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

DOT/FAA/CT-ACW10093/1
May 1993

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1. INTRODUCTION

1.1 PURPOSE

The purpose of this report is to provide a preliminary assessment on the data collected during the Air Traffic 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 Airways Facilities (AF) phases of the Upgrade PRM OT&E. These phases are scheduled to be conducted beginning 6/1/93.

1.2 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 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 Air Traffic Operational phase. These tests are detailed in section 6.2 (AT 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 April 14th, to April 21st 1993.

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 feasibility of flying simultaneous, independent approaches to the parallel runways separated by 3500 feet or greater during (Instrument Flight Rules) IFR conditions with the added capabilities provided by a PRM.

2. TEST DESCRIPTION

The AT Operational Test was an evaluation of suitability and effectiveness of the Upgrade PRM/NAS system and the associated contractor provided documentation and training. This test effort did not evaluate the Air Traffic procedures or operational training. Nor did this test effort attempt to revalidate the PRM concept. However, this test effort was designed to provide the test controllers with various operational situations so that they could independently evaluate the Air Traffic procedures and operational training and report directly to air traffic.

The Upgrade PRM/NAS system was evaluated by four RDU AT controllers (one was a supervisor) and two FAA test engineers. Tests were conducted while the Upgrade PRM/NAS system was operating under normal conditions, and while operating under various degrees of degraded operation. The tests used targets of opportunity, simulators, and FAA test aircraft.

2.1 TEST OVERVIEW

The AT OT&E Operational tests were conducted as a multi step strategy starting with simple tests using targets of opportunity, progressing through tests dealing with PRM target alerts and system alarms using simulators and finally culminating with full flight tests.

The target of opportunity tests allowed two AT controllers to view the PRM displays at the same time while the other two AT controllers evaluated the associated contractor supplied documentation. When the controllers had completed the test's Questionnaires, they exchanged places allowing all four to complete the evaluations. There was one test added to the target of opportunity non-critical degraded modes test. This test demonstrated the status reporting of the PRM power systems.

The simulation tests were conducted with two AT controllers manning the PRM displays while the other two AT controllers acted as pseudo pilots. Three separate scenarios were run, with each scenario being run twice, so that all four controllers manned the PRM display for all three scenarios.

The live flight tests were conducted with two AT controllers manning the PRM displays (as Monitor controllers), a third controller manned a final controller position, and the fourth controller manned a tower controller position. The flight tests were run twice, so that all four controllers were able to act as Monitor controllers at the PRM displays. The time period available to conduct the live flight tests was reduced because of the lack of an override capability on the Monitor Controller's communications. For this reason the flight profiles were modified in agreement with local RDU AT and the test AT Controllers to optimize the data collected. The lack of the override capability did not impact the tests since the objectives of the tests did not require this capability.

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 Controllers.

The test AT Controllers 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 a Monitor controllers tasks and responsibilities.

2.2 TEST ANALYSIS

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

Deployment Critical (DC)- This problem poses a serious risk to the safe operation of the PRM/NAS system and should be corrected before the deployment of the Upgrade PRM system.

Deployment Non-critical (DNC)- This problem poses a significant risk, but can be worked around temporarily and need not hold up the deployment of the Upgrade PRM system. Since the problem may increase either the workload or stress level on a Monitor Controller it should be corrected as soon as possible.

Non Deployment (ND) - This problem poses a low risk that can be worked around on the Upgrade PRM. However the problem may increase the workload or stress level on a Monitor Controller and should be corrected if time and costs constraints allow.

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

3. TEST RESULTS

The initial data collection phase of the AT Operational tests was successfully completed. It should be noted that problems 1 and 2 were not encountered during this test phase but were encountered during the Contractor Development Test and Evaluation (DT&E). The problems are noted here due to their impact on PRM's ability to support Air Traffic's mission. The problem matrix in section 3.1 contains a description and proposed solution for each problem. There are 8 Deployment Critical Problems, 13 Deployment Non-critical Problems, and 25 Non-deployment Problems. While any changes to the system should be made with the concurrence of Air Traffic, problems 4, 6, 18, 19, 27, 28, 38 will require additional direction from RDU AT. Problems 9, 10, 41, and 44 will require additional direction from Headquarters AT. Since there was no playback or simulation functions as part of the deliverable PRM system, those functions were not tested; these items are noted as problems 17 and 18.

3.1 PROBLEM MATRIX

#	Problem Description	Class	Proposed Solution
1	Antenna Failures - The antenna fails it's azimuth accuracy monitoring tests in various icing conditions such as freezing rain, sleet, snow, etc...	DC	1- Place a heated radome on the antenna, or 2- Increase the size of the NTZ to coincide with the reduced accuracy (in agreement with AT Headquarters).
2	Antenna Monitor Failures - The antenna monitor strips may fault in driving rain.	DC	1- Place a radome on the antenna, or 2- Fix the monitor strips.
3	Power Monitoring - The UPS status is not presented to the controllers. I.e. although the system will go onto UPS batteries due to a power failure (for 8 minutes) the only notification of the event is on the PSD.	DC	1- Add the system's power status to the AT status window and aural alarm, or 2- Add PRM power status lights and alarms in the TRACON.
4	System Coverage Area - The system coverage area should be reduced to the minimum required.	DC	1- The system coverage width should be reduced, and 2- The system altitude should be reduced to 6,000 feet.
5	Overflow Status - An overflow/overload event does not sound a system alarm or force the system status onto the master display.	DC	1- An overflow/overload event should sound the system alarm and force the status on the master display, and 2- An 80% load condition should also sound the system alarm and force that status on the master display.
6	Controller Setups - The controller setups need to be set to properly support AT's mission.	DC	1- Set the controller setups as directed by RDU AT and, 2- Comment out the command to delete setups and to save new setups, or 3- Increase the number of controller setup to allow each controller to have 4 setups.
7	ARTS Interface Configuration - With the single MDBM ARTS configuration a PRM/ARTS I/F Unit failure (or the failure of it's associated GP) will result in a lack of ARTS data.	DC	1- Restore the dual MDBM configuration, or 2- Modify the PRM system to automatically switch to the backup PRM/ARTS I/F Unit when a fault is detected in the active unit, or 3- Add a manual switch for the PRM/ARTS I/F Units.
8	Antenna Faults cause System Faults - Any antenna fault causes a total PRM system failure.	DC	1- Modify the system so that any antenna faults (including parrot faults) send notification to the controller displays but does not fault (stop) the system.
9	Voice Alert - The quality of the voice alert is poor.	DNC	1- Speed up the rate of speech & 2- Use group form, & 3- Update aircraft call signs & 4- Remove excess words (in agreement with AT Headquarters) & 5- Stop the voice when the alert ends (target turns green) & 6- Improve the voice quality.
10	Nuisance Alerts - There are too many nuisance alerts .	DNC	1- Inhibit cross over targets from alarming, and 2- Inhibit departures from alarming.

#	Problem Description	Class	Proposed Solution
11	Display Contrast and Brightness - The display's contrast and brightness controls are not readily available to the controller.	DNC	1- Extend the contrast and brightness controls to the front of the display.
12	Runway Intensity - The intensity of the runway is too bright.	DNC	1- Add a command to adjust the intensity of the runway, or 2- Make the intensity of the runway the same as the antenna and obstruction marks and add the control of this intensity to the ant/obstruction mark intensity adjustment command, or 3- Lower the default intensity of the runways to an acceptable level.
13	Dual Tracks - When a track drops and restarts that dropped track is not removed from the display or coast list.	DNC	1- Modify the system to remove CSTD tracks when the cstd track is reacquired, and 2- Remove tracks from the coast list when the track is reacquired, and 3- Add a drop track command so that the controller can remove CSTD tracks from the coast list and the display.
14	CSTD Tracks Presentations - CSTD tracks should remain on the display longer.	DNC	1- CSTD tracks should remain on the display for 30 seconds or until removed by the controller as above.
15	ARTS Tag Start - There is no manual way to make the PRM get an ARTS tag.	DNC	1- Add a command to allow the controller to have the PRM refresh (look for) ARTS data on a track, or 2- Have the system refresh ARTS data more frequently.
16	Time Alert Presentation - Following a PRM system failure the targets go to time alert for ten seconds.	DNC	1- The targets should remain on the display for 5 minutes or until the system is reset.
17	Playback Function Required - A means to playback recorded data on the displays is required.	DNC	1- Restore playback to the system, and 2- Get playback to work to AT's requirements.
18	Simulation Capability Required - A means to play simulated data on the displays is required for recurrent training.	DNC	1- Supply the desktop simulator to AT RDU, and 2- Provide documentation, training, and maintenance for the desktop simulator.
19	Training Modifications - The contractor training should be modified.	DNC	1- Provide a separate training course to the AT RDU staff for the PRM listing and playback functions, and 2- Provide only overview training on these functions to controllers.
20	Cursor Presentation - The cursor on the PRM display is always visible.	DNC	1- Make the cursor disappear and position it in the center of the display after each use.
21	Excessive Number of Non-deployment Problems - The number of Non-deployment Problems taken as a whole will create a system that is unacceptable to the controllers.	DNC	1- Fix as many Non-deployment Problems as practicable.
22	Prediction Pointer Intensity - There is no command to adjust the intensity of the prediction pointer.	ND	1- Add a command to adjust the intensity of the prediction pointer, or 2- tie it's intensity to that of the history trails.

#	Problem Description	Class	Proposed Solution
23	Text Intensity - There is no command to adjust the intensity of the text.	ND	1- Add a command to adjust the intensity of the text areas.
24	Data Block Intensity - There is no command to adjust the intensity of the data blocks.	ND	1- Add a command to adjust the intensity of the target symbol, the leader line and the data block.
25	Parallel Lines Intensity- There is no command to adjust the intensity of the parallel lines.	ND	1- Add a command to adjust the intensity of the parallel lines.
26	Text Size - There is no command to adjust the size of the text areas.	ND	1- Add a command to adjust the size of the text in the text areas.
27	Default System Status Position - The default position of the system status area should be in the top left corner of the display.	ND	1- Move the default position of the text area on the display to appropriate positions for both the initial system startup condition and for the controller default command (CDEF) condition.
28	Default Display Presentation - The default display presentation is not a usable presentation.	ND	1- Make the default display presentation appropriate for monitoring traffic for both the initial system startup condition and for the controller default command (CDEF), and 2- Tie the CDEF command to the active runway.
29	Command Entry Consistency - The RR and HLEN command operate differently than all other commands.	ND	1- Modify the RR and HLEN command to operate as the size and intensity commands do, i.e, RR3, HLEN4, etc...
30	Zoom Step Size - There are too many commands/keystrokes required to zoom in and out.	ND	1- Add a command to zoom in 5 mile steps, or 2- Allow for the entry of the same command with one keystroke.
31	Operator Reference Card Improvements - The operator reference card should be easy to use.	ND	1- In conjunction with problem 38 remove all supervisor commands, and 2- Group commands by object rather than function, i.e, commands related to history trails, alarms/alerts, etc..., and 3- Make the card smaller.
32	Modify the OC command - The Orient around Cursor (OC) command operates differently than it does on the ARTS.	ND	1- Modify the OC command to operate as the ARTS command does.
33	Delete the OA command - The Orient around Antenna (OA) command is not needed by air traffic.	ND	1- Delete the OA command, or 2- In conjunction with problem 38 make this command a protected (AF) command.
34	Multi Function not previewed - The multi-function key is shown as a blank space in the preview area.	ND	1- Represent the multi-function key as <F7> in the preview area.
35	Alarm Turnoff Too Cumbersome - Too many keystrokes are required to turn off the alert and alarm tones.	ND	1- Combine the SAT and SSYS commands to S<enter> and in conjunction with problem 38 make this a controller command, and 2- Use it to silence the current voice alert.

#	Problem Description	Class	Proposed Solution
36	Supervisor Command Concept - The term and concept of supervisor commands should be replaced with protected commands.	ND	1- Replace the term and concept of supervisor commands with "protected commands", and set the password (unchangeable) to PRM.
37	Delete unnecessary supervisor (protected) commands - These commands are not required.	ND	1- Delete (comment out) the following commands: DM, SDEF, DSS, SRES, SSAV, LSS.
38	Command Access - Controllers should have access to AT commands.	ND	1- Make the following commands controller (unprotected) commands: CH1, CH2, MSTAT, 05A, 23A, DATE, TIME, SSYS, TCA, TLA, STAT, TEST, REC, STPT
39	System Status Window - The system status display should not be tied to the display logged in the protected command mode.	ND	1- A change in system status should force the status onto all GPs regardless of which display is logged in the protected command mode.
40	System Status Display Presentation - The system status is difficult to read and decipher.	ND	1- Remove unnecessary items from the status presentation, i.e., DP, SP, INT, EM, and 2- Highlight failures in red, fixes in bright green, and 3- Simplify and make consistent the display of the required data.
41	CA and LA alert presentation - The CA and LA alerts presentation is too dramatic.	ND	1- Modify the presentation of CA and LA alerts to only make the CA or LA fields yellow, or 2- With agreement by AT remove the CA and LA alert presentation.
42	Transponder Alert Presentations - Transponder alerts overwrite the ground speed of the target.	ND	1- Modify the presentation of transponder alerts so that the (EM, RF, HJ) alert field does not replace the ground speed, put the alert on line one.
43	Display Control Lighting - The controls on the display are difficult to see in the dark.	ND	1- Add backlighting to the controls on the displays.
44	Listing Program - The data extraction listing program is cumbersome and difficult to operate and understand.	ND	1- Simplify the program's commands, and 2- Provide more detailed documentation.
45	System Capacity - The 25 target capacity limit provides only a limited safety margin.	ND	1- Revalidate the Air Traffic capacity requirement and, 2- Modify the system so that an overload condition causes the system to either slow up or drop tracks on a priority basis.
46	System Resets - The PRM system fault latches all faults with no reset attempted.	ND	1- Modify the system so that a faulted channel will attempt at least 1 reset before latching nogo, and 2- Modify the GPs so that the controller can push a button to reset a faulted GP.

3.2 FURTHER TESTING.

Further testing for this test effort should include the remaining phases of the Upgrade PRM OT&E and retesting for modifications made to the PRM/NAS system in addressing these OT&E problems.

4. CONCLUSIONS

This test effort highlights 8 Deployment Critical Problems. The consensus opinion of the Test Engineers and the Test AT Controllers is that the PRM system should not be deployed without addressing each of these Problems.

This test effort highlights 13 Deployment Non-critical Problems. The consensus opinion of the Test Engineers and the Test AT Controllers is that these problems could be temporarily worked around so that the PRM system could be deployed, but that these problems may place an unwarranted amount of stress or additional workload on the Monitor Controller. Action should be taken to address each of these problems as soon as possible.

This test effort highlights 25 Non-deployment Problems. While each Non-deployment problem taken separately is one that the test AT controllers felt could be worked around, the number of these problems leads to a system that may create excess stress to a monitor controller. As many of these Non-deployment Problems as possible should be addressed to minimize the additional stress or workload placed on the Monitor controller. Also, all of these problems should be evaluated against the limited production PRM design and corrective action taken for those problems that apply.

5. RECOMMENDATIONS

The Secondary Surveillance Division, ACW-100, recommends against commissioning of the Upgrade PRM system until each of the 8 Deployment Critical Problems have been addressed, a corrective action plan for the 13 Deployment Non-critical Problems has been developed, and the remaining phases of the Upgrade PRM OT&E have been successfully completed.

APPENDIX A. ACRONYMS

AF	Airways Facilities
ARTS	Automated Radar Terminal System
AT	Air Traffic
CA	Conflict Alert
CSTD	Coast Dropped (track)
DC	Deployment Critical
DOT	Department of Transportation
DNC	Deployment Non-critical
DT&E	Development Test and Evaluation
FAA	Federal Aviation Administration
GP	(PRM) Graphics Processor
IFR	Instrument Flight Rules
I/F	Interface
LA	Low-altitude Alert
MDBM	Multiplex Data Buffer Memory (ARTS device that the PRM interfaces to)
NAS	National Airspace System
NC	Non-deployment
NTZ	No Transgression Zone
OT&E	Operational Test and Evaluation
PRM	Precision Runway Monitor
PSD	PRM Status Display
RDU	Raleigh-Durham International Airport
UPS	Uninterruptable Power Source