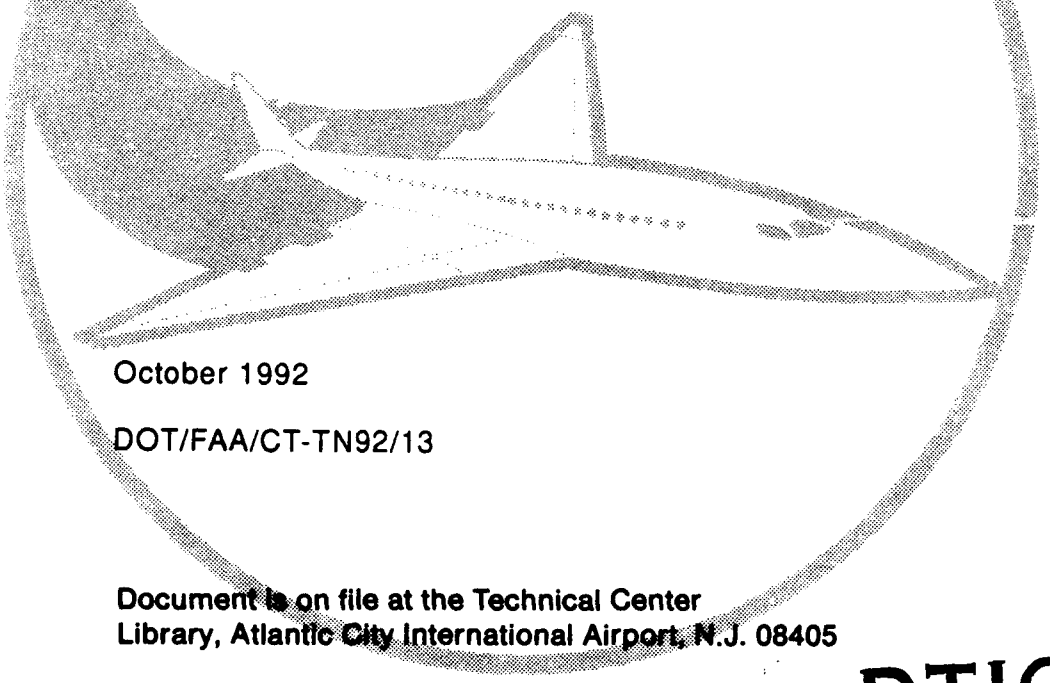
Upgrade Precision Runway Monitor (PRM) Operational Test and Evaluation (OT&E) Test Plan

Ricardo Astillero
Thomas Bratton
Charles Dudas
Jeffrey Livings



October 1992

DOT/FAA/CT-TN92/13

U.S. Department of Transportation
Federal Aviation Administration

Technical Center
Atlantic City International Airport, N.J. 08405

NOTICE

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for the contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/CT-TN92/13		

4. Title and Subtitle	5. Report Date
UPGRADE PRECISION RUNWAY MONITOR (PRM) OPERATIONAL TEST AND EVALUATION (OT&E) TEST PLAN	October 1992
	6. Performing Organization Code
7. Author's: Ricardo Astillero, Thomas Bratton, Charles Dudas, Jeffrey Livings	8. Performing Organization Report No. DOT/FAA/CT-TN92/13
9. Performing Organization Name and Address Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405	10. Work Unit No. (TRAIS)
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address U.S. Department of Transportation Federal Aviation Administration Technical Center Atlantic City International Airport, NJ 08405	13. Type of Report and Period Covered Technical Note
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This document defines the Upgrade Precision Runway Monitor (Upgrade PRM) Operational and Integration tests that will be conducted at the Federal Aviation Administration (FAA) Operational facilities. These tests will be executed at Raleigh-Durham Airport (RDU) following the Contractor Site Acceptance Test. The Upgrade PRM test configuration is addressed in conjunction with the associated interfaces which will be required to perform the testing in as near an operational environment as possible.

The Air Traffic (AT) Operational requirements and test objectives are contained in this test plan. In addition to providing requirements traceability, this plan contains a description of the tests which will be executed, associated success criteria, roles and responsibilities of test personnel, and the overall flow of activities required for a successful test program.

17. Key Words	18. Distribution Statement
Upgrade PRM OT&E RDU	Document is on file at the Technical Center Library, Atlantic City International Airport, NJ 08405

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	42	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

EXECUTIVE SUMMARY

The Upgrade Precision Runway Monitor (Upgrade PRM) is designed to provide faster and more accurate surveillance of aircraft on instrument landing approaches. The system uses a phased array, electronically scanned (E-scan) beacon radar to achieve target update rates of up to one-half second. The system includes high resolution displays with specific blunder alarms to enable a monitor controller to precisely monitor landing aircraft. A system with these capabilities will allow an increase in airport landing capacity at the Raleigh-Durham International Airport (RDU) in North Carolina by allowing simultaneous, independent IFR approaches to the parallel runways separated there by 3500 feet.

The Upgrade PRM is a one of a kind system scheduled for operational use at RDU. It is a modification of the Demonstration PRM which was used in the summer of 1990 to prove the concept of precision runway monitors.

This Operational Test and Evaluation (OT&E) test plan establishes the framework to guide and direct the Upgrade PRM OT&E test program by addressing the responsibilities of the Federal Aviation Administration (FAA). Sufficient detail is provided in this document to define and direct the next lower level of test documentation and to permit the allocation of resources to the test program. Specific information is provided on test cases, objectives, prerequisites, methods, completion criteria, and support requirements.

References are made to the appropriate documents which describe the Developmental Testing and Evaluation (DT&E) test plans and the OT&E Shakedown test plan.

1. INTRODUCTION.

1.1 PURPOSE.

The purpose of the Upgrade Precision Runway Monitor (Upgrade PRM) Operational Test and Evaluation (OT&E) Test Plan is to define the test philosophy, required planning, testing, and coordination necessary to fully test the Upgrade PRM during the OT&E phase of testing.

This test plan establishes the framework to direct the Upgrade PRM OT&E test program. Detail is provided to define and direct the development of the Upgrade PRM OT&E test procedures and to permit an allocation of resources to the test program. This test plan allocates responsibilities to the various organizations involved in the test effort. The test plan includes information on the tests to be conducted during the OT&E phase of testing. This information consists of the test objectives, along with the associated prerequisites, methods, success criteria, data analysis, and support requirements. More specific details on each test will be included in the OT&E test procedures documentation.

This test program will ensure that the Upgrade PRM meets the requirements of the Air Traffic Operational Requirements for a PRM System (see appendix A). As in Chapter 7, National Airspace System Plan (NAS Plan) project, the Upgrade PRM is not subject to the NAS System general requirements as defined by NAS-SS-1000. Chapter 7 of the NAS Plan defines other capital needs to functionally improve the air traffic control (ATC) system that has been identified as the NAS Plan has progressed.

1.2 SCOPE.

This plan details:

a. The structure of the overall Upgrade PRM test program and the responsible organizations.

b. The integration and operational requirements to be verified by the Federal Aviation Administration (FAA) Technical Center.

c. The scope and degree of testing during the integration and operational test and evaluation phase by the FAA Technical Center.

d. The resources and activities to be coordinated in preparation for and support of this test program.

e. The objectives, prerequisites, support requirements, test descriptions, data analysis, and success criteria of each test case which will be used to perform OT&E testing.

2. RELATED DOCUMENTATION.

1. ATC, Air Traffic Operational Requirements for a PRM System, 1991.

2. MSI and Bendix, Upgrade PRM Integration and Test Plan, PRM-OITP-F1.00, July 1, 1991.

3. MSI and Bendix, Upgrade PRM Inspection and Test Plan, PRM-OTDP-F1.00, April 1, 1991.

4. FAA ANR-120, Upgrade Precision Runway Monitor System Program Requirements Document, February 22, 1991.

5. FAA ASM-600, ASM-600 Shakedown Test Plan, STP-630-011.

3. TEST AND EVALUATION PHILOSOPHY, APPROACH, AND CONCEPT.

The Upgrade PRM OT&E test effort is designed to ensure that the requirements levied in the Air Traffic Operational Requirements for a PRM System, detailed into individual "shall" requirements in appendix A, have been satisfied and that the system's effectiveness and suitability for inclusion into the NAS system is satisfactory. The contractor performed Development Testing and Evaluation (DT&E) and Acceptance Tests which verifies that each of the performance requirements of Upgrade Precision Runway Monitor System Program Requirements Document, including accuracy, resolution, and throughput, have been satisfied. The OT&E test effort ensures that the air traffic (AT) community is exposed to the Upgrade PRM in its full NAS configuration. The data collected during the OT&E test phase will provide the basis for the AT community to use in determining the operational suitability and effectiveness of the Upgrade PRM. Data will be collected in both a normal operating environment and a degraded operating environment. Primarily, data will be collected through the use of controller questionnaires. Close coordination will be necessary with AT Raleigh Tower to develop these questionnaires and to classify the degradation states. The controller questionnaires will also be coordinated with the local controller union.

4. PROGRAM SUMMARY.

Figure 4-1 shows the flow of testing for the overall Upgrade PRM test program.

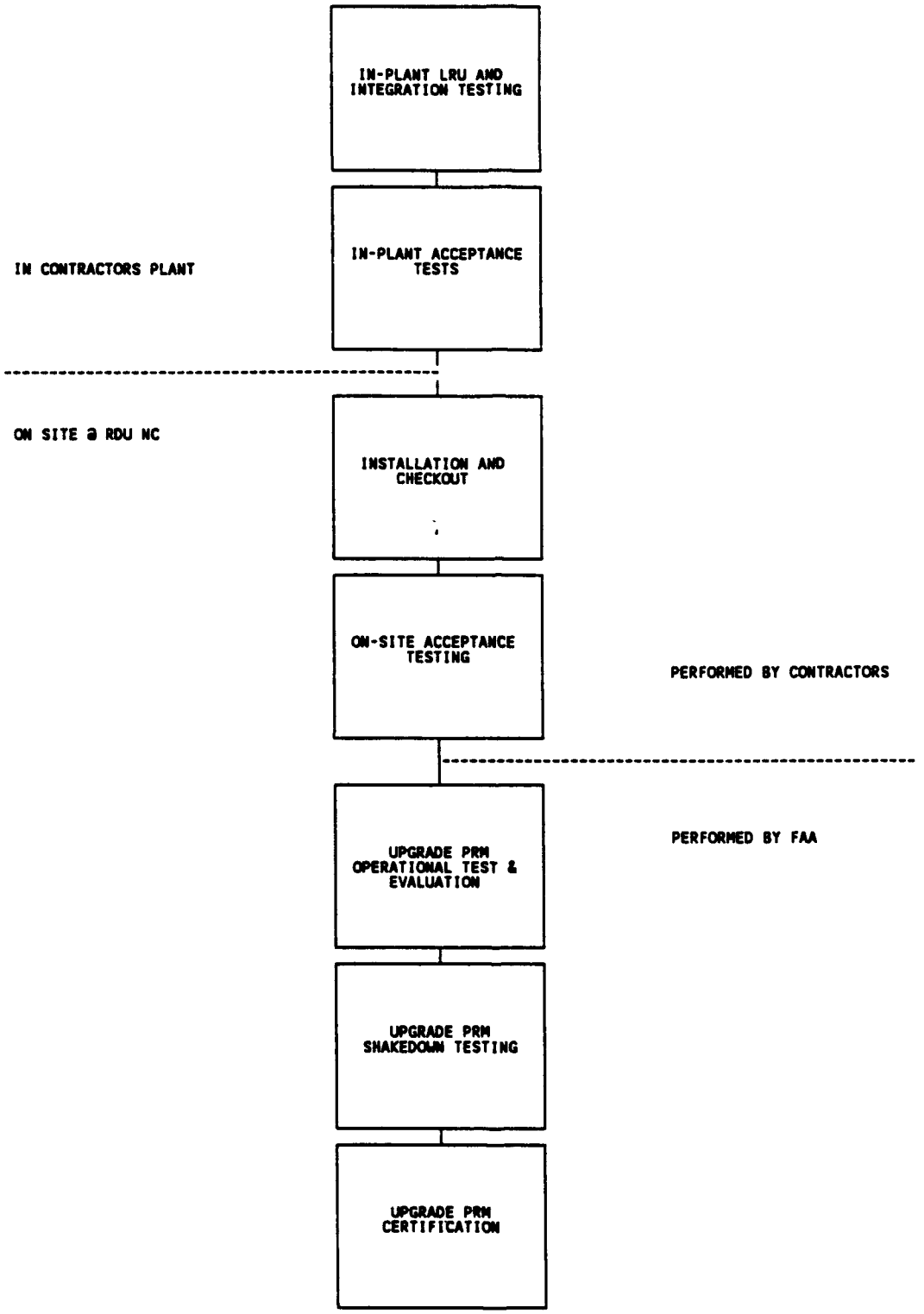


FIGURE 4-1. UPGRADE PRM TEST PROGRAM

4.1 MANAGEMENT.

The Upgrade PRM Test and Evaluation management organization is accountable for the verification of all requirements during the DT&E and OT&E test periods. The management organization is under the direction of ANR-120 (the Upgrade PRM Program Office) and ACW-100A, as delegated by FAA Order 1810.4A, FAA NAS Test and Evaluation Program and includes representatives from the FAA technical/operating services and their designated support contractors.

ACW-100A has the primary responsibility for the direction of test planning, conduct, and reporting activities associated with the Upgrade PRM OT&E program. These responsibilities are carried out by the test management group and test support group.

4.1.1 Upgrade PRM Test Management Group.

The Upgrade PRM test management group has the responsibility to direct, control, and monitor all test efforts relative to the Upgrade PRM. This group is comprised of representatives from ANR-120 and ACW-100A. The responsibilities of the test management group include:

a. Establish policies related to the Upgrade PRM test activities.

b. Review and approve all contract deliverable test plans and procedures related to the Upgrade PRM test effort.

c. Review the Upgrade PRM contractor test documentation.

d. Distribute any Upgrade PRM T&E activity related documentation.

4.1.2 Upgrade PRM Test Support Group.

The Upgrade PRM test support group will consist of specialists who are knowledgeable in specific technical areas. The role of this group will be to support the Upgrade PRM test management group in developing test requirements, plans, procedures, scenarios, and other support tools. The group will also assist in the test conduct, test analysis, and test report generation and will be comprised of personnel from the organizations shown in table 4.1.2-1.

TABLE 4.1.2-1. UPGRADE PRM SUPPORT ORGANIZATIONS

ORG.	Responsibilities/Title
ASM-630	Systems Maintenance, Radar Engineering Branch
ATP-120	Air Traffic Rules and Procedures, Terminal Procedures Branch
ATR-120	Air Traffic Plans and Requirements, Terminal Branch
ATM-120	Air Traffic System Management
ANR-120	Program Director for Surveillance, Terminal Radar Branch
ACN-300	Engineering, Test, and Evaluation Service, Technical Facilities Div.
ASO-400	Southern Region, Airway Facilities Division
ASO-500	Southern Region, Air Traffic Division
Raleigh Tower	

4.2 OTHER TESTING.

For completeness, the following sections outline the remaining test phases of the overall test program for the Upgrade PRM. These are the test activities which will be completed that are outside the scope of this OT&E plan.

4.2.1 DT&E Outline.

The responsibility for DT&E has been allocated, by contract, to the prime contractor (Minority Services, Incorporated (MSI)) and subcontractor (Bendix Communications Division (BCD) of Allied-Signal, Inc.) The DT&E is testing performed for design assistance, technical risk assessment, and specification performance verification. This test phase is being conducted via the FAA monitoring of the Upgrade PRM contract and the associated deliverable documents. The deliverable documents are prepared by the Upgrade PRM contractors for review and approval by the FAA as the Upgrade PRM program develops. The Upgrade PRM Integration and Test Plan and Upgrade PRM Inspection and Test Plan are the contractor-developed DT&E test plans for the Upgrade PRM.

4.2.2 Production Acceptance Test and Evaluation (PAT&E).

Production Acceptance Test and Evaluation (PAT&E) is testing performed to ascertain whether a production system has been fabricated properly and, as such, satisfies the specification to which it was built. Since the Upgrade PRM is a one of a kind system, PAT&E is not required for this program.

4.3 TEST PLANS AND PROCEDURES.

There are three major test plans besides this OT&E test plan developed for the Upgrade PRM program:

a. Upgrade PRM Inspection and Test Plan.
b. Upgrade PRM Integration and Test Plan.
c. Upgrade PRM Shakedown Test Plan.

The relationship of these three test plans to the OT&E Test Plan and related documentation is shown in figure 4.3-1.

The Upgrade PRM Inspection and Test Plan is an Upgrade PRM contractor deliverable which documents the contractor responsibilities for testing the Upgrade PRM. This plan details the project level tests, performed during the DT&E phase of the project, to test and evaluate the technical performance of the Upgrade PRM. This test plan shall be used as acceptance testing of the system. A subsequent test procedure document will be developed to support the test plan by the contractor.

The Upgrade PRM Integration and Test Plan is the responsibility of the Upgrade PRM contractor. This test plan will detail the lower level factory tests and integration tests prior to the start of the Acceptance Tests. Subsequent test procedures (nondeliverable to the government) will be developed to support this test plan by the contractor.

The Upgrade PRM Shakedown Test Plan is the responsibility of ASM-600 and shall be prepared in accordance with FAA Order 1810.4A. A subsequent test procedure document will be developed to support the test plan by ASM-600.

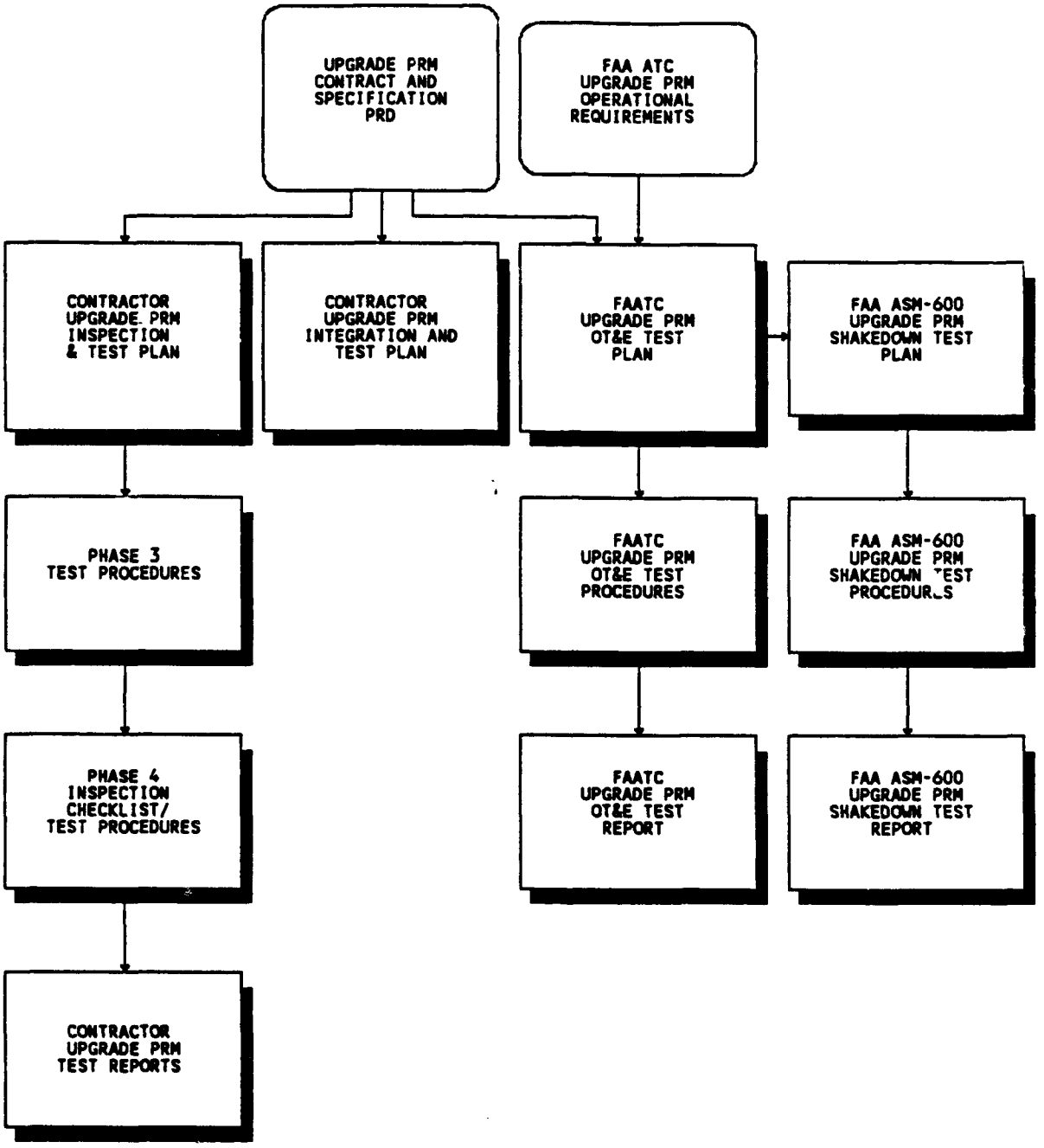


FIGURE 4.3-1. UPGRADE PRM TEST DOCUMENT FLOW

The expected delivery dates and the organization responsible to provide each test plan and the subsequent test procedures are summarized in table 4.3-1.

TABLE 4.3-1. UPGRADE PRM T&E DOCUMENTATION SCHEDULE

Testing Phase	Document Title	Organization Responsible for Preparation	Date
DT&E	Upgrade PRM Integration and Test Plan	MSI	7/91
	Upgrade PRM Inspection and Test Plan	MSI	4/91
	Upgrade PRM Phase 3 Test Procedures	MSI	9/91
	Upgrade PRM Phase 4 Test Procedures	MSI	1/92
	Upgrade PRM Test Reports	MSI	30 days after DT&E completed
OT&E OPERATIONAL & INTEGRATION	FAA Upgrade PRM OT&E Test Plan	ACW-100A	4/1/92
	FAA Upgrade PRM OT&E Test Procedures	ACW-100A	8/1/92
	FAA Upgrade PRM OT&E Test Report	ACW-100A	30 days after OT&E completed
OT&E SHAKEDOWN	FAA Upgrade PRM Shakedown Test Plan	ASM-600	11/1/90
	FAA Upgrade PRM Shakedown Test Procedures	ASM-600	8/1/92
	FAA Upgrade PRM Shakedown Test Report	ASM-600	30 days after Shakedown completed

5. TEST DESCRIPTIONS.

The tests to be performed by the FAA include the Operational and Integration tests described in the following sections. These tests are intended to fulfill the OT&E objectives stated in NAS-MD-110. The OT&E Shakedown tests are not included in the following test descriptions but are described in ASM-600 Shakedown Test Plan.

In order to commence the FAA Technical Center Operational and Integration tests described in the following sections, the following general prerequisites must be satisfied:

a. The Upgrade PRM has successfully completed Acceptance Testing (named Phase 3 and Phase 4 testing in the contractor documentation) unless the individual test description or later test procedure specifically waives this requirement along with a description of a minimally acceptable Upgrade PRM status.

b. This test plan and subsequent test procedures are approved.

c. Necessary coordination between the Raleigh-Durham International Airport (RDU) airport security, the RDU Air Traffic Manager, the Southern Region, Frequency Control, and the Program Office has been completed.

Also, the following general support requirements must be available at the start of testing:

a. Contractor support personnel to maintain and operate the Upgrade PRM and the PRM Antenna and Target Traffic Simulator (PATTS) is available.

b. The PATTS must be available for use.

c. The required Data Reduction and Analysis (DR&A) programs must be available for use.

5.1 INTEGRATION TESTING.

Integration testing for this program is designed to ensure that the Upgrade PRM becomes a functional part of the current ATC configuration at RDU. The NAS components to which the Upgrade PRM must integrate are limited to the Automated Terminal Radar System (ARTS)-IIIA and the current ATCBI-5 radar system. The ARTS-IIIA interface is a passive interface developed for and used by the Upgrade PRM. This interface obtains data block information (i.e., Aircraft ID, runway assignment), along with conflict alert and low altitude warnings from ARTS-IIIA communication messages for display on the Upgrade PRM graphics displays. While there is no direct interface between the PRM and the ATCBI-5, there is a possibility that the two could interfere with one another through the generation of asynchronous replies. Because of the close proximity of the two systems, the issue of high Voltage Standing Wave Ratio (VSWR), created by both antenna systems directly pointing at each other while in the interrogation mode, will also be evaluated. Integration testing of the Upgrade PRM with the Air Traffic Control Beacon Interrogator-5 (ATCBI-5) at RDU is necessary to show that the operation of the Upgrade PRM does not impact the operational performance of the ATCBI-5.

5.1.1 Upgrade PRM/ARTS-IIIA Interface.

5.1.1.1 Objectives.

The objective of the Upgrade PRM/ARTS-IIIA Interface Integration test is to show that the Upgrade PRM/ARTS-IIIA Interface is nonintrusive to the ARTS-IIIA system.

Requirements Tested:
AT-OR 20(a)
AT-OR 27

5.1.1.2 Prerequisites.

The Upgrade PRM must meet the general prerequisites as defined in section 5 prior to the start of this test.

5.1.1.3 Support Requirements.

The general support requirements stated in section 5 must be available at the start of this test.

5.1.1.4 Test Description.

This test uses test personnel to review and analyze the DT&E On-site Acceptance Tests (i.e., Phase 4 tests) test procedures and results which pertain to the ARTS interface. Specifically, the Upgrade PRM Confidence and Performance Monitoring tests, including Fault Isolation, will be reviewed to ensure that the scope and results of Phase 4 testing was sufficient to fulfill the requirements stated in the AT Operational Requirements.

The subsequent test procedures for this OT&E test plan will itemize the exact Phase 4 test procedures and results to be reviewed.

5.1.1.5 Data Analysis.

Data analysis will be limited to the review of Phase 4 test procedures and results and the development of an analysis report to be included as test results.

5.1.1.6 Success Criteria.

This test is considered successful when it is shown that the Upgrade PRM and the Upgrade PRM/ARTS-IIIA Interface do not adversely affect the ARTS-IIIA System utilized at RDU.

5.1.2 Interference Testing.

Interference testing for this program is designed to ensure that the addition of the Upgrade PRM into the local AT environment does not cause a degradation to any surveillance system already in place.

5.1.2.1 Objectives.

The objective of the Upgrade PRM Interference tests is to show that addition of the Upgrade PRM into RDU does not cause a degradation to the surveillance data from the current beacon interrogator or the other local area airports.

5.1.2.2 Prerequisites.

The prerequisites for Interference tests are those stipulated in section 5.

5.1.2.3 Support Requirements.

The support requirements for the Interference tests are those stipulated in section 5, plus the following:

a. A Transportable Radar Analysis Computer System (TRACS)

b. TRACS analysis programs; Radar Analysis Radar Reinforced Evaluator (RARRE), and Beacon False Target Analysis (BFTA).

Each of the above items are available within the ACW-100A group.

5.1.2.4 Test Description.

This test will consist of using the TRACS to record data from the RDU and the Benson beacon interrogators. The TRACS will record this data after it has been digitized by the ASR-9. Data will be collected during the high traffic loads (pushes). During the first hour of the push, data will be collected while the Upgrade PRM is not operational (off-line). During the second hour of the push, data will be collected with the Upgrade PRM in the operational (on-line) state. Data will be collected for a total of four pushes.

5.1.2.5 Data Analysis.

The digitized surveillance data record from the ASR-9 will be analyzed by using the RARRE and BFTA program. The RARRE will be used to preprocess the data for the BFTA program. The BFTA program will be used to conduct an analysis of Pulse Repetition Frequency (PRF) interference. This analysis specifically looks for PRF interference caused by another beacon interrogator within the coverage area of the systems whose data is being analyzed. First, the data that was collected without the Upgrade PRM in operation will be analyzed. This will be done to attain a baseline of the surveillance environment at RDU without the Upgrade PRM in operation. Next, the data that was collected with the Upgrade PRM in operation will be analyzed. The data sets from each push can then be compared to determine if the addition of the on-line Upgrade PRM causes any degradation to the surveillance environment.

5.1.2.6 Success Criteria.

This test will be successful when the data analyzed indicates that the addition of the Upgrade PRM does or does not cause PRF interference in the current beacon interrogators at either RDU or Benson. If the data indicates that a problem may exist at either of these sites, then other local sites will be tested as well.

5.2 OPERATIONAL TESTING.

Operational testing is an evaluation of the Upgrade PRM/NAS system performance from the user's perspective. The Upgrade PRM/NAS system will be evaluated by ATC controllers, ATC supervisors, FAA test pilots, and FAA engineers. Tests will be conducted while the Upgrade PRM/NAS system is operating under normal conditions, and while operating under various degrees of degraded operation. Tests will use targets of opportunity, FAA test aircraft, and simulators. Operational testing is subdivided into two categories, Normal Operational tests and Degraded Operations tests.

5.2.1 Normal Operational Tests.

The Normal Operational tests will evaluate the suitability and effectiveness of the Upgrade PRM/NAS system and the associated ATC procedures to conduct simultaneous parallel landings at 3500 feet (the runway separation at RDU) during instrument meteorological conditions.

5.2.1.1 Simulation Tests.

The simulation tests will use the configuration as shown in figure 5.2.1.1-1. This configuration uses the Desktop Simulator (DTS) to supply targets to the Upgrade PRM controller displays. The DTS is an interactive simulator. This means that the simulator operator will respond to the controllers instructions verbally over the operator's headset and functionally through any instructed flight changes with the simulator.

5.2.1.1.1 Objectives.

The main objectives of the simulation tests are to:

a. Determine by questionnaire whether the implemented display features are suitable for use in the NAS environment.

b. Determine by questionnaire whether there is any undue stress or otherwise adverse conditions induced on the monitor controllers while using the Upgrade PRM during periods of heavy and light blunder loads.

c. Determine by questionnaire whether any modifications to the ATC PRM procedures used by the monitor controllers are required.

d. Determine by measurement the effectiveness of the Upgrade PRM when used to conduct simultaneous parallel landings.

e. Determine by questionnaire whether the program supplied to list the data from the Upgrade PRM data extraction tape is suitable.

Requirements Tested:

AT-OR 7	AT-OR 8	AT-OR 11	AT-OR 12	AT-OR 13	AT-OR 14
AT-OR 15	AT-OR 16	AT-OR 17	AT-OR 19	AT-OR 20	AT-OR 21
AT-OR 22	AT-OR 23	AT-OR 24	AT-OR 25	AT-OR 26	

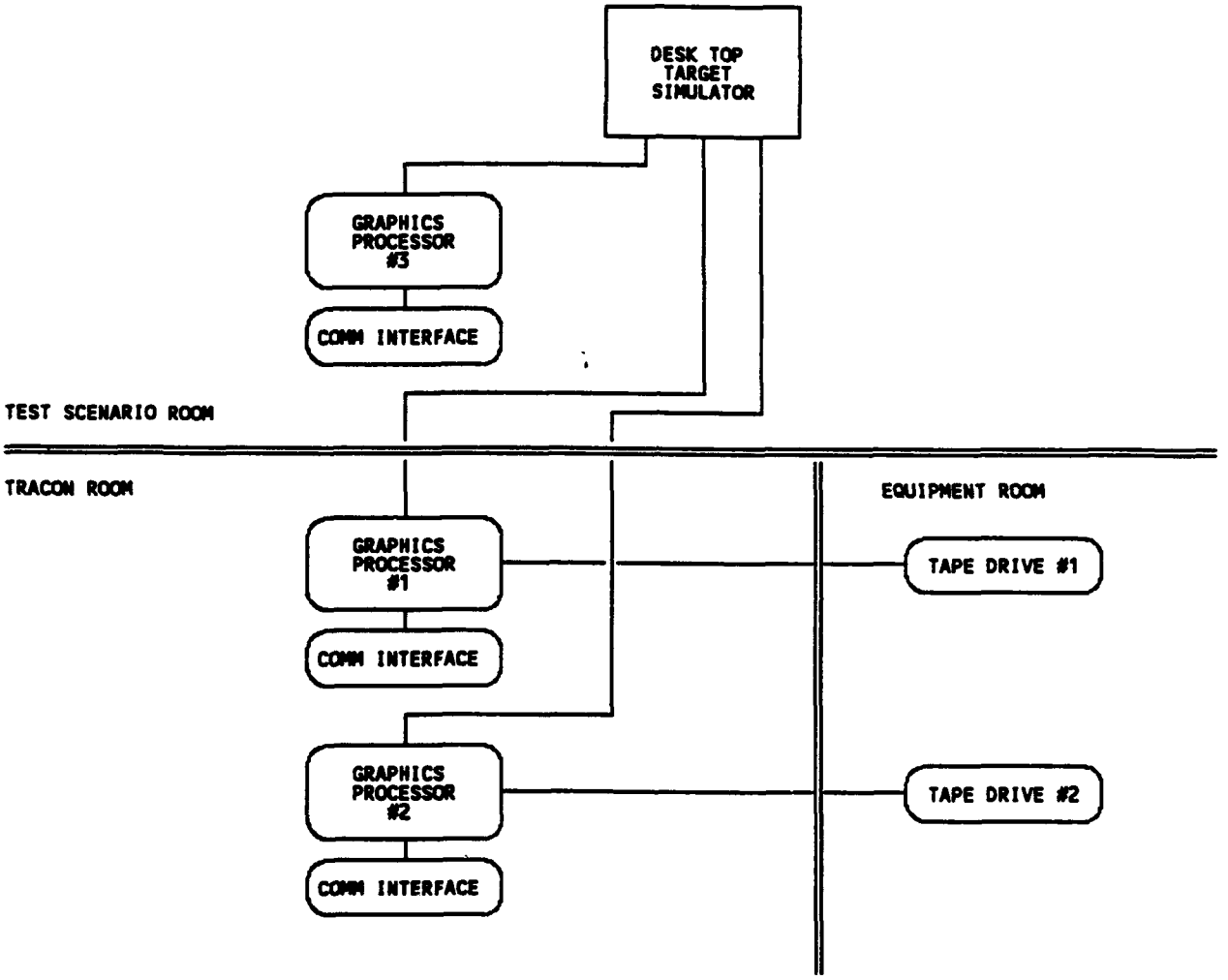


FIGURE 5.2.1.1-1. DESKTOP TRAFFIC SIMULATOR CONFIGURATION

5.2.1.1.2 Prerequisites.

The prerequisites for Simulation Tests are those stipulated in section 5, plus the following:

a. Provisional ATC procedures to support PRM landings, while using the Upgrade PRM/NAS system, have been established.

b. Training with the Upgrade PRM, and the associated ATC procedures, has been completed by the controllers involved in the test effort.

5.2.1.1.3 Support Requirements.

The support requirements for the simulation tests are those stipulated in section 5, plus the following:

a. Two sets of monitor controllers (two controllers per set)
b. DTS (with operator and scenarios)
c. Voice recorders
d. Controller Questionnaires
e. Significant Event Log

5.2.1.1.4 Test Description.

The DTS will be used to supply targets while subject controllers monitor the simulated PRM landings at the Upgrade PRM displays. Data for the effectiveness measurements will be collected at an update rate of 1 second. No transgression zone (NTZ) blunders will consist of 30° turns outside the outer marker, 30° turns inside the outer marker, and 15° turns on missed approaches. A minimum of 25 NTZ blunders, per blunder type, will be collected for each of two sets of controllers. This will yield a minimum of 150 blunders for analysis purposes. This effort will be conducted over a 3-week period. The simulations will contain both heavy and light traffic/blunder loads. For light blunder loads, very few blunders will occur during the data collection period. For heavy blunder loads, up to six blunders will occur per hour. Some simulations will be conducted through a controller shift change to investigate the transition from one controller set to the next. Time-tagged data will be collected to allow the determination of the alert response time for each blunder. The Upgrade PRM listing program will be used to list pertinent data from one of the simulation tests. The subject controllers will fill out Controller Questionnaires at the conclusion of each test period. These questionnaires will be developed with the assistance and concurrence of ATC and be included as part of the test's procedure. The questionnaire will contain sections addressing each of the objectives listed in section 5.2.1.1.1. The simulation tests will be conducted as outlined in the following steps:

a. A dry run of each test will be conducted before using subject controllers. The test engineer will use the dry runs to debug the test's procedure and simulation.

b. After the test has had a successful dry run, a test for the record shall be conducted with ATC monitor controllers. Test engineers shall maintain a Test Log to record all events as they occur. The Upgrade PRM data extraction functions will be used to collect the time of each yellow (blunder) alarm. Voice recorders will be used to collect the time of the controller's response to each alarm.

c. At the completion of each test, the monitor controllers will complete a Controller Questionnaire.

5.2.1.1.5 Data Analysis.

The test engineers will first analyze each test's Test Log to determine whether the test was concluded acceptably. The data from tests which are not concluded acceptably will not be included in any further analysis.

The Controller Questionnaires will then be analyzed. The initial analysis of the questionnaires shall be conducted by the test engineers. Any answers that point to a deficiency or a difference of controller opinion will then be reviewed with the controllers. This review will be conducted to form a consensus of controller opinions for each question.

The alert response time will then be computed for each blunder conducted. This will be done by computing the time between the Upgrade PRM yellow alarm and the time at which the monitor controller begins to issue a breakout instruction. The resultant set of alert times will then be used to compute the mean and standard deviation for each type of blunder as well as for each update rate.

5.2.1.1.6 Completion Criteria.

The simulation tests will be completed when:

a. The alert response times for the simulated blunders have been determined.

b. A consensus of controller opinions have been formulated for each of the following concerns:

1. Whether using the Upgrade PRM/NAS system to conduct PRM landings places any undue stress or otherwise adverse affects upon the monitor controllers.

2. Whether any modifications to the monitor controller's ATC PRM procedures are required or recommended.

3. Whether any modifications to the Upgrade PRM display presentation are required or recommended.

4. Whether the Upgrade PRM listing program is suitable.

5.2.1.2 Flight Tests.

The flight tests will use the configuration as shown in figure 5.2.1.2-1. This configuration uses FAA test aircraft to supply targets to the Upgrade PRM/NAS system. This configuration uses the full complement of air traffic controllers for each controller test set (approach, final, tower, and monitor controllers). This configuration is required to ensure that the coordination/communications between the controllers and pilots is suitable.

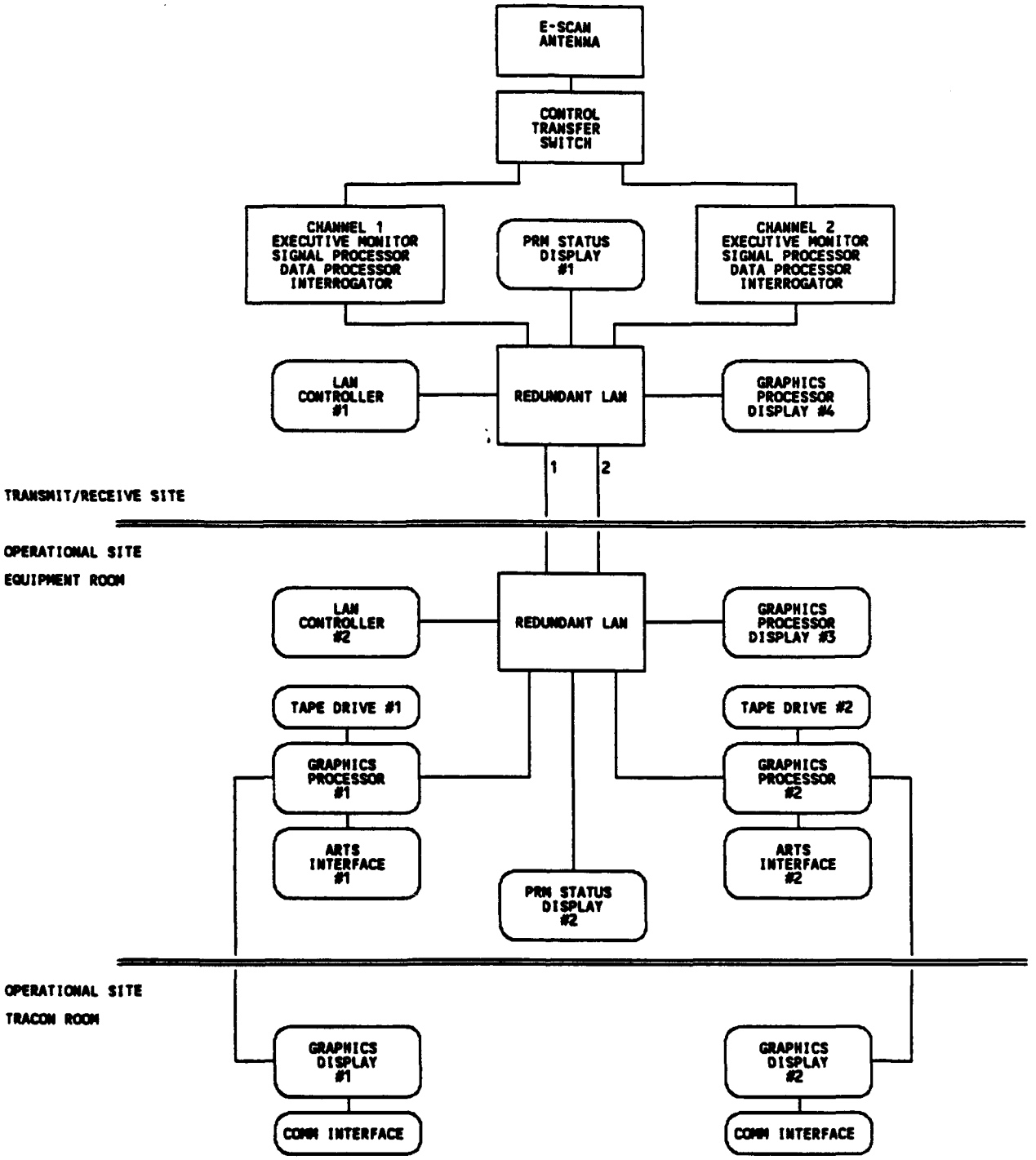


FIGURE 5.2.1.2-1. FLIGHT TEST CONFIGURATION

5.2.1.2.1 Objectives.

The objective of the flight tests are to:

a. Determine the suitability of the Upgrade PRM/NAS system to conduct PRM landings.

b. Determine whether there is any undue stress or otherwise adverse conditions induced on the involved controllers and pilots while using the Upgrade PRM/NAS system.

c. Determine whether any modifications to the ATC PRM procedures, to the Upgrade PRM/NAS interfaces, or to the controller/controller or controller/pilot coordination/communications are required.

Requirements Tested:
AT-OR 1 AT-OR 2 AT-OR 3 AT-OR 4 AT-OR 5 AT-OR 6
AT-OR 18 AT-OR 20

5.2.1.2.2 Prerequisites.

The prerequisites for the flight tests are those stipulated in section 5, plus the following:

a. ATC procedures to support PRM landings while using the Upgrade PRM/NAS system.

b. Training with the Upgrade PRM and the associated ATC procedures has been completed by the controllers involved in the test effort.

5.2.1.2.3 Support Requirements.

The support requirements for the flight tests are those stipulated in section 5, plus the following:

a. Two sets of controllers (approach, final, tower, and monitor controllers)
b. Two test aircraft with crews and associated flight plans
c. Controller Questionnaires
d. Pilot Questionnaires
e. Test Log

5.2.1.2.4 Test Description.

The flight tests will use two FAA aircraft flown by FAA test pilots. The flight tests will be designed to primarily test the coordination between the various controllers, the communication between the controllers and the aircraft, and the validity of the controllers' procedures. These flight tests will consist of scenarios such as poor turn-ons, incorrect runways, missed approaches, nonblunder conflicts, and NTZ blunders. The test subject controllers will include the two Upgrade PRM monitor controllers as well as the normal approach, final, and tower controllers. The monitor controllers shall follow the ATC procedures during each test flight to respond to system alarms by issuing warnings and instructions to the aircraft. When necessary, the monitor controllers will coordinate with approach, final, and tower control for breakout maneuvers. The NTZ blunders will be flown at

different ranges to test the controller/controller coordination in these different areas. The type and location of test flight will be precoordinated with the test pilots and the on-duty ATC supervisor. The flight tests will be conducted as outlined in the following steps. Two flight tests of 2-hour duration will be conducted per day. Two weeks of flight tests will be planned. A third week of flight tests will be scheduled but with the types of flight tests to be determined by the outcome of the initial 2 weeks of tests. The third week of flight tests will be used to test areas of controller concerns that might not have been tested sufficiently or to retest areas in which modifications to the controllers' procedures or coordination have been made.

a. A dry run of each test will be conducted before using either subject controllers or test aircraft. The test engineer will use the dry run to debug the test procedure and coordinate with the test pilots and the on-duty ATC supervisor.

b. After a successful dry run, a test for the record shall be conducted with subject controllers. Test engineers shall maintain a Significant Event Log to record events as they occur.

c. At the completion of each test, the subject controllers will complete a Controller Questionnaire and the test pilots, if applicable, will fill out a Pilot Questionnaire.

5.2.1.2.5 Data Analysis.

The test engineers will first analyze the Test Log to determine whether the test was concluded acceptably. The data from tests which are not concluded acceptably will not be included in any further analysis.

The initial analysis of the Controller and Pilot Questionnaires shall be conducted by the test engineers. Any answers that point to a deficiency or a difference of controller opinion will then be reviewed with the subject controllers (or test pilots). This review will be conducted to form a consensus of controller (pilot) opinion for each question.

5.2.1.2.6 Completion Criteria.

The flight tests will be completed when a consensus of controller and pilot opinions have been formulated for each of the following concerns:

a. The suitability of the Upgrade PRM/NAS system to conduct PRM landings.

b. Whether using the Upgrade PRM/NAS system to conduct PRM landings places any undue stress or otherwise adverse affects upon either the controllers (monitor, tower, final, or approach) or the test pilots.

c. Whether any modifications to the monitor controller's ATC PRM procedures, to the Upgrade PRM/NAS interfaces, or to the controller/controller or controller/pilot coordination/communications are required or recommended.

5.2.2 Degraded Operation Tests.

The degraded operation tests will analyze the adequacy of the Upgrade PRM/NAS system performance and the associated ATC procedures when failures in the Upgrade PRM/NAS system are encountered.

Before these tests can be conducted, the test engineers must determine, classify, and group all the possible degraded states of the Upgrade PRM/NAS system. This will be done for each type of Upgrade PRM failure (down to the LRU level), for stress conditions (i.e., high fruit, traffic), and for each possible Upgrade PRM/NAS system failure (communications and interface failures). These degradation states will be classified as either noncritical or critical. A noncritical degradation state is one in which PRM landings can be continued. A critical degradation state is one in which a reversion to staggered approaches is required. The degradation states will be grouped to produce a minimum number of individual degradation tests. This classification and grouping effort will be done with the assistance and concurrence of AT (Raleigh Tower). Examples of possible Upgrade PRM/NAS system degradation states are an Upgrade PRM channel switch, an Upgrade PRM display outage, nonupdating Upgrade PRM displays, reduced accuracy, reduced coverage, Upgrade PRM/ARTS interface failures, and blocked communications.

There will be two different configurations used during the degradation test. One will involve the use of the PATTS as shown in figure 5.2.2-1. The second configuration will use the DTS referred to in figure 5.2.1.1-1.

5.2.2.1 Noncritical Degradation Tests.

A noncritical degradation state is one in which PRM landings can be continued.

5.2.2.1.1 Objectives.

The major objectives of the noncritical degradation tests are:

a. To determine if the continuation of PRM landings can be safely maintained while using the Upgrade PRM/NAS system in each noncritical degradation state.

b. To determine whether there is any undue stress or otherwise adverse conditions induced on the controllers or pilots while using the Upgrade PRM/NAS system in each noncritical degradation state.

c. To determine the suitability of the Upgrade PRM/NAS system status reporting for each noncritical degradation state.

d. To determine whether any modifications to the ATC breakout procedures or to the controller/controller or controller/pilot coordination/communications are required.

e. To determine whether any of the degradation states classified as noncritical should be reclassified as critical.

Requirements tested:
AT-OR 9 AT-OR 10

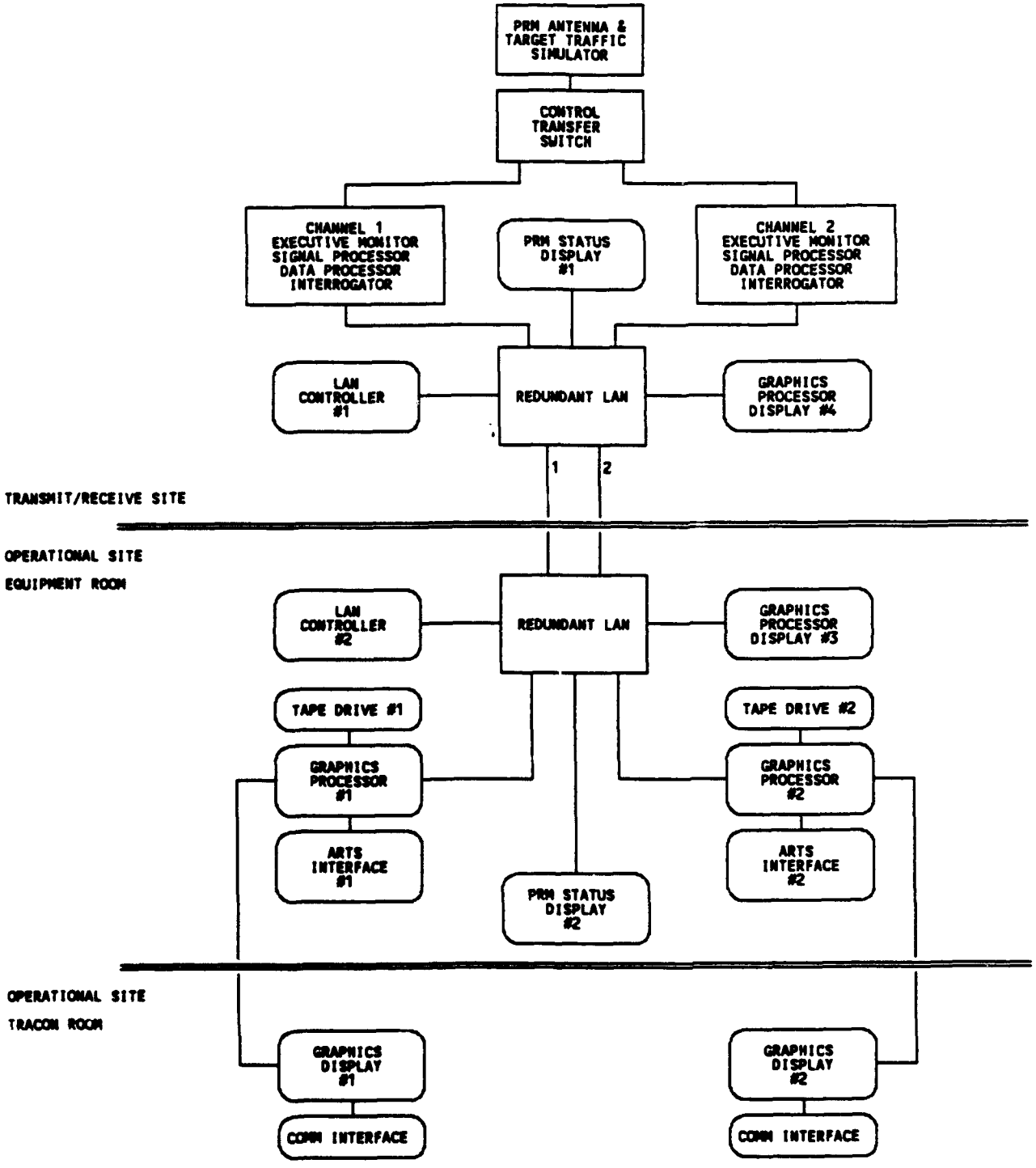


FIGURE 5.2.2-1. PRM ANTENNA AND TARGET TRAFFIC SIMULATOR CONFIGURATION

5.2.2.1.2 Prerequisites.

The prerequisites for the noncritical degradation tests are those stipulated in section 5, plus the following:

a. ATC procedures to support PRM landings, while the Upgrade PR' [illegible] in a degraded state, have been established.

b. Satisfactory completion of section 5.2.1 (Normal Operational Tests).

5.2.2.1.3 Support Requirements.

The support requirements for the noncritical degradation tests are those stipulated in section 5, plus the following:

a. Two sets of controllers (approach, final, tower, and monitor controllers)
b. PATTS simulator and associated scenarios
c. DTS and associated scenarios
d. Two test aircraft with crews and associated flight plans
e. Controller Questionnaires
f Pilot Questionnaires
g. Test Log

5.2.2.1.4 Test Description.

A list of the noncritical Upgrade PRM/NAS degradation states of the Upgrade PRM/NAS system, along with a test procedure for groups of similar states, is required before the start of the noncritical degradation tests. At any point in the tests, a degradation state that proves to be critical will be reclassified and tested in section 5.2.2.2. Tests where a demonstration of the degradation state is sufficient will use a monitor controller and targets of opportunity. Tests where the degradation state requires a capacity target load will use either the PATTS or the DTS. Live flights will be required where either the control of the aircraft, the coordination between the controllers, or the accuracy of the Upgrade PRM is at issue. For live flights, the flight plan will be precoordinated with the test pilots and the on-duty ATC supervisor. Flights will normally consist of NTZ blunders of 15° and 30°. Other flight scenarios will be designed to test the specific nature of the degradation state. The noncritical Upgrade PRM/NAS degradation state tests will be scheduled for 2 weeks. This estimate may change depending on the actual number of degradation states that require testing and the need for retesting if any modifications to the controllers' procedures or the NAS/Upgrade PRM configuration are required. The testing will be conducted as outlined in the following steps:

a. A dry run of each test will be conducted before using either subject controllers or test aircraft. The test engineer will use the dry run to debug the test's procedure and coordinate any flight tests with the FAA test pilots and the ATC supervisor.

b. After the test has had a successful dry run, then the test for the record shall be conducted with ATC subject controllers. Test engineers shall maintain a Test Log to record all events as they occur.

c. At the completion of each test, the subject controller will complete a Controller Questionnaires and the test pilots, if applicable, will fill out a Pilot Questionnaire.

5.2.2.1.5 Data Analysis.

The test engineers will first analyze each Test Log to determine whether the test was concluded acceptably. The data from tests which are not concluded acceptably will not be included in any further analysis.

The initial analysis of the Controller and Pilot Questionnaires shall be conducted by the test engineers. Any answers that point to a deficiency or a difference of controller (pilot) opinion will then be reviewed with the test's subject controllers (or test pilots). This review will be conducted to form a consensus of controller (pilot) opinion for each question.

5.2.2.1.6 Completion Criteria.

The noncritical degradation tests will be complete when a consensus of controller and pilot opinions have been formulated for each of the following concerns:

a. The operational impact and the resultant degree of safety for each noncritical degradation state.

b. Whether using the Upgrade PRM/NAS system in each of the noncritical degradation states to conduct PRM landings places any undue stress or otherwise adverse affects upon either the controllers (monitor, tower, final, or approach) or the test pilots.

c. Whether any modifications to the monitor controller's ATC procedures, NAS interfaces, or to the controller/controller or controller/pilot coordination/communications are required or recommended for each noncritical degradation state.

d. The suitability of the Upgrade PRM/NAS system status reporting for each noncritical degradation state.

5.2.2.2 Critical Degradation Tests.

A critical degradation state is one in which a reversion to staggered approaches (non-PRM landings) is required.

5.2.2.2.1 Objectives.

The major objectives of the critical degradation tests are:

a. To determine whether the reversion to non-PRM landings can be accomplished for each degradation state classified as critical.

b. To determine the suitability of the Upgrade PRM/NAS system status reporting for each critical degradation state.

c. To determine whether any modifications to the ATC PRM procedures, to the Upgrade PRM/NAS interfaces, or to the controller/controller or controller/pilot coordination/communications are required.

Requirements Tested:
None

5.2.2.2.2 Prerequisites.

The prerequisites for the critical degradation tests are those stipulated in section 5, plus the following:

a. ATC procedures to support PRM landings, while the Upgrade PRM/NAS is in a degraded state, have been established.

b. ATC procedures to support the reversion from PRM to non-PRM landings have been established.

c. Satisfactory completion of section 5.2.1. (Normal Operational tests).

d. Satisfactory completion of section 5.2.2.2 (noncritical degradation tests).

5.2.2.2.3 Support Requirements.

The support requirements for the critical degradation states tests are those stipulated in section 5, plus the following:

a. Test Log

b. Two sets of controllers (approach, final, tower, monitor, and supervisory controllers)

c. PATTS simulator and associated scenarios

d. Two test aircraft with crews and associated flight plans

e. Supervisor Controller Questionnaires

f. Pilot Questionnaires

g. DTS

5.2.2.2.4 Test Description.

Note that degradation states that compel the same controller actions are grouped into single tests. Test procedures are required before the start of the critical degradation tests. Tests where the degradation state requires a capacity target load will use either the PATTS or the DTS. Live flights will be required where either the control of the aircraft or the coordination between the controllers is at issue. These flights would be done with FAA aircraft and FAA test pilots. Flight scenarios will be designed to test the specific nature of the degradation

state. The NTZ blunders will not be tested during critical failures. The critical degradation tests will be scheduled for 2 weeks. This estimate may change depending on the actual number of degradation states that require testing and the need for retesting if any modifications to the controllers' procedures or the NAS/Upgrade PRM configuration are required. The critical degradation tests will be conducted as outlined in the following steps:

a. A dry run of each test will be conducted before using either subject controllers or test aircraft. The test engineer will use the dry run to verify the degradation state's classification, debug the test's procedure, and coordinate with the test pilots and the on-duty ATC supervisor.

b. After the test has had a successful dry run, then the test for the record shall be conducted with the subject controllers. Test engineers shall maintain a Test Log to record all events as they occur.

c. At the completion of each test, the supervisory controllers will complete a Controller Questionnaire and the test pilots, if applicable, will fill out a Pilot Questionnaire.

5.2.2.2.5 Data Analysis.

The test engineers will first analyze each Test Log to determine whether the test was concluded acceptably. The data from tests, which were not concluded acceptably, will not be included in any further analysis.

The initial analysis of the Controller and Pilot Questionnaires shall be conducted by the test engineers. Any answers that point to a deficiency or a difference of controller opinion will then be reviewed with the test's subject controllers (or test pilots). This review will be conducted to form a consensus of controller (pilot) opinion for each question.

5.2.2.2.6 Completion Criteria.

The critical degradation tests will be complete when a consensus of controllers' and pilots' opinion have been formulated for each of the following concerns:

a. The operational impact and the resultant degree of safety present when reverting to non-PRM landings for each critical Upgrade PRM/NAS system degradation state.

b. The suitability of the Upgrade PRM/NAS system status reporting for each of the Upgrade PRM/NAS system's critical degradation states.

c. Whether any modifications to the monitor controller's ATC procedures, NAS interfaces, or to the controller/controller or controller/pilot coordination/communications are required or recommended for each of the Upgrade PRM/NAS system's critical degradation states.

5.2.2.3 Reliability Analysis.

The reliability analysis will consist of a review of the contractor provided reliability study along with the actual system failure history during the Upgrade PRM Acceptance Tests and the OT&E test program.

5.2.2.3.1 Objectives.

The major objectives of the reliability analysis are:

a. To determine the reliability and availability of the Upgrade PRM system.

Requirements tested:
AT-OR 9

5.2.2.3.2 Prerequisites.

The prerequisites for the reliability analysis are those stipulated in section 5, plus the following:

a. The contractor's reliability study
b. The Upgrade PRM system Failure Log

5.2.2.3.3 Support Requirements.

The support requirements for the reliability analysis are those stipulated in section 5.

5.2.2.3.4 Test Description.

The test engineers will review the contractor's reliability study, along with the actual Upgrade PRM system Failure Log.

5.2.2.3.5 Data Analysis.

The test engineers will analyze the contractor's reliability study when viewed against the Upgrade PRM system operation during the OT&E test program to determine the systems reliability and availability figures.

5.2.2.3.6 Completion Criteria.

The reliability analysis will be complete when reliability figures can be determined that they are substantiated by actual "in use" failure data.

6. SCHEDULE.

The current schedule of the test and evaluation (T&E) activities for the Upgrade PRM program is depicted in table 6-1 below. This schedule is subject to modification.

TABLE 6-1. UPGRADE PRM T&E SCHEDULE

Test Description	Date/Time Allowance
Contractor System Integration and Test	3/92
Contractor Phase 3 Test (In-plant)	6/92
Contractor Phase 4 Test (On-Site)	9/92
FAA OT&E Program	
Integration Testing	
ARTS-IIIA Testing	2 days
Interference Testing	3 days
Operational Testing	
Normal Operational Testing	
Simulation Tests	3 weeks
Flight Tests	3 weeks
Degraded Operations Testing	
Noncritical Degradation Tests	2 weeks
Critical Degradation Tests	2 weeks
OT&E Total	3 months

7. DOCUMENTATION AND REVIEWS.

This section describes the test documentation, reviews, and reports that are necessary for the OT&E effort.

7.1 DOCUMENTATION.

The required documents for planning, conducting, and reporting the Upgrade PRM OT&E test activities are presented below. Table 7.1-1 illustrates the sequence of documentation preparation, who should prepare each document, and when the document should be completed.

TABLE 7.1-1. OT&E DOCUMENT SUMMARY

Document Name	Responsible Organization	Date
Operational Test and Evaluation Plan	ACW-100A (1)	3/92
OT&E Test Procedures	ACW-100A (1)	8/92
OT&E Pilot Controller Questionnaires	ACW-100A (1)	8/92
OT&E Mission Log	ACW-100A	Throughout OT&E testing
OT&E Anomaly Report	ACW-100A	Throughout OT&E testing
OT&E Upgrade PRM Failure Log	ACW-100A	Throughout OT&E testing
OT&E Final Report	ACW-100A	30 days after OT&E completed

(1) Developed with the aid and concurrence of the AT community.

7.1.1 Operational Test and Evaluation Plan.

This plan establishes the test configurations, requirements, objectives, and general test cases.

7.1.2 OT&E Test Procedures.

The test procedures will contain instructions for use while conducting each test. Included will be detailed instructions for data analysis, a checklist of required materials, any controller/pilot questionnaires required, and a test mission log for the specific test.

7.1.3 OT&E Pilot/Controller Questionnaires.

The Controller/Pilot Questionnaires will be used to collect controller/pilot evaluations of the Upgrade PRM/NAS system. Each test that requires one will have a specific questionnaire developed for that test. The Controller Questionnaires will be developed with the assistance/concurrence of Raleigh Tower and be coordinated with the controller union. The Pilot Questionnaires will be developed with the assistance of the test pilots (ACN-300).

7.1.4 OT&E Mission Log.

The test mission log shall be used to make notes about the test during either the pretest review, test conduct, or the post-test review.

The pretest section of the mission log shall be used to document any open items (to be determined or discrepancies from the test procedure), a list of the test conduct members, and any discrepancies from the planned test configuration.

The test conduct section will be used to record specific test events as noted in the test procedure.

The post-test section shall be used to document any deviations from the test procedure that were not noted in the pretest section, a summary of the test conduct, and a preliminary assessment of the test results.

7.1.5 OT&E Anomaly Report.

The test anomaly report shall be completed during the post-test review. Test anomaly reports shall be used to document any hardware/software/system anomalies encountered during testing. These reports shall list in detail as much information about the anomaly as is known.

7.1.6 OT&E Upgrade PRM Failure Log.

An Upgrade PRM failure log shall be maintained during the OT&E test effort. This log will be filled out for any system failure whether during an actual test or not. The log should also indicate the failure type, date, severity, and resolution data. This resolution data should consist of when the Upgrade PRM maintenance contractor was notified of the problem, when the contractor responded, and when the system was once again available for use.

7.1.7 OT&E Final Report.

A Final Test Report will be produced and delivered to the program manager within 30 working days after the final test has been completed. The report will document the results of the test analysis and assess the ability of the Upgrade PRM to perform the required tasks. The Final Test Report will contain the following:

a. A description of the test configurations.

b. References to the applicable test plan and procedures.

c. Identification of the specific tests and the dates of the test runs.

d. The specific test objectives, including references to the applicable requirements and specifications.

e. A description of the criteria used for evaluation of each test.

f. Detailed test results for each test.

g. A summary of the results of each test.

h. A summary of the DT&E test effort.

i. Conclusions and Recommendations.

7.2 REVIEWS.

The following subsections describe the pretest reviews and the post-test reviews that will be held for each test.

7.2.1 Test Readiness Review.

This review will be held prior to the start of each test. The purpose of this review will be to accomplish the following:

a. Identify any needed changes and redline the procedures accordingly.

b. Review the hardware and software configurations of the test environment.

c. Ensure that all items in the test procedure's material checklist have been received.

d. Fill out the pretest section of the Test Mission Log.

7.2.2 Post-Test Review.

This review will be held upon the completion of each test. The purpose of this review will be to accomplish the following:

a. Identify any procedure step changes or test discrepancies and their significance to the test results.

b. Identify the "as-run" hardware and software configurations.

c. Summarize the actual test conduct and determine a preliminary assessment of the test results.

d. Fill out the post-test section of the Test Mission Log.

8. TEST TRAINING.

Contractor and FAA test personnel need not undertake formal Upgrade PRM training. The FAA air traffic controllers who take part in the operational tests must have received formal AT training in the use of the equipment and the formal air traffic procedures used during Upgrade PRM type operations.

9. ACRONYMS AND DEFINITIONS.

ATCBI	Air Traffic Control Beacon Interrogator
AT	Air Traffic
ATC	Air Traffic Control
ARTS	Automated Radar Terminal System
ASR	Airport Surveillance Radar
BCD	Bendix Communications Division
BFTA	Beacon False Target Analysis
DR&A	Data Reduction and Analysis
DT&E	Developmental Test and Evaluation
DTS	Desktop Simulator. An Upgrade PRM test tool which simulates air traffic (in the form of tracks) to the Graphics Processor.
E-Scan	Electronically Scanned. A 360° phased array of dipole columns which use phase shifters to electronically form a beam pattern.
FAA	Federal Aviation Administration
ILS	Instrument Landing System
MLS	Microwave Landing System
MSI	Minority Services, Inc.
MTBCF	Mean Time Between Critical Failure
NAS	National Airspace System
Non-PRM Landings	Staggered approaches to parallel runways which are used to maintain the legal separation of aircraft in IMC at airports without a PRM.
NOZ	Normal Operating Zone
NTZ	No Transgression Zone
OT&E	Operational Test and Evaluation
PAT&E	Production Acceptance Test and Evaluation

PATTS	PRM Antenna and Target Traffic Simulator. An Upgrade PRM test tool which allows capacity testing (fruit and target) within a controlled (simulated) environment.
PRF	Pulse Repetition Frequency
PRM	Precision Runway Monitor
PRM landings	Parallel simultaneous approaches to parallel runways using the PRM system configuration.
RARRE	Radar Analysis Radar Reinforced Evaluator
RDU	Raleigh/Durham International Airport, North Carolina
T&E	Test and Evaluation
TRACS	Transportable Radar Analysis Computer System
Upgrade PRM	The subject system of this test plan. The Precision Runway Monitor system to be commissioned for operational use at RDU.

APPENDIX A

AIR TRAFFIC OPERATIONAL REQUIREMENTS FOR A PRM SYSTEM

AIR TRAFFIC OPERATIONAL REQUIREMENTS (AT-OR)
FOR A PRM SYSTEM

AT-OR 1:

(a) The PRM shall be capable of providing coverage at the subject airport* for all parallel runways which have a parallel approach application**. This requirement may be satisfied by multiple sensors capable of presenting all data (and/or and part) on a common display***.

1a* Raleigh/Durham International Airport (RDU).
1a** Runways 5L/23R and 5R/23L.
1a*** This does not apply to RDU PRM implementation.

AT-OR 2:

(a) Elevation coverage shall extend from no higher than 50 feet above the airport surface(*) to at least 1,500 feet above the highest initial approach altitude for any Instrument Landing System (ILS)**/Microwave Landing System (MLS)*** approach used.

2a* Airport surface is defined as 436 feet MSL at RDU.
2a** The highest initial ILS approach altitude at RDU is 4000 feet MSL.
2a*** MLS not in use at RDU. Highest initial ILS approach is 4000 feet MSL.

AT-OR 3:

(a) Range coverage shall be up to 30 nautical miles (nmi) from runway end* on the final approach course continuous to 5 nmi beyond (the) approach end on the departure/missed approach side** of the airport.

3a* Defined as 1.1 nmi from the PRM antenna for runway 5R (which has the furthest approach end from the PRM antenna).
3a** Defined as 0.29 nmi from the PRM antenna for runway 23L (which has the nearest approach end to the PRM antenna).

AT-OR 4:

(a) Azimuth coverage shall extend a minimum of 2 miles (nmi) (to) either side of the parallel/converging* runways final approach paths continuous through the missed approach courses**.

4a* Converging runways are not applicable at RDU.
4a** Requirement states that 360° coverage is required for a total distance of 2 nmi, plus the distance from the PRM antenna to the furthest of the RDU missed approach points (missed approach point for runway 5R).

AT-OR 5:

(a) The area of nonreturn around the sensor shall not adversely affect (the) controller(s') capability to monitor final or initial missed approach courses*.

5a* This requirement effectively allows for an area of nonreturn (i.e., the area shielded by the RDU ATC tower), if this area of nonreturn does not affect the controllers' ability monitor PRM missed approaches.

AT-OR 6:

(a) Sensor accuracy shall be verified to ensure correlation of target symbology with actual aircraft position, assuming the aircraft equipment has zero error*.

6a* This requirement recognizes that transponder delay is a function of individual transponders.

AT-OR 7:

(a) Independent displays shall be provided for each monitor position. However, for availability* a single display may be used for two monitor positions.

7a* Requirement states that PRM approaches can continue if one of the two displays is inoperable.

AT-OR 8:

(a) System capacity shall be at least 25 tracked targets for dual operations.

(b) System capacity shall be at least 35 tracked targets when used for triple parallel operations*, and

(c) 50 tracked targets when used for quadruple parallel operations*.

8b* Not applicable at RDU.
8c* Not applicable at RDU.

AT-OR 9:

(a) System reliability shall be at least equivalent to existing Airport Surveillance Radar (ASR) monitor systems*,

(b) including uninterruptable power source and,

(c) fail safe capability (all display data retained when changing power source).

9a* Existing ASR monitor system reliability equals 1000 hours Mean Time Between Critical Failure (MTBCF) for the ASR-9.

AT-OR 10:

(a) System failures which compromise (the) safety of the PRM shall generate a visual alarm on the display,

(b) as well as an aural signal.

(c) In the event of a system overload or partial failure, an appropriate message shall be generated and displayed for the controller.

(d) The system shall not "bomb out," but will drop data based on its relative importance, temporarily reduce range, or otherwise allow the system to recover.

(e) Tracked targets shall not be affected.

AT-OR 11:

(a) Tracked target recording, replay, and simulation shall be a capability.

AT-OR 12:

(a) Resolution and display presentation shall enable a monitor controller to detect tracked target deviations from a course of 100 feet or less.

AT-OR 13:

(a) The display shall be at least 18 inches in diameter or diagonally,

(b) and the console shall not exceed the size of the current AT ARTS consoles*.

13b* The size of the current ARTS console is 48 inches H, 30 inches W, and 56 inches D.

AT-OR 14:

(a) Each monitor position shall have operator controls and keypack units immediately accessible to the user.

AT-OR 15:

(a) The display shall have full variable range and offset capability.

(b) Display presentation quality shall recover within 1 second after range change or offset.

AT-OR 16:

(a) Display presentation quality shall provide sufficient contrast and brightness under normal TRACON ambient lighting conditions

(b) and must be free of reflection and glare.

AT-OR 17:

(a) Display presentation quality shall be constant throughout the display area,

(b) clear of clutter,

(c) flicker free,

(d) of uniform brightness,

(e) and well defined with no blooming.

AT-OR 18:

(a) The system shall be relatively free of false targets or other spurious returns on the display.

AT-OR 19:

(a) Display mapping capability shall be available for selection by the controller.

(b) Line widths and any associated alphanumerics shall be as small as practicable with variable intensity.

(c) Mapping shall include as a minimum:

1. Runway outline(s) of all runways within the coverage area of the PRM system.

2. A broken line in one-half or 1-mile increments (site selectable) representing the final approach course to each runway to be used for simultaneous approaches.

3. Final approach fix and other appropriated fixes as displayed on the ARTS display*.

4. Prominent obstructions.

5. A no transgression zone (NTZ) 2,000 feet wide located equidistant between (the) parallel runway centerlines.

6. The normal operating zone (NOZ) is that area between (the) runway centerline (extended) and the closest edge of the NTZ.

7. The NOZ shall be clearly distinguishable from the NTZ and displayed in increments of 200 feet.

AT-OR 20:

(a) Tracked targets shall automatically display associated ARTS data block information including low altitude and conflict visual alerts when appropriate.

(b) Character size, intensity, data block offset, leader line length, and field inhibit shall be controller selectable at each display.

AT-OR 21:

(a) Target symbology on the largest setting shall not exceed the approximate size of a large (B-757) type aircraft*,

(b) and shall represent the most recent return for each tracked target.

21a* On the RDU 20- x 20-inch Sony displays, the largest target symbol extrapolates to 0.1875 inches.

AT-OR 22:

(a) Tracked target symbols shall have a track history displayed that

(b) shall be variable in intensity and its length (from) 0-16 hits,

(c) it shall also be controllable from the keyboard or console.

(d) The use of this feature shall be optional on the controllers' part as directed by the procedures*.

22d* Procedures refer to the Air Traffic Controller Handbook procedures.

AT-OR 23:

(a) Tracked target symbols shall have a projected track vector generated from track history and ground speed,

(b) and then displayed as a keyboard or console controlled variable length line.

AT-OR 24:

(a) A track projected to enter the NTZ in 10 seconds shall uniquely change to alert the controller (flashing data block, color change, etc.).

(b) This number of seconds shall be programmable from 0-16.

AT-OR 25:

(a) A distinctive voice alert shall sound only at the monitor position when a track is projected to enter the NTZ.

(b) This alert shall have a controllable volume switch at each operational position.

AT-OR 26:

(a) Track deviations which infringe into the NTZ shall generate a printout of track data (data block information, etc.).

(b) System parameter changes shall also generate printout.

AT-OR 27:

(a) The PRM system shall have a passive ARTS interface.