QUICK LOOK REPORT
for the AIRWAYS FACILITIES PHASE of the UPGRADE PRECISION RUNWAY MONITOR (PRM) OPERATIONAL TEST AND EVALUATION (OT&E)

DOT/FAA/CT-ACW10093/3
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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY.

This Quick Look Report provides a preliminary assessment of the Airways Facilities phase of the Operational Test and Evaluation (OT&E) on the Upgrade Precision Runway Monitor (PRM) at Raleigh-Durham International Airport (RDU).

Analysis on the data collected indicates that there are 7 major deficiencies, 11 moderate deficiencies and 1 minor deficiency.

2. PURPOSE.

The purpose of this report is to provide an early assessment on the data collected during the Airways Facilities phase of the Operational Test and Evaluation (OT&E) on the Upgrade Precision Runway Monitor (PRM) at Raleigh-Durham International Airport (RDU).

3. SCOPE.

This document is limited to providing a preliminary assessment on the data collected during the Airways Facilities phase of the Operational Test and Evaluation (OT&E) on the Upgrade Precision Runway Monitor (PRM) at Raleigh-Durham International Airport (RDU). This report does not address either the Integration or the Air Traffic phases of the Upgrade PRM OT&E. It is not the intention of this report to document the detailed analysis performed.

This report also provides a proposed solution for each deficiency. This proposed solution is not intended as the only possible or the required solution, the solution may not be the optimal engineering solution, or the most practical. The proposed solution is offered to provide additional insight into the deficiency and to provide a starting point in developing an acceptable solution.

The final OT&E Test Report will include details of the testing performed and will also provide updated recommendations. Solutions to deficiencies implemented at the time of the final report will be noted, along with the results of any subsequent OT&E retesting.

4. BACKGROUND.

The Upgrade PRM OT&E Integration and OT&E Operational test effort is being conducted in three separate phases; Integration, Air Traffic (AT) Operational, and Airways Facilities (AF) Operational. The OT&E Integration phase determines the suitability and effectiveness of the PRM interfaces and their technical performance. The AT Operational phase determines the suitability and effectiveness of the PRM system to support AT's mission. The OT&E AF Operational phases determines the suitability and effectiveness of the PRM system to support AF's mission. This report documents the results of the Airways Facilities Operational phase. These tests are detailed in section 6.3 (AF OT&E Operational Tests) of the Upgrade PRM OT&E Integration and OT&E Operational Test Procedures: DOT/FAA/CT-ACW10093/2. These tests were conducted at RDU, from June 2nd, to June 11th 1993.

5. TEST DESCRIPTION.

The AF Operational Test was an evaluation of suitability and effectiveness of the Upgrade PRM/NAS system the PRM Instruction Book (IB) and the associated contractor provided training to support the maintainability of the PRM system.

The Upgrade PRM/NAS system was evaluated by two RDU AF technicians, one AF sector supervisor, and two FAA test engineers.

5.1 TEST OVERVIEW.

The AF OT&E Operational tests were conducted as a multi step strategy starting with tests of the PRM's fault detection and isolation capabilities, progressing through LRU (lowest replaceable unit) replacement, and leading to tests to insure that the FAA technicians (using the contractor provided training, the IB and the FAA Maintenance Handbook) can successfully certify the Upgrade PRM system.

The PSD Fault Detection and Isolation Tests determined the suitability of the fault detection and isolation capabilities provided by the PRM PSD and the operational effectiveness of the associated sections of the IB and contractor provided training. These tests had the Test Technician use the IB and PSD to detect and isolation various faults inserted into the PRM system.

The LRU Replacement Tests and Analysis determined the suitability and effectiveness of the contractor provided training and the IB to enable a technician to replace LRUs in the PRM system. This tests had the test technicians use the IB to remove and replace selected LRUs as well as walk through the IB for other selected LRU replacements.

The PRM Certification Tests determined whether the Test Technician could certify the PRM system using the PRM IB, the contractor provided training and the FAA Maintenance Handbook. This test included having the test technician perform selected subsystem certifications as well as an overall PRM certification.

The System Reliability was determined through an analysis of the reliability data collected on the system beginning during the On-site DT&E through the OT&E test period.

For each test conducted, the test engineers filled out Test Data Logs to document the actual test conduct. This information included the actual system configuration used, any changes from the test procedure, any significant events that took place and any relevant comments from the Test Technicians.

The test Technicians filled out Questionnaires at the conclusion of each test. These Questionnaires pertain to the suitability and effectiveness of the PRM/NAS system and the contractor provided documentation and training to support the maintenance of the Upgrade PRM system.

5.2 TEST ANALYSIS.

The analysis conducted for this evaluation consisted of a review of the test data logs, the Technician questionnaires, and any outstanding deficiencies reported from the DT&E test phase. The initial review was conducted by the test director. This review highlighted and assigned a deficiency classification to each deficiency. A second review was then conducted with the test director, test engineers and the test Technicians. In this review each deficiency was discussed and a consensus was reached. This consensus determined whether the deficiency should be identified at all, and if so, what the deficiency was, what it's classification should be, and what the proposed solutions should be. The deficiencies were classified as either Major, Moderate or Minor. These classifications are defined as:

Major - This deficiency either by itself or in combination with other factors may preclude a deployment recommendation.

Moderate - This deficiency results in either an increase in life cycle costs or provides unsatisfactory performance that can be worked around and perhaps eventually fixed but does not of itself prevent a deployment recommendation.

Minor - This deficiency results in undesirable performance that is inconveniencing but does not significantly affect mission effectiveness or life cycle costs.

Note that all the deficiencies should be reviewed to assess their impact on the limited production PRM program.

6. TEST REPORTS.

The initial data collection phase of the AF Operational tests was successfully completed. The deficiency matrix in section 6.1 contains a description, classification and proposed solution for each deficiency.

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Note that all the deficiencies should be reviewed to assess their impact on the limited production PRM program.
There are 7 Major Deficiencies, 11 Moderate Deficiencies, and 1 Minor Deficiency.

6.1 DEFICIENCY MATRIX.

#	Deficiency Description	Deficiency Classification	Proposed Solution
1	PRM Maintenance Handbook - The draft of the FAA Maintenance Handbook available for the OT&E contained numerous redlines, was incomplete, and contained certification procedures that could not be successfully conducted.	Major - The PRM cannot be certified with the current draft of the FAA Maintenance Handbook.	1- Incorporate redlines, and 2- Add checks for alarm speakers, and 3- Revise certification procedures for range/azimuth accuracy and sensitivity.
2	PRM Instruction Book (IB) Certification Issues - The PRM Maintenance Handbook references sections of the PRM (IB) which are not complete.	Major - The PRM cannot be certified with the current draft of the FAA Maintenance Handbook referencing the current PRM IB.	1- Modify the PRM IB as required: list all PSD screens and, add text to describe the PSD screens and add steps to get to the various PSD screens, or 2- Modify the PRM Maintenance Handbook so that there are no PRM IB references.
3	PRM System Certification Issues - The PRM Maintenance Handbook references PRM system features that do not exist.	Major - The PRM cannot be certified with the current draft of the FAA Maintenance Handbook referencing the unavailable PRM system features.	1- Modify the PRM as required: list output power on the PSD as the Maintenance handbook requires and, add parrot obstruction marks, and add manual check for the PRM alarm speakers, or 2- Modify the PRM Maintenance Handbook so that these PRM system features are not required.
4	Certified Test Equipment - The test equipment leased by MSI is not certified following local RDU guidelines.	Major - The PRM cannot be certified with the current test equipment available.	1- Insure that the leased test equipment is certified as required by local RDU AF.
5	Maintenance Coordination Procedures - Local procedures for maintaining the PRM system have not yet been developed.	Major - The PRM cannot be certified until the FAA technicians understand there role in the PRM maintenance and certification procedures.	1- Develop local procedures to detail the roles and responsibilities of the FAA technicians, the maintenance contractor technicians and RDU AT.
6	UPS Status Reporting - The UPS status is not suitably presented by the PRM. The UPS status is presented as GO/NOGO where the NOGO conditions could mean numerous things: the UPS has failed, the UPS is on batteries, etc. The UPS status is also located on a submenu screen and is not suitably listed on the main PSD screen.	Major - The continuous operation of the PRM cannot be insured given the status reporting by the PRM on the UPS subsystem.	1- Modify the PRM PSD so that UPS status is on the main PSD screen, and 2- details what the status of the UPS is (faulted on batteries, etc), and 2- Add an aural alarm on the PSD for pertinent UPS status, and 3- Add a time indication for UPS "on battery" conditions.
7	MDBM Certification Check - MDBMs that have PRM/ARTS interface units attached to them fail the ARTS certification checks.	Major - The PRM cannot be interfaced to a certified MDBM.	1- Modify the ARTS MDBM certification check.
8	PSD Aural Alarm - The aural alarm on the PSD can not be heard over the background noise in the AF Equipment room.	Moderate - There are numerous alarms that only come from the PSD alarm speaker that could result in lower system availability if not timely responded to.	1- Increase the volume on the PSD speaker or, 2- Add an external speaker.

#	Deficiency Description	Deficiency Classification	Proposed Solution
9	PSD Indicator for Supervisor GP - There is no suitable way to determine which GP is in supervisor mode.	Moderate - The supervisor GP is required to perform almost any maintenance on the PRM. To have to check 3 locations to determine which GP is supervisor will increase maintenance costs.	1- Add an * next to the current supervisor GP on the main PSD display screen.
10	PSD Tape Status Reporting - The tape status is not suitably presented to the Technicians. I.e., both tape failure conditions and tape full conditions are reported on the PSD as tape drive failures.	Moderate - The lack of tape status leads to an assumption that a reported tape fault indicates a full tape. This may not be the case an would lead to decreased system availability and maintenance costs when it is not.	1- Modify the PSD to indicate tape full conditions as such and not as a tape fault.
11	Tape Fault Latching - Dual tape faults latch GP1 and GP2 into a maintenance status.	Moderate - Because tape faults are latched the GPs must be reset to clear the faulted condition leading to decreased system availability. Note: that until deficiency #10 is resolved full tape are faults.	1- Modify the PRM so that tape faults are not latched, or 2- Modify the PRM so that tape faults can be cleared without needing to reset the associated GP.
12	Power supply check points - The PRM channel power supply check points have a shorting hazard. To check the voltage levels the voltmeter probe must be inserted through a metal opening which could cause a short and damage the power supply.	Moderate - The unintended shorting out of a power supply will increase life cycle costs.	1- Add rubber grommets to the power supply check point openings.
13	RFD Shock Hazard - The RFD is a non-waterproof installation with a metal floor this is an unacceptable condition to work on electrical equipment.	Moderate - Technicians would be unable to work on the RFD in certain conditions increasing maintenance costs.	1- Obtain a rubber mat to be put down as needed in the RFD.
14	Antenna Maintenance Safety - The removal/replacement of an antenna element or monitor strip is hazardous.	Moderate - Technicians would be unable to work on the PRM antenna increasing maintenance costs.	1- Obtain safety belts, and 2- Add appropriate tie downs to the PRM antenna structure.
15	Spare PSD/Parrot - There is currently no spare PSD or Parrot.	Moderate - The lack of spares could lead to decreased availability and increased maintenance costs.	1- Obtain a spare parrot, and 2- Obtain a spare PSD and preload the PSD software onto it.
16	PRM Instruction Book - The PRM IB is deficient in almost all areas it is unorganized, incomplete, and incorrect. The PRM IB can not be used to trouble shoot PRM system problems, remove/replace LRUs, or even properly reset the PRM subsystems.	Moderate - The lack of a suitable Instruction Book could lead to decreased availability and increased maintenance costs.	1- Reorganize the IB, and 2- Add the missing sections (refrain from simply referring to a COTS manual, and more information as appropriate), and 3- Correct the IB entries.

#	Deficiency Description	Deficiency Classification	Proposed Solution
17	PRM Maintenance Training - The PRM Contractor provided maintenance training did not cover or use the PRM Instruction Book.	**Moderate** - The lack of knowledge about the PRM Instruction Book could lead to decreased availability and increased maintenance costs.	1- Add to the training a section on the organization and use of the PRM IB, and 2- Use the PRM IB in the hands on labs.
18	System Reliability - The system reliability data collected (2009 hours) beginning with Phase 4 tests through this OT&E period indicates that the PRM MTBCF = 670 hours and the MTBF = 144 hours (without including PRM ARTS I/F faults, and parrot faults).	**Moderate** - The MTBCF and MTBF indicate a system that will have unacceptable availability and high maintenance costs.	1- Resolve AT OT&E issues 1 & 2 (rain and ice), and 2- Add a third parrot or move the 23 right parrot to a better location, and 3- Do not latch the PRM/ARTS I/F units faults.
19	System Fault Latching - The PRM system latches all faults with no reset attempted.	**Minor** - The PRM fault latching design leads to high maintenance cost and lower availability then is optimum.	1- Modify the system so that a faulted channel will attempt 2 or 3 resets before latching nogo, and 2- Modify the GPs so that a faulted Graphics Display/Processor will attempt 2 or 3 resets before latching nogo.

6.2 FURTHER TESTING.

Further testing for this test effort should be limited to retesting any modifications made to the PRM/NAS system in addressing OT&E deficiencies.

7. CONCLUSIONS

This test effort highlights 7 Major Deficiencies. The consensus opinion of the Test Engineers and the Test Technicians is that the PRM system should not be deployed without addressing each of these Deficiencies.

This test effort highlights 11 Moderate Deficiencies. The consensus opinion of the Test Engineers and the Test Technicians is that these deficiencies could be temporarily worked around so that the PRM system could be deployed, but that these deficiencies may results in lower system availability and increased maintenance costs. Action should be taken to address each of these deficiencies as soon as possible.

This test effort highlights 1 Minor Deficiency. This deficiency should be evaluated against the limited production PRM design.

8. RECOMMENDATIONS

The Secondary Surveillance Division, ACW-100, recommends against commissioning of the Upgrade PRM system until each of the 7 Major Deficiencies have been addressed, a corrective action plan for the 11 Moderate Deficiencies has been developed.

APPENDIX A. ACRONYMS

AF	Airways Facilities
ARTS	Automated Radar Terminal System
AT	Air Traffic
DOT	Department of Transportation
DT&E	Development Test and Evaluation
FAA	Federal Aviation Administration
GP	(PRM) Graphics Processor
I/F	Interface
MDBM	Multiplex Data Buffer Memory (ARTS device that the PRM interfaces to)
NAS	National Airspace System
OT&E	Operational Test and Evaluation
PRM	Precision Runway Monitor
PSD	PRM Status Display
RDU	Raleigh-Durham International Airport
UPS	Uninterruptable Power Source