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Final Report for the Air Traffic Control (ATC) Evaluation of the Prototype Terminal Doppler Weather Radar (TDWR) System

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16. Abstract

This report details the results of the Federal Aviation Administration (FAA) operational evaluation of the Prototype Terminal Doppler Weather Radar (TDWR). The evaluation was conducted by the controllers and supervisors at the Orlando International Airport (MCO), Orlando, Florida. The purpose of the test was to obtain the controller's and supervisor's evaluation of the Geographical Situation Display (GSD) and the Ribbon Display Terminal (RDT) installed at the air traffic control tower (ATCT).

The responses from the air traffic controllers and supervisors led to several conclusions concerning the prototype TDWR: (1) the participants generally liked the system and felt that the prototype TDWR was suitable and effective for air traffic control (ATC) operations, (2) the supervisors, in particular, were pleased with the GSD as it helped them in planning and making runway configuration decisions prior to weather events, and (3) the controllers were pleased with the products displayed on the RDT and felt that the RDT was effective and suitable for their operations. There were, however, some reservations about the size of the RDT and the location of the centerfield wind on the RDT. The responses from the controllers indicated that they preferred the smaller RDT (12" x 11" x 6") for operational purposes and would like to have the centerfield wind displayed in the upper left corner of the RDT.

Based on these conclusions, two primary recommendations were made to improve the system prior to the Raytheon production TDWR. The first was that the user evaluation of the size of the RDT be considered in the production TDWR and the second was the location of the centerfield wind on the RDT be relocated to the top of the display.

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EXECUTIVE SUMMARY

The air traffic control (ATC) interface element of the functional prototype Terminal Doppler Weather Radar (TDWR) was evaluated at the Orlando International Airport (MCO) during the period May 4 through July 7, 1992. The 1992 demonstration of the prototype TDWR was a continuation of the operational demonstration conducted during the summer of 1991. The 1992 demonstration evaluated new products and algorithms, in addition to the existing products. Some of the new products were the integration of the TDWR and the 14 sensor Low Level Wind Shear Alert System (LLWAS-3), storm tracking, and the effectiveness of the Reflectivity Attenuation Flagging function.

The objective of the evaluation was to obtain Federal Aviation Administration (FAA) air traffic controller/supervisor reaction to the prototype TDWR weather data and display equipment. The displays consisted of four Ribbon Display Terminals (RDTs) and one Geographical Situation Display (GSD) in the tower, and one each RDT and GSD in the Terminal Radar Approach Control (TRACON). Questionnaire forms were used to obtain responses from supervisors and controllers relative to operational suitability of these displays.

The following are highlights of the evaluation:

1. The displayed storm motion information on the GSD was most helpful to the supervisor/controller.

2. The usefulness of the Wind Shift Prediction was rated as good.

3. Sixty-four per cent of the participants rated the usefulness of the displayed microburst (MB) information on the RDT as good.

4. Most of the participants preferred the "small" RDT over the "large" RDT and the centerfield wind displayed in the upper left corner of the RDT.

Generally, the participants liked the system. The supervisors were pleased with the help they received from the GSD in the runway planning and configuration decisions. The controllers were pleased with the products displayed on the RDT and felt that the RDT was suitable and effective in their operations. There were, however, some reservations about the size of the RDT and the location of the centerfield wind on the RDT.

It is recommended that if this system is tested in the future, the "small" RDT should become the primary RDT for testing, and that consideration be given to the location of the centerfield wind on the RDT.

INTRODUCTION

PURPOSE.

The purpose of this evaluation was to determine the operational suitability and effectiveness of new products and algorithms, in addition to the existing products, provided by the functional prototype Terminal Doppler Weather Radar (TDWR) hazardous weather messages to the controllers and supervisors. Some of the new products were the integration of the TDWR with the 14 sensor Low Level Wind Shear Alert System (LLWAS-3), storm motion, and the effectiveness of the Reflectivity Attenuation Flagging function. The evaluation was conducted by the Weather and Primary Radar Division, ACW-200D, of the Federal Aviation Administration (FAA) Technical Center. The plan for this evaluation is detailed in the FAA Technical Center Plan for the Evaluation of the Prototype TDWR System at Orlando International Airport (MCO), Orlando, Florida, dated June 1992.

BACKGROUND.

The TDWR was added to the Capital Investment Plan (CIP) in 1986. The project consists of the procurement and installation of 47 TDWR systems which will detect microburst (MB), gust fronts (GF), wind shifts, and precipitation. The TDWR will be used to provide alerts of hazardous weather conditions in the terminal area and to provide advanced notice of changing wind conditions to permit timely changes of active runways.

The Massachusetts Institute of Technology and Lincoln Laboratory (MIT/LL) supports the demonstration of the FAA prototype TDWR. The MIT/LL established a prototype TDWR test-bed radar site (FL-2) near the Orlando Airport. The site was used to develop operational algorithms, collect experimental data, and develop user friendly products for displays and use by the supervisors and controllers in the air traffic control tower (ATCT) and the Terminal Radar Approach Control (TRACON). This demonstration was a continuation of the demonstrations started in the summer of 1990 and 1991 at Orlando Airport.

METHOD

PARTICIPANTS.

There were 50 supervisors/controllers that participated in this evaluation (39 controllers and 11 supervisors). The Plans and Procedure Specialist (PPS) of MCO ATCT administered the questionnaires to the participants.

TRAINING.

In preparation for the demonstration, MIT/LL provided training to the ATCT and TRACON personnel in the interpretation and use of the TDWR products, and in the use of the Geographical Situation Displays (GSDs) and the Ribbon Display Terminals (RDTs). The PPS gave the supervisors/controllers a briefing prior to the evaluation and the administration of the questionnaires.

EQUIPMENT.

The equipment that was evaluated consisted of four RDTs and one GSD in the tower, and one each RDT and GSD in the TRACON.

RDT.

The alphanumeric products from the TDWR were displayed on RDTs located at the controller's position (circular) in the tower and supervisor's position in the TRACON. There were two different RDTs sizes: (1 each) 12" x 11 1/4" x 6" (small size) and (4 each) 15" x 15" x 6" (large size). The small RDT was located near the tower cab. During the evaluation, in lieu of the hazardous alert data from the operational LLWAS, alphanumeric wind shear and microburst alert messages from the prototype TDWR system were displayed on the RDTs. These messages were displayed along with the LLWAS centerfield and active runway threshold winds.

The alert warning messages were displayed on the RDTs in the following form:

Runway ID (dir/kts)	Wind Shear Type	Expected loss/gain	Location 1st Encounter (kts)	Threshold
A typical example might be:				
19D	MBA	80K	2MD	320 14

which is read as: runway 19 departure, microburst alert (MBA), expect 80 knot loss, encounter at 2 miles on departure, runway threshold winds at 320° at 14 knots.

GSD.

The tower and TRACON had a color GSD which uses a Sun workstation to display weather information to air traffic control (ATC) supervisors and controllers. It functions as a situation display monitor and as an air traffic planning tool for runway management. This color workstation provides graphical representation of the location and intensity of MBs, precipitation cells, and GFs, as well as estimates of the speed and direction of motion for precipitation cells and GFs.

EVALUATION QUESTIONNAIRE.

In order to obtain feedback from the users, two questionnaires were developed by the FAA Technical Center. One of the questionnaires concerns itself with the RDT, the other with the GSD. The questionnaires were structured to obtain the evaluation of the prototype TDWR by rating a statement about each feature/function on a five-point scale ranging from Good to Poor, plus a Don't Know category for participants who did not see a specific feature working. Comments were encouraged. (See appendix A.)

PROCEDURE.

The prototype TDWR evaluation took place at the Orlando ATCT. On May 5 to May 8, 1992, the FAA Technical Center test team made an initial visit to the Orlando ATCT and the MIT/LL radar site to obtain specific information that was necessary to conduct the evaluation. This information included the number of controller/supervisor participants, layout of the tower cab, display equipment, duty schedule of participants, etc. The visit was coordinated with MIT/LL, the PPS, and other ATCT personnel.

The Test Director, FAA Technical Center, ACW-200D, provided the Orlando PPS with adequate copies of the supervisor/controller questionnaires for the evaluation of the prototype TDWR. The PPS distributed and collected these questionnaires during daily briefings in July, and then returned them to the FAA Technical Center.

ANALYSIS.

Numerical values were assigned to the questionnaire responses with the following scale: -2 = Poor, -1 = Fairly Poor, 0 = Fair, +1 = Fairly Good, +2 = Good, and ? = Don't Know. The total number of respondents, the means and the standard deviation for the scaled items on the GSD and the RDT questionnaires are presented in the Results and Discussion section. The written responses from the summary part of the questionnaire were analyzed using content analysis. These responses were categorized and quantified to provide additional controller feedback. (See appendix B.)

RESULTS AND DISCUSSION

The questionnaires (appendix A) were designed to determine the usefulness of the products generated by the prototype TDWR to the ATC personnel.

There were a total of 50 responses from the ATCT and the TRACON (39 controllers and 11 supervisors). The high rate of Don't Know response to the question on both the RDT and GSD questionnaires concerning the rate of false alarms of MB and GF (questions 1e and 1f on the RDT, and questions 1b and 1c on the GSD) indicates that the respondents did not understand the question or did not have enough information to answer the question. The low rating of question 1b and the high rating of question 1c on the RDT indicates that the majority of the respondents prefer the smaller RDT for operational use. This was the same consensus as in the 1991 evaluation. The questions 1e and 1f of the GSD questionnaire on the usefulness of the storm motion and GF information were rated as Good by the majority of the participants.

GEOGRAPHICAL SITUATION DISPLAY (GSD).

The mean rating, standard deviation, and the number of respondents for question 1 of the GSD questionnaire are presented in table 1. Overall, the GSD was rated in the Fairly Good category (mean value of 1.4). Questions 1b and 1c, rate of false alarm of the MB and GF, both had a Very Poor rating (mean value of .5 and .96, respectively). Most respondents answered Don't Know. To determine the rate of false alarms, the controller would have to be present at a given display over a specific period of time. This was not part of the procedure for this demonstration.

The following were identified from the results of the GSD questionnaire (tables 1 and 2):

1. Thirty-nine of 47 respondents (83 percent) rated the usefulness of the wind shift prediction (question 1a) as Fairly Good or above, and 43 of 46 respondents (93 percent) rated the usefulness of the storm motion information (question 1f) as Fairly Good or Good.

2. Forty of 47 respondents (85 percent) rated the usefulness of the displayed MB (question 1d) as Fairly Good or better. Forty-two of 47 respondents (89 percent) rated the displayed GF (question 1e) as Fairly Good or better.

3. Most comments from the respondents indicate that they are generally pleased with the GSD. Seven of the 9 responses from supervisors (78 percent) found the GSD to be a very useful tool in making runway configuration changes prior to weather events (appendix B, GSD question 3).

TABLE 1. QUESTION 1 ON THE GSD QUESTIONNAIRE

	GSD		
Question 1	Number of Respondents	Mean Rating	Standard Deviation
a. Usefulness of the wind shift prediction	47	1.725	0.554
b. Rate of false alarm-MB	47	0.500	0.913
c. Rate of false alarm-GF	46	0.962	0.958
d. MB display usefulness	47	1.568	0.818
e. GF display usefulness	44	1.682	0.740
f. Usefulness of the storm motion information	46	1.755	0.712

Number of respondents, mean rating, and standard deviation of the GSD questionnaire (question 1).

TABLE 2. GSD RESPONSES

Total GSD Responses And Ratings For Question 1

-2 = Poor; -1 = Fairly Poor; 0 = Fair; +1 = Fairly Good;
+2 = Good; ? = Don't Know

1. Evaluation Of The Geographical Situation Display (GSD)	Rating Scale						Total Responses
	-2	-1	0	+1	+2	?	
a. Usefulness of the wind shift prediction	1	0	2	7	32	5	47
b. Rate of false alarms (MB)	1	1	8	10	3	24	47
c. Rate of false alarms (GF)	1	0	6	11	8	20	46
d. Usefulness of the displayed MB information	1	0	3	9	31	3	47
e. Usefulness of the displayed GF information	1	0	1	8	34	3	47
f. Usefulness of the displayed storm motion information	1	0	1	5	38	1	46

RIBBON DISPLAY TERMINAL (RDT).

The mean rating, standard deviation, and the number of respondents to the RDT questionnaire appear in table 3. Overall, the RDT was rated as in the Fairly Good category (mean value of 1.17).

The mean value for question 1b on the RDT questionnaire (adequacy of the display size "large") was 0.422 or Fair. This was similar to the 1991 evaluation of the same item. This evaluation reflects the general opinion of the respondents, that of the two RDTs that were tested (small size and large size), the small RDT was most preferred.

The following items were identified as a result of the RDT questionnaire (tables 3 and 4):

1. Thirty-nine of 47 respondents (83 percent) rated the displayed MB information (question 1h) as Fairly Good or above, 4 rated it as Fair, and 4 said Don't Know. Thirty-six of 47 respondents (77 percent) rated the displayed GF information (question 1i) as Fairly Good or Good, 2 as Fair, and 9 as Don't Know.

2. Thirty-five of 47 of the respondents (74 percent) rated the adequacy of the small RDT (12" x 11" x 6") as Fairly Good or above for operational purposes. Six rated the adequacy as Fair, one as Fairly Poor, two as Poor, and three as Don't Know. On the other hand, only 26 respondents (55 percent) rated the large RDT as Fairly Good or above for their operations. Seven rated the large RDT as Fair, 2 as Fairly Poor, 10 as Poor, and 1 Don't Know.

3. Thirty-nine of 46 respondents (85 percent) rated the daytime readability of the "small" RDT (question 1c) as Fairly Good or above, 3 as Fair, and 4 rated it as Don't Know. Thirty-seven of 46 respondents (80 percent) rated the nighttime readability of the "small" RDT (question 1d) as Fairly Good or above, 3 as Fair, and 6 as Don't Know.

4. Thirty-eight of 47 respondents (81 percent) rated the timeliness of the displayed data (question 1g) as Fairly Good or better, 3 as Fair, and 6 as Don't Know.

5. Five of the 18 comments from the respondents indicate that they would like to see the centerfield wind displayed in the upper left corner of the display rather than in the lower part of the display (appendix B, RDT question 3). No reason was given for this preference.

TABLE 3. QUESTION 1 ON THE RDT QUESTIONNAIRE

	RDT		
Question 1	Number of Respondents	Mean Rating	Standard Deviation
a. Adequacy of small RDT	47	1.250	1.080
b. Adequacy of large RDT	46	0.422	1.545
c. Daytime readability of small RDT	46	1.548	0.633
d. Nighttime readability of small RDT	46	1.575	0.636
e. MB rate of false alarm	47	0.529	1.790
f. GF rate of false alarm	46	0.563	1.153
g. Timeliness of data	47	1.415	0.631
h. Usefulness of the MB displayed information	47	1.604	0.660
i. Usefulness of the GF displayed information	47	1.658	0.582

Number of respondents, mean rating, and standard deviation of the RDT questionnaire (question 1)

TABLE 4. RDT RESPONSES

Total RDT Responses And Ratings For Question 1

-2 = Poor; -1 = Fairly Poor; 0 = Fair; +1 = Fairly Good;
+2 = Good; ? = Don't Know

1. Evaluation Of the Ribbon Display Terminal (RDT)	Rating Scale						Total Responses
	-2	-1	0	+1	+2	?	
a. Adequacy of display size "small"	2	1	6	10	25	3	47
b. Adequacy of display size "large"	10	2	7	11	15	1	46
c. Daytime readability of "small" RDT	0	0	3	13	26	4	46
d. Nighttime readability of "small" RDT	0	0	3	11	26	6	46
e. Rate of false alarms (MB)	1	2	5	5	4	30	47
f. Rate of false alarms (GF)	1	1	6	4	4	30	46
g. Timeliness of displayed data	0	0	3	18	20	6	47
h. Usefulness of the displayed MB information	0	0	4	9	30	4	47
i. Usefulness of the displayed GF information	0	0	2	9	27	9	47

CONCLUSIONS

The evaluation of the Massachusetts Institute of Technology/Lincoln Laboratory (MIT/LL) prototype Terminal Doppler Weather Radar (TDWR) by air traffic control (ATC) personnel at the Orlando International Airport (MCO), Orlando, Florida, has provided input as to the weather warnings, readability and adequacy of the Ribbon Display Terminal (RDTs), adequacy of the RDT size, and the storm movement and gust front (GF) information on the Geographical Situation Display (GSD). The evaluation was unable to give any useful information regarding the rate of false alarms. This may have to be evaluated in the MIT/LL final report on the 1992 system. Some of the significant findings are:

1. The ATC generally liked the system and found it helpful in their operations.

2. Supervisors found the GSD helpful in making runway configurations prior to weather events.

3. Ninety-three percent of the respondents rated the usefulness of the displayed storm motion information (GSD question 1f) as Fairly Good or above, and 89 percent rated the usefulness of the displayed GF information (GSD question 1e) as Fairly Good or Good. These were two of the highest ratings on the questionnaire.

4. The rate of false alarms could not be evaluated by the ATC personnel with the limited information available to them during the demonstration.

5. The size of the RDT and the location of the centerfield is important to the controllers. Six of 18 comments were about the size of the RDT. The respondents generally preferred the small RDT (12" x 11 1/4" x 6") over the large RDT (15" x 15" x 6") and most felt that the centerfield should be at the top of the display.

RECOMMENDATIONS

The Orlando air traffic control (ACT) personnel have accepted the prototype Terminal Doppler Weather Radar (TDWR) as a functional radar system capable of meeting their operational needs. However, two minor problems that should be considered are: (1) the preference of the small Ribbon Display Terminal (RDT) to the large, and (2) the location of the centerfield winds on the RDT. These concerns may be resolved with the Raytheon production TDWR.

It is recommended that a user evaluation of the production TDWR prior to the decision for full deployment be conducted, and if any major problems occur, that they be addressed at that time.

ACRONYMS AND ABBREVIATIONS

ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
CIP	Capital Investment Plan
FAA	Federal Aviation Administration
GF	Gust Front
GSD	Geographic Situation Display
LL	Lincoln Laboratory
LLWAS-3	Low Level Wind Shear Alert System
MB	Microburst
MBA	Microburst Alert
MCO	Orlando International Airport
MIT	Massachusetts Institute of Technology
PPS	Plans and Procedure Specialist
RDT	Ribbon Display Terminal
TDWR	Terminal Doppler Weather Radar
TRACON	Terminal Radar Approach Control

APPENDIX A

TDWR EVALUATION QUESTIONNAIRES

RDT

TOWER_____ TRACON_____

CONTROLLER_____ SUPERVISOR_____

Please rate the TDWR using the following scale:

-2 = Poor; -1 = Fairly Poor; 0 = Fair; +1 = Fairly Good;
+2 = Good; ? = Don't Know

1. Evaluation Of The Ribbon Display Terminal (RDT)	Rating Scale					
	-2	-1	0	+1	+2	?
a. Adequacy of display size "small"						
b. Adequacy of display size "large"						
c. Daytime readability of "small" RDT						
d. Nighttime readability of "small" RDT						
e. Rate of false alarms (MB)						
f. Rate of false alarms (GF)						
g. Timeliness of displayed data						
h. Usefulness of the displayed MB information						
i. Usefulness of the displayed GF information						

2. Please state instances (if any) of wind shear that the system did not display:

   a. Microburst _____,

   b. Gust Front _____.

3. Please provide comments on any rating of 0 or lower and/or any other comments on the role of the RDTs (Ribbon Display Terminals).

_____

_____

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GSD

TOWER_____ TRACON_____

CONTROLLER_____ SUPERVISOR_____

Please rate the TDWR using the following scale:

-2 = Poor; -1 = Fairly Poor; 0 = Fair; +1 = Fairly Good;
+2 = Good; ? = Don't Know

1. Evaluation Of The Geographical Situation Display (GSD)	Rating Scale					
	-2	-1	0	+1	+2	?
a. Usefulness of the wind shift prediction						
b. Rate of false alarms (MB)						
c. Rate of false alarms (GF)						
d. Usefulness of the displayed MB information						
e. Usefulness of the displayed GF information						
f. Usefulness of the displayed storm motion information						

2. Please state instances (if any) of wind shear that the system did not display:

   a. Microburst _____,

   b. Gust Front _____.

3. <u>Supervisors only</u>: Was the GSD useful in making runway configurations changes prior to weather events? Yes or No. Please explain.

_____

_____

_____

4. Please provide comments on any rating of 0 or lower and/or any other comments on the Geographical Situation Displays (GSD).

_____

_____

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APPENDIX B

QUESTIONNAIRE COMMENTS

Comments from the GSD questionnaire:

GSD Question 2. Please state instances (if any) of wind shear that the system did not display: a. Microburst; b. Gust Front.

Of the nine responses to this question, the answers were as follows:

a. One answer of "not applicable" to both "a" and "b" parts.

b. Six respondents answered with a question mark (?) to both "a" and "b" parts.

c. One answer was "Pilots reported wind shear when not detected."

d. One answer was "More often than not."

It would appear from these responses that the respondents either did not understand the question or did not have enough information to give a definitive answer.

GSD Question 3, supervisors only. Was the GSD useful in making runway configuration changes prior to weather events? Yes or No.

Of the nine responses to this question to the supervisors, the responses were as follows:

a. Seven replied affirmative or yes to the question.

b. One replied "Not applicable."

c. One replied "How would you know if it were a false alarm or not?"

The majority of the responses to this question seem to indicate that the GSD was useful in making the runway configuration. The two questionable responses may have come from someone that did not have access to the GSD (controllers rather than supervisors).

GSD Question 4. Please provide comments or any rating of 0 or lower and/or any other comments on the Geographical Situation Display (GSD).

1. "The system is very, very unreliable. It seems to go out every time the bad Wx moves in."

2. "Total system seems to always fail when severe weather is around."

3. "This is very useful and effective equipment."

4. "Do not care for the "downgraded" version which lacks movement speeds, etc. LLWAS arrows not necessary.-USEFUL not as good."

5. "Good system."

6. "Excellent system."

7. "What constitutes a false alarm."

8. "Wind speed red circles are too small and not readable when you are on a 30-50 mile range."

9. "This year in particular (as opposed to years past) seem to be more false MBA & WSA (possible due to new algorithms)."

10. "It has seemed that when it is most needed the system goes down."

11. "Excellent, well worth the $. Reliability could be better. Why, why are you going to dismantle this equipment."

12. "It would be nice to have a window feature in the corner of the GSD crt for the purpose of zooming in on a particular area of Wx. This way you could stay on the big range for the overall picture and get detailed information for a specific Wx area. Need some type of graphic anti-overlap so that the storm track and gust front graphic don't obscure each other. That was a problem on several occasions."

13. "Very good system...especially the storm motion info (since the ASR9's weather is almost as good for seeing the location of the Wx). I would like to see other range possibilities, other than just 15 miles, 30 miles, etc. Possibly a "window" somewhat like AutoCad, that can be positioned with the trackball for a closeup of the actual storm and its relation to the airport."

Comments from the RDT questionnaire:

RDT Question 2. Please state the instances (if any) of wind shear that the system did not display: a. Microburst; b. Gust Front.

The responses to this question were as follows:

a. Seven respondents gave question marks ("?") as their answer to the question (both parts "a" and "b").

b. One respondent answered "None."

The responses from the supervisors/controllers seem to indicate that they could not determine if and when the RDT did not display a Microburst or Gust Front. The reason may be the lack of information to make this determination or the lack of understanding the system.

RDT Question 3. Please provide comments on any rating of "0" or lower and/or any other comments on the role of the RDT's (Ribbon Display Terminals).

1. "Displays are too large."

2. "A,B - Both displays are too large and in an unsafe location, blocking the view of the runways when in a seated position."

3. "Several times the RDT was showing a "MBA" but did not have a aural alarm."

4. "The large RDT is too large."

5. "Did not use."

6. "RDT's should be made to fit into existing LLWAS cavity. Centerfield wind should be in the upper left corner."

7. "Centerfield wind should be on the top line rather than the bottom line."

8. "Excellent system."

9. "Not sure of the rate of false alarm."

10. "Approach end and departure end information displays together."

11. "Keep rwys together; i.e. arrival, dept end of the same rwy together -- don't split them up."

12. "Move the centerfield wind back to the top of the Ribbon Display."

13. "Severe weather causes a "shut down" -- too much delay."

14. "Reliability could be better - excellent piece of equipment, <u>but</u>, why does it cost so much? I feel that the RDTs cost <u>way</u> too much."

15. "RDTs should utilize economical off the shelf hardware to reduce cost and facilitate repairs. The exotic RDT used during testing is cost prohibitive and once in production there may be problems getting spare parts. RDT should be dual purpose so they could replace LLWAS display and display LLWAS info when doppler was not operational."

16. "Centerfield wind should be in the upper left. Why can't they use regular small TV monitors? I understand your Ribbon Displays cost $7000.00 - that's ridiculous."

17. "Display too large. Centerfield wind indicator should be moved to the upper part of display."

18. "Large display is way too cluttersome."

The comments on question 4 are self explanatory, however the following should be noted:

a. The largest number of comments (6 of 18) were comments stating that the RDTs were too large.

b. Five of the comments were comments on the centerfield winds. Most respondents wanted the centerfield wind indicator moved to the top of the RDT's display.

c. Three of the respondents questioned the reliability of the system and three thought the system was too expensive.