antenna that allows for dynamic beam steering. The E-Scan PRM provides a target update rate of 1.0 seconds. The PRM systems have a range coverage of up to 32 nautical miles (nmi) and an azimuth coverage of 360°. The PRM monitors all approaches in its coverage area and generates controller alerts, on its high resolution displays, when an aircraft is deviating (blundering) from its assigned runway path.

3.2.1 Key Functions.

The key functions of the PRM systems are the following:

- a. Provides actual position of aircraft simultaneously approaching parallel runways.
- b. Provides predicted position of aircraft simultaneously approaching parallel runways.
- c. Provides controller alerts for aircraft blundering towards and into the no-transgression zone (NTZ).
- d. Provides improvements to aircraft missed approach monitoring and control.

3.2.2 Interfaces.

The PRM systems will have the capability to interface to the following systems:

- a. Passive ARTS-IIIA

3.2.3 Unique Characteristics.

The unique characteristics of these systems which make an improvement over the existing ASR radar systems are the following:

- a. High resolution digital color-displays
- b. Highly accurate aircraft position, including coverage over the terminal runway areas.
- c. Track history
- d. Track projection
- e. Higher update rates
- f. Blunder alarms
- g. Parallel approach operations for closely spaced runways.

3.3 REQUIRED OPERATIONAL CHARACTERISTICS.

The major operational characteristics to be provided by the PRM systems include but not limited to the following:

- a. 25 tracked targets for dual operations
- b. 35 tracked targets for triple parallel operations
- c. Improved target position accuracy and increased airport capacity gains where parallel runways exist without adversely affecting operations.
- d. Capability to operate with required ATC systems such as ARTS-IIIA.
- e. Generate blunder alarms when operating within the NAS system.
- f. System capacity in the search mode shall be 64 target reports distributed within the 360° coverage.

A complete listing of Air Traffic (AT) operational requirements for PRM systems are presented in the Test Verification Requirements Traceability Matrix (TVRTM) in appendix A.

3.4 REQUIRED TECHNICAL CHARACTERISTICS.

The major technical characteristics to be provided by the PRM systems include but are not limited to the following:

- a. Acceptance of input replies as specified in FAA Order 1010.51A
- b. Communication - interrogation 1030 megahertz (MHz)/ receive 1090 MHz
- c. Range coverage up to 32 nmi from runway end
- d. Azimuth coverage 360°
- e. 1.0 seconds target display update rate
- f. Capability to interface with required NAS subsystems

3.5 CRITICAL T&E ISSUES.

The PRM critical T&E issues are those aspects of the system's capability, either technical or operational, that must be examined before the system's effectiveness can be determined. Identification of these issues and the development of concepts for testing them will be addressed in lower level test documents. These issues will be of primary importance to the FAA in reaching a decision to implement the PRM in the NAS.

3.5.1 Technical Issues.

The critical T&E technical issues will focus primarily on verification of the PRM systems engineering requirements of the contract.

The T&E will be performed to determine the PRM systems capability to perform the following functions successfully:

- a. Surveillance processing accuracy
- b. 1.0 seconds target update rate
- c. Channel switchover accuracy
- d. Blunder detection accuracy
- e. Target track projection accuracy
- f. Target track trail accuracy

3.5.2 Operational Issues.

The critical T&E operational issues will focus primarily on determining operational effectiveness and operational suitability of the PRM systems in the NAS.

The critical T&E operational effectiveness and operational suitability issues will focus primarily on testing the following PRM systems capabilities:

- a. The display of 25 tracked targets with its associated information on a dual runway.
- b. The display of 35 tracked targets with its associated information on a triple parallel runway.
- c. System integration and transition with other elements of the NAS without affecting the ATC operation of either system.
- d. Determination that the required system availability through an effective fault tolerant design is accomplished.
- e. The display of ARTS data block information for tracked targets.
- f. Provide 32 nmi coverage in 360° coverage area.
- g. The PRM/NAS systems performance and the associated ATC procedures when failures are encountered do not degrade the operations of the systems.
- h. The throughput timeliness for PRM data from detection of targets at the PRM antenna to display.

4. PROGRAM SUMMARY.

4.1 MANAGEMENT.

The PRM program is controlled and directed by the Terminal Radar and Mode S Branches, ANR-120, under the direction of one Program Manager (PM). The PM and designated team members are responsible for procurement and implementation of the PRM from contract award through installation, checkout, and integration into the NAS. The PM is the single focal point for all program activities to monitor specific areas such as contractor performance and project implementation. Matrix management will be used by the PM.

The PM is responsible for ensuring that the intent of FAA Order 1810.4B, FAA NAS Test and Evaluation Program, is met. This order establishes the FAA NAS T&E Program for a MSA and/or non-MSA. It defines the procedures for planning and executing a T&E program for effective transition through the life cycle of the PRM project.

The PM will utilize personnel from various FAA organizations and their support contractors to accomplish the T&E program defined in FAA Order 1810.4B. The combined T&E organization will support the policies, procedures, and directives established within the FAA. The T&E organization will be responsible to assure that all requirement verification is accounted for during the Development Test and Evaluation (DT&E), Production Acceptance Test and Evaluation (PAT&E), and Operational Test and Evaluation (OT&E) test periods.

4.1.1 Management Responsibility.

FAA organizations required to support the NAS T&E program and their responsibilities are detailed in FAA Order 1810.4B. This Order establishes a Test Policy Review Committee (TPRC) and a FAA Technical Center Associate Program Manager for Test (APMT). The TPRC consists of members from AND-3/AFE/ASM/AAP/ATR/ALG/ANR/ACN/ASE/DOD/ACT-2. Some specific organizational responsibilities extracted from the Order are listed below.

Surveillance Service (ANR) and the PM:

- a. Manage the accomplishment of the project by the contractor.
- b. Approves the Program Directive (PD). (The Program Directive is the vehicle which documents the agreement between the PM at the FAA Technical Center APMT.)
- c. Responsible for jointly preparing the FAA MTP with the APMT and its distribution.
- d. Responsible for receiving TPRC approval for the FAA MTP.
- e. Arranges DT&E/PAT&E test support, and provides or has the APMT provide technical direction for DT&E when a contractor is involved.
- f. Approves DT&E test plans, procedures, and reports.
- g. Approves OT&E Integration test plans, procedures, and reports.
- h. Monitors OT&E Integration and Shakedown tests.

Engineering, Integration, and Operational Evaluation Service (ACN) and the APMT:

- a. Prepare program directive to direct DT&E/NAS Integration OT&E, and coordinate Shakedown testing and approve the budget to fund for the accomplishment of these activities.
- b. Jointly prepares and updates the FAA MTP with the PM.

- c. Prepares test monitor guidelines; prepares test plans and test procedures for OT&E in accordance with FAA-STD-024, prepares NAS Integration test plan and procedures in accordance with FAA-STD-024; and prepares/concurs on DT&E test plans and procedures.
- d. Directs the conduct of NAS Integration, PAT&E, and OT&E; NAS Integration and OT&E data analysis and prepares reports; conducts DT&E if tasked to do so by the PM.

NAS Systems Engineering Service (ASE)/Engineering Specialties and Configuration Management Division (ASE-600):

- a. Formulates test policy, test standards, and definitions for consideration and approval by the TPRC.
- b. Verifies compliance with FAA Order 1810.4B, standards and NAS system level and OT&E requirements for T&E in support of the TPRC.
- c. Provides NAS-SS-1000 System Specification requirements for inclusion in the FAA MTP VRTM or provide requirements for those projects not included in the NAS-SS-1000.
- d. Reviews FAA MTPs.
- e. Serves as Secretariat of the TPRC.

Systems Maintenance Service (ASM):

- a. Identifies and develops with the PM and APMT, OT&E Shakedown requirements for inclusion in the FAA MTP.
- b. Develops OT&E Shakedown test plans and test procedures in accordance with FAA-STD-024A.
- c. Conducts OT&E Shakedown testing.
- d. Conducts OT&E Shakedown data analysis and prepares reports.

Office of Administrative Support (ASU):

- a. Reviews FAA MTP and contractor MTP.
- b. Reviews DT&E test plans, procedures, and reports.
- c. Reviews PAT&E test plans, procedures, and reports.
- d. OT&E Shakedown test plans and procedures are developed in coordination with ATR.
- e. Provides personnel for conduction and/or monitoring the conduct of OT&E Shakedown.

- f. Verifies completeness of program by reviewing the final OT&E Integration, Shakedown, and field Shakedown reports from each site.
- g. Monitors the contractor's quality control system and witness testing to ensure that the PRM system meets the contract requirements.

Airway Traffic Plans and Requirements Service (ATR):

- a. Provides requirements for and reviews the FAA MTP.
- b. Provides tests requirements (via the FAA MTP) and reviews test plans and procedures for OT&E Integration and Operational tests.
- c. Provides personnel to support monitoring and conduct of DT&E.
- d. Provides personnel to support monitoring and conduct of PAT&E.
- e. Provides personnel for conducting and/or monitoring the conduct of OT&E Integration and Operational tests.
- f. Provides personnel for conducting and/or monitoring the conduct of OT&E Shakedown tests.
- g. Monitors field Shakedown tests.

Office of Air Traffic System Management (ATM)

- a. Reviews field Shakedown test requirements, plans, procedures, and reports.
- b. Monitors field Shakedown tests.
- c. Assess the operational capability and functional verification of the PRM system prior to deployment for testing and use in field facilities.
- d. Monitors computer program implementation schedules to ensure operational requirements are met.
- e. Manages requirements for new airspace management systems.
- f. Supports automation system development in meeting operational requirements.
- g. Supports the site selection process for deployment of the PRM system.

Air Traffic Rules and Procedures Service (ATP)

- a. Reviews field Shakedown test requirements, plans, procedures, and reports.
- b. Monitors field Shakedown tests.

Flight Standards Service (AFS)

- a. Reviews field Shakedown requirements, plans, procedures, and reports.
- b. Participates in the conduct of OT&E Integration, OT&E Shakedown, and field Shakedown as required by AFD.
- c. Monitors field Shakedown tests.

4.2 INTEGRATED SCHEDULE.

Figure 4.2-1 depicts the integrated schedule of T&E events for the entire PRM program. The scheduled activities are shown with the month of year and months after contract for sequence tracking. The integrated schedule begins from the time of the PRM contract up to the time the system is scheduled for commissioning. The activity schedule is subject to change as the program evolves. The NAS OT&E Integration testing of the PRM system will be accomplished at the first FAA field site.

Year	1991			1992			1993			1994				
Month	9	12	3	6	9	12	3	6	9	12	3	6	9	12
Months After Contract	X	X	0	3	6	9	12	15	18	21	24	27	30	33
Contract Award (3/92)														
FAA MTP (2/92)														
CDR (9/92)														
Contractor DT&E: Phase 1 - In Plant 1st System Delivery Phase 2 - On Site														
SAT (5/94)														
CAI (6/94)														
OT&E Integration and OT&E Operational Test (9/94)														
OT&E/Shakedown (9/94)														
ORD (11/94)														

FIGURE 4.2-1. INTEGRATED SCHEDULE

4.3 TEST PLANS.

The PRM test plans to be developed are the PRM DTE Test Plan, the PAT&E, the PRM OT&E Integration Test Plan, and the PRM OT&E Shakedown Test Plan.

The PRM DT&E/PAT&E Test Plans are prepared by the PRM contractor. The PRM contractor is responsible for conducting the specific tests which demonstrate compliance of the PRM system specification and the statement of work. The contractor's test plans shall ensure the verification of all performance requirements.

The PRM OT&E Integration and Operational Test Plan is prepared by ACW-100. It shall be prepared in accordance with FAA-STD-024A. As applicable, a unique PRM configuration will have its unique characteristics tested at its operational field facility. An OT&E Integration and Operational Test Procedure will be written for this test plan. The OT&E Integration and Operational tests will be conducted at the operational field facilities. The OT&E operational testing verifies the suitability and effectiveness of the equipment. A functional performance check of the interface and a preliminary evaluation of key operational requirements will be performed prior to formal OT&E Integration testing.

The PRM OT&E Shakedown Test Plan is prepared by ASM-600. It shall be prepared in accordance with FAA-STD-024A. An OT&E Shakedown Test Procedure will be written for this test plan. Formal Shakedown testing will be performed by ASM-600. The tests will be conducted for each configuration either at each unique field facility. Shakedown Test Plans and Shakedown Test Procedure will be provided to the appropriate FAA regions.

The responsible organization and its required test plan and delivery date is concisely outlined as follows:

PRM Contractors	-	DT&E Test Plan	09/92
PRM Contractors	-	OT&E Test Procedures	11/92
ACW-100	-	OT&E Integration and OT&E Operational Test Plan	02/94
ACW-100	-	OT&E Integration and OT&E Operational Test Procedures ..	04/94
ASM-600	-	OT&E Shakedown Test Plan	02/94
ASM-600	-	OT&E Shakedown Test Procedures	04/94

Formal test reports will be prepared at the conclusion of each test phase. The reports will be submitted to the PRM Program Office, ANR-120. Test reports are due 30 days after the tests are completed. The following is the test report delivery schedule:

PRM Contractors	-	DT&E Test Report	07/94
ACW-100	-	OT&E Integration and OT&E Operational Test Report	10/94
ASM-600	-	OT&E Shakedown Test Reports	10/94

5. DT&E/PAT&E.

The DT&E for PRM systems is conducted by the contractor on the first five systems. It is conducted primarily to assist the engineering design and development process by determining incrementally the degree to which functional engineering specifications are attained. The DT&E effort will use multiple test beds to accomplish its goal on the first five systems in a minimum time.

The PAT&E for PRM systems is conducted by the contractor. It is conducted to demonstrate that the PRM production article meets the specified requirements. The contractor will conduct PAT&E on each of the PRM systems to verify that the end-item conforms to applicable specifications and is free from manufacturing defects.

Contractor DT&E and PAT&E test documentation and test conduct is reviewed and approved by the FAA.

5.1 DT&E/PAT&E TO DATE.

There has been no completed DT&E/PAT&E events on the PRM systems.

5.2 FUTURE DT&E/PAT&E.

5.2.1 DT&E/PAT&E Objectives.

The objectives of the future LP PRM DT&E/PAT&E events are to complete the following phases of tests:

- Phase 1. In-Plant DT&E
- Phase 2. On-Site DT&E
- Phase 3. In-Plant PAT&E
- Phase 4. On-Site PAT&E

Refer to the contractor LP PRM DT&E/PAT&E Test Plans.

The objectives of the future LP PRM PAT&E events are to conduct testing to verify that all production articles conform to the specification and first article capabilities.

There is no contractor test plan available for the LP PRM at this time.

5.2.2 DT&E/PAT&E Events/Scope of Testing/Basic Scenarios.

Tests shall be conducted by using simulated input scenarios, live flights, and suitable instrumentation and loads to verify that each production system complies with the specification. The required NAS interfaces shall be tested with the PRM system.

Refer to the contractor LP PRM DT&E/PAT&E Test Plans.

5.3 CRITICAL DT&E/PAT&E OUTLINE.

The contractor must verify the suitability of PRM throughput timeliness for the end-state NAS. The timeliness is to be measured from the detection of targets at the PRM antenna to display. All other critical items are detailed in the LP PRM Specification.

6. OT&E/ST&E.

LP PRM Shakedown T&E (ST&E) will be conducted by the National Engineering Field Support Division, ASM-600. ATR will provide personnel for monitoring the conduct of OT&E Shakedown tests.

The ST&E will be conducted in parallel with OT&E Integration and Operational T&E. The ST&E will exercise the PRM in an operational environment. The test results will be used to make the determination that the PRM systems are ready for full field operation as part of NAS. The ST&E will confirm that, when the PRM systems are operated and maintained by operational personnel in the operational environment, all requirements are met. Successful completion of ST&E will reflect the integrated readiness of people, procedures, and the PRM systems to assume field operational status.

6.1 OT&E/ST&E TO DATE.

NONE

6.2 FUTURE OT&E/ST&E.

The OT&E/ST&E testing is planned to commence following FAA Site Acceptance and Integration testing by the contractor at the first FAA facility.

The OT&E/ST&E is the responsibility of ASM-600 and shall be conducted through a series of procedures to be used for field site testing. These procedures will be used to determine the maintenance of the operational system and its readiness for field certification.

The prerequisites of the OT&E/ST&E test must be satisfied prior to commencement. The prerequisites are:

- a. Functions of the PRM hardware will have been tested and verified to be in compliance with the PRM specifications.
- b. Functions of the PRM software will have been tested and verified to be in compliance with the PRM specifications.
- c. The contractor has successfully completed system level test.
- d. Operating PRM systems provided for T&E will have been accompanied by associated logistics support including spares, instrumentation, and system documentation.
- e. Maintenance personnel will have been trained in system operations and maintenance of the PRM.

f. AT personnel will have been trained in the use of the LP PRM and the associated air traffic procedures.

6.2.1 OT&E/ST&E Objectives.

The OT&E/ST&E testing is conducted to meet the following objectives:

a. Independent verification and validation conducted by user organization to verify the operational suitability and operational effectiveness of the PRM to be integrated with the NAS.

b. Identify required PRM system modifications.

c. Identify required air traffic procedure modifications.

d. Demonstrate that the PRM system is acceptable for field certification.

e. Identify data needed to improve training/logistics concepts, programs to support/update user manuals, and updates to the systems.

f. Estimate and/or determine the maintainability of the PRM systems to be integrated with the NAS.

6.2.2 OT&E/ST&E Events/Scope of Testing/Basic Scenarios.

The following subsections summarize the key OT&E/ST&E events planned to address the test objectives. Tests shall be conducted with simulated system failures, review of the maintenance handbooks, and diagnostic procedures to verify that the PRM systems comply with the requirements documents.

6.2.2.1 Logistics Support.

The T&E of Logistics Support will assist in determining the degree of supportability needed to operate and maintain the PRM as part of the NAS. All National Airspace Integrated Logistics Support (NAILS) requirements as outlined in FAA Order 1800.58A will be considered. Areas of special concern to the NAILS environment for the PRM system are maintenance planning, supply support, support equipment, technical documentation, and training and type of training support.

6.2.2.1.1 Objectives.

The objectives of the Logistics Support consist of the following:

a. Validate that the course objectives for each formal training program have been met by determining the degree to which operations and maintenance personnel will effectively operate and maintain the system.

b. Assess the depth and range of supply support and support equipment needed to maintain the PRM system.

c. Validate that the technical data is adequate to operate and maintain the system.

6.2.2.1.2 Test Descriptions.

The tests to be performed during Logistics Support T&E are:

- a. Conduct diagnostics procedures, problem isolation methods, equipment repair with typically trained personnel utilizing available test equipment, spares, and procedures to assess the degree to which the operational system can be operated and maintained without impacting operations.
- b. The test team personnel should assess the value of the test equipment, operations and maintenance procedures, technical documentation, and training, when performing operations and maintenance procedures of the system.
- c. The evaluation of spare parts and consumables availability will be done during the repair time.
- d. The maintenance test data will be collected in a test log form.

6.2.2.1.3 Supply Support and Support Equipment Requirements.

The primary support requirements and organizations for Logistics Support are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ASM-600
Operational PRM system	Contractor
All test equipment to maintain the system	ASM-600
Spare parts and consumables	AAC-4

6.2.2.1.4 Completion Criteria.

The Logistics Support tests will be completed when the following criteria are met:

- a. The verification that course objectives for each formal training program have been met by determining the degree to which maintenance personnel effectively maintains the system.
- b. The degree to which the depth and range of supply support and support equipment for maintaining the system is determined.
- c. The verification that technical data is adequate to operate and maintain the system.
- d. The formal test report has been approved.

6.2.2.2 Support Hardware and Software and Document Validation.

The Support Hardware and Software and Document Validation T&E will be conducted with operational and maintenance personnel. It will be conducted using support hardware and software and documents required for support of the operational system. It validates that they are adapted to user personnel, are technically accurate, complete, and adhere to existing orders and policies and satisfies the operational requirement for the development, maintenance, test, and operation of the PRM system.

6.2.2.2.1 Objectives.

The objectives of Support Hardware and Software and Document Validation T&E consist of the following:

- a. Assess the degree to which operational and maintenance personnel can use system documentation and support tools to effectively support the PRM systems.
- b. Assess the quality and availability of the system documentation.
- c. Assess the quality and sufficiency of training materials.

6.2.2.2.2 Test Description.

The testing to be conducted during the Support Hardware and Software and Document Validation T&E are:

- a. An assessment of the degree to which system documentation supports system operational and maintenance based on the utility of the documentation in supporting personnel training, FAA Technical Center testing, shakedown, and certification at early operational sites.
- b. Reviews of system documentation to determine its accuracy, completeness, and availability.

6.2.2.2.3 Technical Documentation and Training Requirements.

The primary support requirements and organizations for the Support Hardware and Software and Document validation T&E are:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ASM-600
Operational PRM system	Contractor
All documentation required for the support of the operational system	ANR-120/ ASM-600/ AAC-4
Training materials.	AAC-900/ AHT-400/500/ ATZ-100

6.2.2.2.4 Completion Criteria.

The Support Hardware and Software and Document Validation T&E will be completed when the following has been met:

- a. The degree to which operational and maintenance personnel can use the system documentation and support tools to effectively support the PRM system has been determined.
- b. The quality and availability of system documentation have been ascertained.
- c. The quality and sufficiency of training materials are ascertained.
- d. The formal test report is approved.

6.2.2.3 Maintainability Evaluation.

The maintainability T&E will be conducted to estimate and/or verify that the maintainability requirements including mean-time-to-restore, parts accessibility, and diagnostic coverage are achievable in an operational environment.

6.2.2.3.1 Objectives.

The overall objectives of the PRM system maintainability evaluation is to determine its capability to handle maintenance requirements without affecting the operations of the system.

The following are further PRM maintainability evaluation objectives:

- a. Provide an initial assessment of the PRM service restoration times.
- b. Assess the impact of corrective maintenance requirements on operations.
- c. Provide an initial assessment of common failure modes and associated operational effects.
- d. Provide an assessment of the preliminary maintenance handbook.

6.2.2.3.2 Test Description.

The tests to be performed during the maintainability evaluation are as follows:

- a. Observance of personnel who will perform preventive and corrective maintenance and diagnostics to support the PRM system.
- b. Maintaining an operating and maintenance log to document all incidents and maintenance actions with its associated down time.
- c. Assess the maintainability requirements with that of the collected data.

6.2.2.3.3 Supply Support, Support Equipment, and Technical Documentation Requirements.

The primary support requirements and organizations for the Maintainability T&E are:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ASM-600/ AAC-4
Operational PRM system	Contractor
All documentation required for the support of the corrective maintenance of the PRM system	ANR-120/ ASM-600/ AAC-4
Spares, consumable packages, instruments, and equipment for support of the maintenance procedures.	ASM-600/ AAC-4

6.2.2.3.4 Completion Criteria.

The maintainability T&E will be completed when the following has been accomplished:

- a. An initial assessment of the PRM service restoration times has been determined.
- b. An assessment of the impact for corrective maintenance on a PRM operational system has been determined.
- c. An initial assessment of common failure modes and associated operational effects has been determined.
- d. An assessment of the preliminary maintenance handbook has been completed.
- e. The formal test report is approved.

6.3 CRITICAL OT&E/ST&E OUTLINE.

There are no critical items required for the conduct of adequate OT&E/ST&E testing.

7. OT&E INTEGRATION AND OT&E OPERATIONAL T&E.

The PRM OT&E Integration and Operational test will be conducted by the FAA Technical Center, Engineering, Integration, and Operational Evaluation Service, Secondary Surveillance Division, ACW-100.

The OT&E will be conducted to determine the PRM systems operational effectiveness and operational suitability to be part of the NAS. Operational suitability is the degree to which the PRM systems can be placed satisfactorily in the field. Operational effectiveness is the degree to which the PRM accomplishes its mission in the context of organization, policy, and environment when it operates as planned. The OT&E Integration and Operational testing will begin immediately after the contractors complete DT&E. The OT&E program will be structured to take full advantage of the earlier DT&E testing.

The LP PRM OT&E will be conducted at the first field site. The other unique LP PRM/NAS configurations will be tested at their field facilities.

7.1 OT&E INTEGRATION AND OT&E OPERATIONAL T&E TO DATE.

To date there has been no testing completed on the LP PRM system.

7.2 FUTURE OT&E INTEGRATION AND OT&E OPERATIONAL T&E.

The OT&E Integration and Operational testing is planned to commence after the contractor's successful completion of the first site acceptance tests (SAT). ACW-100 OT&E Integration and Operational testing would follow the FAA's validation of the first SAT results and the Contractor Acceptance Inspection (CAI).

The OT&E Integration and Operational T&E is the responsibility of the FAA Technical Center. The following prerequisites must be completed prior to OT&E Integration and Operational T&E:

- a. The LP PRM contractors site installation, test, and control documentation have been approved by the FAA.
- b. The LP PRM contractors have completed the site preparation as required by the FAA approved site installation plan.
- c. The LP PRM contractor has delivered a PRM system to the site. The systems shall have successfully completed system level tests.
- d. The PRM systems have successfully completed the Site Acceptance tests at the required locations.
- e. The PRM Antenna Simulator (PATTS) and the desktop simulator are available.
- f. The FAA Technical Center OT&E Integration and Operational test procedures have been approved.
- g. The required Data Reduction and Analysis (DR&A) Programs are available.
- h. The air traffic controllers to be used in the OT&E tests have been trained in the use of the LP PRM and its associated air traffic procedures.

7.2.1 OT&E Integration and OT&E Operational Test Objectives.

The FAA Technical Center OT&E Integration and Operational tests will determine the adequacy of the PRM systems functional interfaces to the intended NAS systems. It will determine the adequacy of the PRM systems in meeting operational requirements and its operational impact on its degraded operations upon NAS. Testing will be accomplished upon completion of contractor testing at the first site. Test objectives are discussed in the subparagraphs of section 7.2.2.

7.2.2 OT&E Integration and OT&E Operational Events/Scope of Testing/Basic Scenarios.

The following subsections summarize the key OT&E Integration and Operational events planned to address the test objectives. Tests shall be conducted by using simulated inputs from simulators and live transponder replies to verify that the PRM systems comply with the requirements documents. The PRM interfaces shall be tested with each required NAS system.

7.2.2.1 Functional Interface Tests.

The functional interface tests are conducted to ensure the PRM systems functionally interface correctly to the appropriate NAS systems.

The PRM systems shall be functionally operational with the following NAS systems:

- a. ARTS-IIIA

7.2.2.1.1 Objectives.

The objectives of the functional interface tests are to:

- a. Verify the functional characteristics of the PRM operational systems.
- b. Verify the effectiveness of hardware and software required to accommodate the NAS functions.
- c. Verify the PRM systems' performance under a NAS operational environment.
- d. Verify that the PRM systems receive the proper information from the ARTS-IIIA system.

7.2.2.1.2 Test Descriptions.

The functional interface tests will address the adequacy of the following interfaces to/from PRM systems:

- a. The ARTS-IIIA will be used to exercise the functional interface to the PRM systems.

7.2.2.1.3 Support Requirements.

The primary support requirements and organizations for the functional interface tests are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100
Operational PRM systems	Contractors
ARTS-IIIA	FAA Facility

7.2.2.1.4 Completion Criteria.

The functional interface tests will be complete when the following requirements are met:

- a. The functional characteristics of the PRM operational systems have been demonstrated in an integrated NAS configuration. The PRM systems have been able to process the information to/from the required NAS system interfaces.
- b. The effectiveness of hardware and software necessary to perform NAS functions has been demonstrated in an integrated NAS configuration. The capability of the test simulators to transmit/receive information via NAS systems can be handled by the PRM systems.
- c. The system performance has been assessed for the operational functions of the PRM systems with desired NAS systems.
- d. The formal test report is approved.

7.2.2.2 Operational Suitability.

The overall objective of operational suitability testing is to verify the PRM production systems are operationally suitable for the ATC operations. It reflects the satisfaction of operational requirements by the PRM systems when operated and maintained by the users. Operational suitability test and evaluation encompasses operational requirements validation, reliability and availability, and degraded operations.

7.2.2.2.1 Operational Requirements Validation.

The operational requirements validation T&E will be conducted to support validation and/or refinement of the operational requirements.

7.2.2.2.1.1 Objectives.

The operational requirements validation objectives are as follows:

- a. Verify the required number of tracked targets for each required operational runway.
- b. Verify target position accuracy.
- c. Verify whether PRM can adequately monitor aircraft conducting simultaneous independent approaches to parallel runways.
- d. Verify the capability to operate with required ATC systems such as ARTS-III A.
- e. Verify that the PRM generates blunder alarms accurately when operating within the NAS.
- f. Verify the PRM system projects target positions accurately.
- g. Verify the PRM system displays target trail positions accurately.
- h. Assess the air traffic controller response time for aircraft within or approaching the NTZ.

7.2.2.2.1.2 Test Description.

The PRM systems shall be observed to process target replies and display them on the parallel runways of the graphics display. The targets will be provided from simulators or from live test target replies.

7.2.2.2.1.3 Support Requirements.

The primary support requirements and organizations for the operational requirements validation tests are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100
Operational PRM systems	Contractors
Test Simulators	Contractors
ARTS-III A	FAA Facility

7.2.2.2.1.4 Completion Criteria.

The operational requirements validation tests will be complete when the following requirements are met:

- a. Verification of all target replies has been properly received and displayed.
- b. Verification of blunder detections and required operational alarms and indicator lamps has been determined.
- c. Verification of PRM systems operation with each of the required NAS systems has been completed.
- d. Verification of the PRM system handles the required number of targets in its required number of parallel runways.
- e. Target position accuracy has been verified.
- f. Airport capacity increase without affecting ATC operations has been assessed.
- g. The air traffic controller response time to control blundering targets has been assessed.
- h. The PRM's capability to project and trail target paths accurately has been tested.
- i. The formal test report has been approved.

7.2.2.2.2 Reliability and Availability Analysis.

The contractor provided reliability study with the actual failure history during the systems's acceptance test and OT&E test will be used to provide the reliability and availability analysis.

7.2.2.2.2.1 Objectives.

The reliability and availability analysis objectives are as follows:

- a. To determine the reliability of the PRM system used as a factor in determining the availability of the PRM system.
- b. To determine if the PRM systems meet the same reliability requirements as the specification.

7.2.2.2.2.2 Test Description.

The PRM system test engineers will analyze the contractor's reliability study along with the actual system failure log. The contractor's DT&E will include a reliability growth test for a duration equal to the systems Mean Time Between Failures (MTBF) requirement.

7.2.2.2.2.3 Support Requirements.

The primary support requirements and organizations for the reliability and availability analysis are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100.
Operational PRM systems	Contractors
Test Simulators	Contractors
Test Logs	ACW-100
Reliability Study	Contractors

7.2.2.2.2.4 Completion Criteria.

The reliability and availability analysis will be complete when the following requirements are completed:

- a. Reliability of the PRM system is determined.
- b. The test report is approved.

7.2.2.2.3 Degraded Operations.

Degraded operations involve T&E conducted to determine the resultant operational degradation when failures are induced in the system. The validation of degraded operations procedures and operational impact of the data preservation/integrity functions will be included.

7.2.2.2.3.1 Objectives.

The objective of degraded operations involve failure modes for the PRM. The evaluation of impact from the degraded operations include:

- a. To determine that the PRM systems can continually process parallel approaches during induced failure modes.
- b. To determine that the PRM system does not adversely impact the controllers or pilots during an induced failure.
- c. To determine the suitability of the PRM system when a failure exists in the NAS environment.
- d. Evaluate the capability of the PRM to support error recovery and degraded operations.
- e. Evaluate to determine if modifications to air traffic procedures are required.

7.2.2.2.3.2 Test Description.

The testing to be conducted during the degraded operations are:

- a. To simulate a large number of test replies to the PRM to observe the effective operations and expected outputs.
- b. To use live targets along with a simulated high fruit rate as input to the PRM to observe the effective operations and expected outputs.
- c. To induce a PRM/ARTS failure by not allowing communications.
- d. To induce faults or failure of the PRM primary channel to stimulate automatic switchover to the secondary channel.

7.2.2.2.3.3 Support Requirements.

The primary support requirements and organizations for the degraded operations are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100
Operational PRM systems	Contractors
Test Simulators	Contractors
Live Targets	FAA Facilities
Air Traffic Controllers	ATR

7.2.2.2.3.4 Completion Criteria.

The degraded operations tests will be complete when the following requirements are completed:

- a. The impact on air traffic controllers during degraded operations has been assessed.
- b. The operational impact of the PRM/ARTS failure has been assessed.
- c. The operational impact due to the switching from the primary channel to the secondary channel during a failure to the primary channel is assessed.
- d. Any required modifications to AT procedures have been resolved.
- e. The test report is approved.

7.2.2.2.4 NAS Interference Testing.

The NAS interference testing is conducted to determine that the PRM is an independent operational system. This testing will be done to ensure that the placement of a PRM in the NAS does not degrade the existing surveillance systems and Nav aids.

7.2.2.2.4.1 Objectives.

The objective of the NAS interference testing is to operate the PRM system in parallel with and without impacting the existing beacon systems. This testing will determine that the PRM system can continually process parallel runway operations without causing a degradation to existing beacon systems.

7.2.2.2.4.2 Test Description.

The PRM system shall be observed to operate in conjunction with an existing beacon system without degrading its surveillance data. The target information will be provided from simulators or from live test aircraft.

7.2.2.2.4.3 Support Requirements.

The primary support requirements and organizations for the NAS Interference testing are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100
Operational PRM systems	Contractors
Test Simulators	Contractors
Live Targets	FAA Facilities

7.2.2.2.4.4 Completion Criteria.

The NAS Interference testing will be complete when the following has been completed:

- a. The determination that the PRM does not interfere with the existing NAS surveillance systems has been done.
- b. The test report has been approved.

7.2.2.3 Operational Effectiveness.

Operational effectiveness OT&E Integration and Operational testing will be conducted to estimate or determine the degree to which the PRM systems accomplishes and/or enhances the overall operational mission. The focus of these tests will be to assess and demonstrate the controller's and field personnel's ability to perform the job effectively when the PRM systems are present in the NAS.

The approach to evaluating overall operational effectiveness involves conducting real-time simulation tests with the PRM systems at the FAA facilities. The testing will focus on determining whether the PRM offers improved or degraded performances relative to the other NAS systems for parallel runway approaches.

7.2.2.3.1 Objectives.

The objectives of operational effectiveness T&E consist of the following:

- a. Evaluate the operational impact of PRM on controller or field personnel workload, operation rates, and system safety.
- b. Determine the operational impact of changes in air traffic procedures.
- c. Evaluate the capability of the PRM to support error recovery and degraded operations.
- d. Evaluate the NAS systems performance and the associated ATC procedures when in normal and degraded operations of the systems.

7.2.2.3.2 Test Descriptions.

The testing to be conducted during the operational effectiveness T&E are:

- a. To simulate aircraft in a parallel approach to the PRM systems to observe the effective operations and expected outputs.
- b. To enable degraded operations of the PRM systems when failures are induced to determine the effectiveness of the operations.
- c. To observe the NAS end-to-end system performance is not degraded in an operational and degraded state.

7.2.2.3.3 Support Requirements.

The primary support requirements and organizations for the operational effectiveness are as follows:

<u>Requirements</u>	<u>Organization</u>
Government-approved Test Plans/Procedures/Reports	ACW-100
Operational PRM systems	Contractors
Test Simulators	Contractors
Live Targets	FAA Facilities
Air Traffic Controllers	ACW-100

7.2.2.3.4 Completion Criteria.

The operational effectiveness test and evaluation will be complete when the following requirements are completed:

- a. The operational impact of PRM on controller or field personnel workload, operation rates, and system safety has been evaluated.
- b. The operational impact of changes in air traffic procedures has been determined.
- c. The capability of the PRM to support error recovery and degraded operations has been evaluated.
- d. The NAS systems performance and the associated ATC procedures, when in normal and degraded operations, are evaluated.
- e. The test report is approved.

7.3 CRITICAL OT&E INTEGRATION AND OT&E OPERATIONAL TEST OUTLINE.

There are no critical items required for the conduct of adequate OT&E Integration and Operational testing.

8. SPECIAL RESOURCE SUMMARY.

8.1 TEST ARTICLES.

The PRM system test articles required to adequately support the FAA Technical Center testing described in this MTP consist of the following:

- a. Instruction/Maintenance/Operations Manuals
- b. Displays

8.2 SPECIAL SUPPORT REQUIREMENTS.

The special support requirements of the FAA Technical Center tests described in this MTP are as follows:

- a. Field Controllers/maintenance personnel
- b. Test aircraft equipped with ATCRBS transponders
- c. Test Pilots

APPENDIX A

TEST VERIFICATION REQUIREMENTS TRACEABILITY MATRIX

This TVRTM is based on the ATR-100 Operational Requirements.

TVRTH Title: PRM MASTER TEST PLAN
TVRTH Legend:

Operational and System Test Level
Operational Test & Evaluation (OT&E)/
Shakedown (SD) - (OT&E/SD)
NAS Integration T&E (INT) - (OT&E/INT)
Development Test & Evaluation (DT&E)

Locations
FAA Technical Center - TC
Key Site - KS
Factory - FA
FAA Facility - FAC

Test Plan Cross Reference
OT&E/Shakedown - OT&E/SD
OT&E/Integration - OT&E/INT

Verification Methods
Analysis - A
Demonstration - D
Inspection - I
Test - T
Not Applicable - NA

Criticality
Critical - C
Non-Critical - NC

Requirements doc. title, para. no. & statement	Test Levels		Test Location			Critical C/NC	Test Plan Cross Ref.	Support Organization	MTP Reference
	Project DT&E	Operation OT&E/SD	System OT&E/INT	TC	KS	FA			

ATR-100 OPERATIONAL REQUIREMENTS of 4/3/91

1. Coverage Area X

The PRM shall be verified to provide coverage at airports with parallel runways with the following requirements:

- Elevation - 50 ft above ground surface to 1500 ft above highest initial approach.
- Range - 30 nmi from runway end.
- Azimuth - 2 mi either side of parallel runways.

5.2

Contractor

2. Sensor Accuracy X

The PRM shall be verified to ensure correlation of target symbology with actual aircraft position.

5.2

Contractor

3. System Capacity X

The system shall be verified to track 25 targets for dual runways and 35 targets for triple runways with its respective update rate.

5.2

Contractor

4. System Reliability X

The PRM shall be verified to provide a reliability equivalent to that of an ASR system. The availability of the PRM should be 0.99975.

5.2

Contractor

7.2

ACW-100

6.2

ASN-630

Requirements doc. title, para. no. & statement	Test Levels			Test Location & Verif Method				Critical C/NC	Test Plan Cross Ref.	Support Organization	MTP Reference
	DT&E	Operation	System OT&E/INT	TC	KS	FA	FAG				
5. System Failure The PRM shall be verified to generate a visual and aural alarm when a system failure is detected. The tracked targets shall not be affected.	X		X			T	T	C		Contractor ACW-100	5.2 7.2
The PRM target tracking performance should be tested for maximum load.											
Verify total system failure and recovery as follows:											
a. Verify recovery from complete power failure with emphasis on retention of system configuration, retention of tracked target data, and orderly data load reduction.											
6. Tracked Target The PRM shall be verified to provide the following tracked target requirements:			X			T	T	C		Contractor ACW-100	5.2 7.2
a. Record a target											
b. Replay a target											
c. Simulate a target											
d. Track history											
e. Projected track											
f. ARTS data block information											
7. Display The PRM shall be verified to provide the following display requirements:			X			D	D	C		Contractor ACW-100	5.2 7.2
a. 18" diagonally											
b. operator controls and keypad units.											
c. variable range and offset capability.											
d. contrast and brightness with respect to TRACON lighting conditions.											

Requirements doc. title, para. no. & statement	Test Levels			Test Location			Critical C/NC	Test Plan Cross Ref.	Support Organization	MTP Reference
	DTGE	OTGE/SD	System OTGE/INT	TC	KS	FA				
e. the throughput timeliness for PRM data from detection of targets at the PRM antenna to display.										
f. demonstrate PRM display of ARTS -IIIA conflict alert, minimum safe altitude warning, runway assignment, and other pertinent flight data.										
8. <u>False Targets</u> The PRM shall be verified to be free of false targets.	X		X				T	T	C	Contractor ACW-100 5.2 7.2
9. <u>Display Resolution</u> The PRM shall be verified to detect tracked targets within 100 ft deviations.	X						T		C	Contractor 5.2
10. <u>Display Mapping</u> The PRM shall be verified to provide the following display mapping capabilities: a. All runway outlines b. Prominent obstructions c. NTZ Zones 2000 ft wide d. NOZ Zones e. final approach broken lines	X		X				D	D	C	Contractor ACW-100 5.2 7.2
11. <u>NTZ Alerts</u> The PRM shall be verified to provide the following NTZ alerts: a. alert controller of aircraft entering NTZ in 10 seconds. b. voice alert sounds when aircraft is projected to enter the NTZ. c. a printout of track data shall be generated when an aircraft enters the NTZ.	X		X				T	T	C	Contractor ACW-100 5.2 7.2
12. <u>ARTS Interface</u> The PRM shall be verified to provide a passive ARTS interface.	X		X				T	T	C	Contractor ACW-100 5.2 7.2