

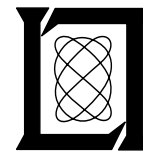
**Project Report
ATC-311**

Medium Intensity Airport Weather System NEXRAD Selection Recommendations

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29 April 2003

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16. Abstract In December of 1999, the Federal Aviation Administration (FAA) contracted Lincoln Laboratory to develop and demonstrate a new type of weather alert system. Their objective was to provide air traffic controllers at medium-intensity airports with a real time color display of weather impacting the terminal airspace. The weather data was to come from nearby Doppler weather surveillance radars, called Next Generation Radar (NEXRAD), typically owned and operated by the National Weather Service (NWS). Lincoln Laboratory has been operating prototypes of the Medium Intensity Airport Weather System (MIAWS) since May of 2000 at field sites in Memphis, TN; Jackson, MS; Little Rock, AR; and Springfield, MO. With the success of the MIAWS prototypes and favorable response among air traffic controller users, the FAA is seeking to rapidly deploy MIAWS systems at 40 airports within the National Airspace System (NAS). This report identifies suitable NEXRAD systems for each of the 40 MIAWS airports and three additional test and/or maintenance FAA facilities. Several other radar selection options are also provided to account for availability and cost-saving contingencies.					
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ABSTRACT

Under Federal Aviation Administration (FAA) sponsorship, Lincoln Laboratory has developed a Medium Intensity Airport Weather System (MIAWS). MIAWS provides air traffic controllers at medium-intensity airports a real time color display of weather impacting the terminal airspace. The weather data comes from nearby Doppler weather surveillance radars, called Next Generation Radar (NEXRAD). Lincoln Lab has been operating prototypes of the Medium Intensity Airport Weather System (MIAWS) since May 2000 at field sites in Memphis (TN), Jackson (MS), Little Rock (AR), and Springfield (MO). With the success of the MIAWS prototypes and favorable response among air traffic controller users, the FAA is seeking to rapidly deploy MIAWS systems at forty airports within the National Airspace System (NAS).

This report identifies suitable NEXRAD systems for each of the 40 MIAWS airports and three additional test and/or maintenance FAA facilities. Several other radar selection options are also provided to account for availability and cost-saving contingencies.

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1. INTRODUCTION

In December of 1999, the Federal Aviation Administration (FAA) recognized the need for a real time hazardous weather detection system at medium-intensity airports, that is, airports with moderate levels of air traffic, throughout the United States. The FAA sought the assistance of MIT Lincoln Laboratory (MIT/LL) to develop and demonstrate a prototype of a new type of weather alert system. The Medium Intensity Airport Weather System (MIAWS) [1] was thus established with the following objectives:

1. Provide air traffic controllers and supervisors with a real time depiction of weather using data acquired from one or more nearby Weather Surveillance Radar, also called Next Generation Weather Radar (NEXRAD), typically operated by the National Weather Service (NWS). Provide color displays showing precipitation with a standard NWS intensity scale.
2. Detect and track storm cells of significant intensity (Level 3 and above) and provide controllers with information regarding storm positions, motion, and forecast positions.
3. Detect and report instances of significant precipitation impacting the airport approach and departure corridors. Approach corridors include the runway and three one-mile-square areas leading up to the runway. Departure corridors include the runway and two one-mile-square areas beyond the runway.

Within six months, Lincoln Lab developed and fielded two MIAWS prototypes. One prototype was installed in a field site owned and operated by Lincoln Lab at Memphis (TN). Another prototype was installed in the air traffic control tower at the Jackson International Airport in Jackson, Mississippi. After receiving positive feedback from the Jackson air traffic controllers, the FAA arranged to have two additional MIAWS prototypes installed in Little Rock (AR) and Springfield (MO) air traffic control towers. Both prototypes were installed during the summer of 2002. Once again, the MIAWS prototype was readily accepted and appreciated by the air traffic controllers.

The FAA is currently seeking to rapidly deploy MIAWS systems at 40 airports within the National Airspace System (NAS). Appendix A contains a list of the proposed MIAWS airport names and identifiers. Appendix B contains a list of the available NEXRAD system names and identifiers. This report identifies suitable NEXRAD systems for each of the 40 MIAWS airports and three additional test/maintenance FAA facilities. The information in this report is expected to assist the FAA with preliminary cost estimates and analysis when planning procurements for leased phone lines to NEXRAD systems.

2. MIAWS NEXRAD SELECTION CRITERIA

Early on in the development of the MIAWS prototypes, the FAA contracted Technology Service Corporation (TSC) to analyze the NEXRAD coverage at each proposed MIAWS airport. TSC generated a series of reports [2], for each proposed MIAWS airport¹, in which NEXRAD selection was based on the following criteria:

1. Coverage Volume Analysis
2. Terrain and Line-of-sight Analysis
3. Weather Detection Performance Analysis

The TSC report recommendations, listed in Table 1, were considered along with a number of other selection criteria in order to generate a list of recommended NEXRAD selections for MIAWS airports. The additional NEXRAD selection criteria, listed below, are described in the following subsections:

1. NEXRAD Weather Products and Airport Coverage
2. NEXRAD Storm Coverage
3. Phone Line Leasing Costs
4. NEXRAD Interface Number Restrictions

2.1 NEXRAD WEATHER PRODUCTS AND AIRPORT COVERAGE

The original MIAWS prototypes relied on NEXRAD Composite Reflectivity, a Cartesian grid product that extended 232 km (124 nmi) from the NEXRAD, with 1 kilometer bin-to-bin resolution. The production system MIAWS, however, is expected to use the High-Resolution Vertically Integrated Liquid (HRVIL) product as its source of weather data. The HRVIL is a radial product with a range extent of 464 km (248 nmi) and 1 km range resolution. The MIAWS ingest process converts the HRVIL radial messages into a Cartesian grid product with 1 km bin-to-bin resolution. When compared with Composite Reflectivity, the HRVIL product is expected to offer superior data quality and range extent. However, in order to continue support of Composite Reflectivity, commonly available from all NEXRAD data providers, the 230-kilometer outer radius restriction was imposed in discussions of NEXRAD selection.

¹ Due to funding constraints, TSC was unable to complete MIAWS site reports for the following airports: MGM, OMA, SFO, and TRI.

Table 2 provides a list of all NEXRAD locations that fall within a 230 km radius of each proposed MIAWS airport. Appendix A and B contain MIAWS airport and nationwide NEXRAD names and identifiers.

Implementing all NEXRAD interfaces listed in Table2, defined within a 230 km radius, would result in excessive, costly, and unnecessary coverage for the airports. Thus, the NEXRAD lists of Table 2 should be reduced to a suitable number while maintaining appropriate coverage for each airport. The following subsections discuss criteria that helped reduce each NEXRAD selection list.

2.2 NEXRAD STORM COVERAGE

It is important to consider how much of the vertical airspace above the airport, and associated runway corridors, are radiated and processed by the NEXRAD. During the course of a volume scan, the NEXRAD sweeps through elevation angles from 0.5 degrees up to 19.5 degrees in order to produce a single composite product. For any given distance between a NEXRAD and an airport, the minimum and maximum altitude above the airport scanned by the NEXRAD may be computed (earth curvature must also be considered when evaluating radar beam coverage). When selecting optimal NEXRAD systems for MIAWS, the preferred NEXRAD system volume scan coverage includes airspace above the airport and below 30,000 feet (above ground level). Choosing a NEXRAD too close to an airport may provide suitable low-level coverage but would miss high-altitude storm cell formation above the airport (See Figure 1). Choosing a NEXRAD too far from the airport would provide suitable high-altitude coverage but would miss the low-elevation weather events (See Figure 2).

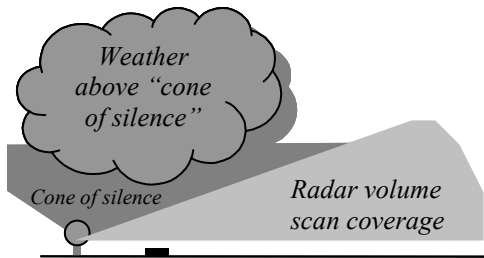


Figure 1. NEXRAD too close to airport.

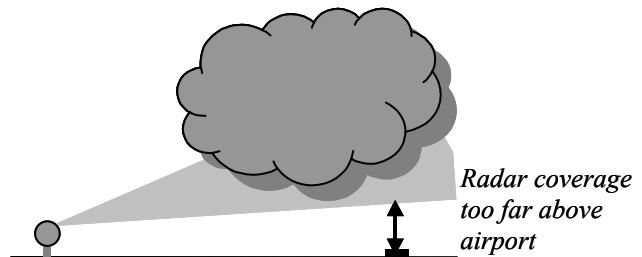


Figure 2. NEXRAD too far from airport

In the TSC report, NEXRAD selections sought to include radars whose low-elevation tilts were above 10,000 feet within the terminal airspace (within 60 nmi of the airport). In several cases, the nearby NEXRAD was rejected, in favor of using a more distant NEXRAD, to ensure more complete volume coverage. Based on operational experience with NEXRAD systems at the MIAWS prototypes, it was observed that the NEXRAD coverage within the TSC minimum range could also provide useful information, regardless of the associated cone of silence. Merging data from two NEXRAD sources, one nearby and one more distant, could provide an improved volumetric coverage of the total airspace. Finding an optimal combination of near and far NEXRAD systems could offer advantages over consistently choosing more distant NEXRAD systems, as recommended in the TSC report. The two MIAWS prototypes installed at Little Rock and Springfield merged weather products from two NEXRAD systems in this fashion (nearby and distant) with favorable results. Not only did dual NEXRAD merging provide more complete volumetric coverage, and improved resolution near the airport, but it also maintained nominal coverage when one radar dropped out due to communication line malfunction or pre-planned radar maintenance.

Another justification for favoring nearby NEXRAD systems, regardless of limitations reported by TSC, involves future NEXRAD product development. Lincoln Lab and the NWS Radar Operations Center (ROC) are working together to add an automatic gust front detection algorithm to the NEXRAD processor. Eventually, MIAWS could receive the gust front detections and provide the associated gust front runway impact alerts to air traffic controllers via the MIAWS Situation Displays. In order to detect gust fronts, a NEXRAD must operate within roughly 55 nmi of the airport in order to have access to surface velocity data.

Table 3 contains a list of suitable NEXRAD selection pairs (nearby and distant) for each MIAWS airport. NEXRAD selections appearing in Table 3 were derived from Table 2 with nearby NEXRAD systems always favored over more distant NEXRAD systems, barring any line-of-sight obscuration indications in the TSC report.

2.3 PHONE LINE LEASING COSTS

A MIAWS interfaces with a NEXRAD through a leased analog data circuit provided by a local telephone line carrier. The circuit baud rates range between 9600 and 14,400 baud. The type of phone line currently used by MIAWS for acquiring weather products from a NEXRAD is gradually becoming obsolete as telephone service providers switch to more modern types of digital telephony, including dedicated digital circuits such as Frame Relay. As a result, the costs associated with analog leased lines have been steadily increasing. Eventually, the phone line costs may be higher than economically practical for a given airport, particularly when spanning a long distance or crossing state boundaries.

In the event prohibitive phone line costs force the FAA to reconsider more distant NEXRAD systems, Table 4 lists the recommended NEXRAD selections, restricted to one NEXRAD per airport and involving the shortest distances.

2.4 NEXRAD INTERFACE NUMBER RESTRICTIONS

The FAA has arranged with the NWS to allocate at least one NEXRAD narrowband port interface for MIAWS airport connections. However, there are instances when one NEXRAD must provide weather data to more than one airport. Fortunately, due to reduced narrowband interface consumption, the NWS has agreed to support multiple MIAWS interfaces. This eliminates the inevitable compromises that would be necessary to resolve NEXRAD selections with interface count restrictions imposed.

Table 5 is included below as a reference in the event a NEXRAD is unable to provide weather products to multiple MIAWS airports.

**TABLE 1
TSC-Recommended NEXRAD Selections**

This table lists identifiers of TSC-recommended NEXRAD systems for each MIAWS airport. NEXRAD systems omitted from this list had issues regarding volume coverage, line of sight, or weather detection. “None” indicates that no suitable NEXRAD systems were recommended. “Unavailable” indicates that no TSC report was generated for the airport.

Three sites will be operated at FAA facilities for testing, training and maintenance: the FAA Technical Center in Atlantic City, NJ (FAA1), the FAA Training Academy in Oklahoma City, OK (FAA2), and the FAA Program Support Facility in Oklahoma City, OK (FAA3).

	1	FAA1	:	Unavailable					
	2	FAA2	:	Unavailable					
	3	FAA3	:	Unavailable					
1	AGS	:	KCAE	KJGX	21	MAF	:	KMAF	KSJT
2	AVL	:	KMRX		22	MGM	:	Unavailable	
3	BIL	:	None		23	MLI	:	KDVN	KILX
4	BTR	:	KLIX		24	MLU	:	KSHV	KDGX
5	CAE	:	KCAE	KCLX	25	MOB	:	KMOB	KLIX
6	CHA	:	KHTX	KOHX	26	OMA	:	Unavailable	
7	COS	:	KPUX	KFTG	27	PIA	:	KDVN	KLOT
8	CRW	:	KRLX	KJKL	28	PNS	:	KMOB	KEVX
9	CSG	:	KEOX	KJGX	29	PVD	:	KBOX	KOKX
10	DAB	:	KMLB	KJAX	30	ROA	:	KFCX	KRAX
11	FAY	:	KRAX	KLTX	31	RST	:	KARX	KMPX
12	FSD	:	None		32	RSW	:	KTBW	KAMX
13	FSM	:	KINX	KLZK	33	SAV	:	KCLX	KJAX
14	GRB	:	KGRB	KMKX	34	SFO	:	Unavailable	
15	GSP	:	KGSP	KCAE	35	SGF	:	KSGF	KEAX
16	JAN	:	KDGX ²	KLIX	36	SHV	:	KSHV	KPOE
17	LAN	:	KGRR	KDTX	37	SPI	:	KILX	KLSX
18	LEX	:	KLVX	KJKL	38	SUX	:	KOAX	KFSD
19	LIT	:	KLZK	KSRX	39	TLH	:	KTLH	KVAX
20	LNK	:	KOAX	KUEX	40	TRI	:	Unavailable	

² The Jackson NEXRAD “KJAN” antenna location was moved and renamed after the TSC report publication. The new Jackson NEXRAD is identified as “KDGX” and may be considered to be identical to KJAN with respect to NEXRAD selections.

TABLE 2
Preliminary NEXRAD Selection List

This table lists all NEXRAD systems located within a 230-kilometer radius of each MIAWS airport. NEXRAD identifiers are sorted by increasing distance to the airport.

1	FAA1	:	KDIX	KDOX	KOKX			
2	FAA2	:	KCRI	KTLX	KVNX	KFDR	KINX	
3	FAA3	:	KCRI	KTLX	KVNX	KFDR	KINX	
1	AGS	:	KCAE	KCLX	KJGX	KGSP		
2	AVL	:	KGSP	KMRX	KCAE			
3	BIL	:	KBLX					
4	BTR	:	KLIX	KPOE	KLCH	KBIX	KJAN	KDGX
5	CAE	:	KCAE	KCLX	KGSP			
6	CHA	:	KHTX	KOHX	KFFC	KMRX		
7	COS	:	KPUX	KFTG				
8	CRW	:	KRLX	KJKL	KFCX	KILN		
9	CSG	:	KMXX	KFFC	KEOX	KJGX	KBMX	
10	DAB	:	KMLB	KJAX	KTBW			
11	FAY	:	KRAX	KLTX	KMHX			
12	FSD	:	KFSD					
13	FSM	:	KSRX	KINX	KLZK	KSGF		
14	GRB	:	KGRB	KMKX				
15	GSP	:	KGSP	KCAE	KMRX			
16	JAN	:	KJAN	KDGX	KLIX	KBIX		
17	LAN	:	KGRR	KDTX	KIWX			
18	LEX	:	KLVX	KJKL	KILN			
19	LIT	:	KLZK	KSRX	KNQA			
20	LNK	:	KOAX	KUEX	KTWX			
21	MAF	:	KMAF	KSJT	KLBB			
22	MGM	:	KMXX	KBMX	KEOX	KEVX	KFFC	
23	MLI	:	KDVN	KILX	KLOT			
24	MLU	:	KSHV	KPOE	KJAN	KDGX		
25	MOB	:	KMOB	KBIX	KLIX	KEVX		
26	OMA	:	KOAX	KDMX				
27	PIA	:	KILX	KDVN	KLOT			
28	PNS	:	KMOB	KEVX	KBIX	KEOX		
29	PVD	:	KBOX	KOKX				
30	ROA	:	KFCX	KRLX	KRAX			
31	RST	:	KARX	KMPX				
32	RSW	:	KTBW	KAMX	KMLB	KBYX		
33	SAV	:	KCLX	KJAX	KCAE	KJGX	KVAX	
34	SFO	:	KMUX	KDAX	KBBX			
35	SGF	:	KSGF	KEAX	KINX			
36	SHV	:	KSHV	KPOE				
37	SPI	:	KILX	KLSX	KDVN			
38	SUX	:	KOAX	KFSD				
39	TLH	:	KTLH	KVAX	KEVX	KEOX		
40	TRI	:	KMRX	KJKL	KGSP	KFCX	KRLX	

TABLE 3
Dual-NEXRAD Selection List (Option 1)

This table lists recommended NEXRAD systems for MIAWS airports, limited to two NEXRAD systems per airport. NEXRAD identifiers appearing in this list were selected using criteria suggested by the TSC reports with the exception that nearby NEXRADs were chosen instead of more distant NEXRADs.

				1	FAA1	KDIX	KDOX				
				2	FAA2	KCRI	KTLX				
				3	FAA3	KCRI	KTLX				
1	AGS	KCAE	KJGX					21	MAF	KMAF	KSJT
2	AVL	KGSP	KMRX					22	MGM	KMXX	KBMX
3	BIL	KBLX						23	MLI	KDVN	KILX
4	BTR	KLIX	KPOE					24	MLU	KSHV	KDGX
5	CAE	KCAE	KCLX					25	MOB	KMOB	KLIX
6	CHA	KHTX	KOHX					26	OMA	KOAX	KDMX
7	COS	KPUX	KFTG					27	PIA	KILX	KDVN
8	CRW	KRLX	KJKL					28	PNS	KMOB	KEVX
9	CSG	KMXX	KEOX					29	PVD	KBOX	KOKX
10	DAB	KMLB	KJAX					30	ROA	KFCX	KRAX
11	FAY	KRAX	KLTX					31	RST	KARX	KMPX
12	FSD	KFSD						32	RSW	KTBW	KAMX
13	FSM	KSRX	KINX					33	SAV	KCLX	KJAX
14	GRB	KGRB	KMKX					34	SFO	KMUX	KDAX
15	GSP	KGSP	KCAE					35	SGF	KSGF	KEAX
16	JAN	KDGX	KLIX					36	SHV	KSHV	KPOE
17	LAN	KGRR	KDTX					37	SPI	KILX	KLSX
18	LEX	KLVX	KJKL					38	SUX	KOAX	KFSD
19	LIT	KLZK	KSRX					39	TLH	KTLH	KVAX
20	LNK	KOAX	KUEX					40	TRI	KMRX	KJKL

The following list shows the NEXRAD connections associated with the selections listed above.

1	KAMX	RSW		21	KFTG	COS		41	KMRX	AVL	TRI
2	KARX	RST		22	KGRB	GRB		42	KMUX	SFO	
3	KBLX	BIL		23	KGRR	LAN		43	KMXX	CSG	MGM
4	KBMX	MGM		24	KGSP	AVL	GSP	44	KOAX	LNK	OMA
5	KBOX	PVD		25	KHTX	CHA		45	KOHX	CHA	
6	KCAE	AGS	CAE	GSP	26	KILX	MLI	PIA	SPI	46	KOKX
7	KCLX	CAE	SAV		27	KINX	FSM			47	KPOE
8	KCRI	FAA2	FAA3		28	KJAX	DAB	SAV		48	KPUX
9	KDAX	SFO			29	KJGX	AGS			49	KRAX
10	KDGX	JAN	MLU		30	KJKL	CRW	LEX	TRI	50	KRLX
11	KDIX	FAA1			31	KLIX	BTR	JAN	MOB	51	KSGF
12	KDMX	OMA			32	KLSX	SPI			52	KSHV
13	KDOX	FAA1			33	KLTX	FAY			53	KSJT
14	KDTX	LAN			34	KLVX	LEX			54	KSRX
15	KDVN	MLI	PIA		35	KLZK	LIT			55	KTBW
16	KEAX	SGF			36	KMAF	MAF			56	KTLH
17	KEOX	CSG			37	KMKX	GRB			57	KTLX
18	KEVX	PNS			38	KMLB	DAB			58	KUEX
19	KFCX	ROA			39	KMOB	MOB	PNS		59	KVAX
20	KFSD	FSD	SUX		40	KMPX	RST				

TABLE 4
Single-NEXRAD Selection List (Option 2)

This table lists recommended NEXRAD systems for MIAWS airports, limited to one NEXRAD (the nearest) system per airport.

			1	FAA1	KDIX		
			2	FAA2	KCRI		
			3	FAA3	KTLX		
1	AGS	KCAE				21	MAF KMAF
2	AVL	KGSP				22	MGM KMXX
3	BIL	KBLX				23	MLI KDVN
4	BTR	KLIX				24	MLU KSHV
5	CAE	KCAE				25	MOB KMOB
6	CHA	KHTX				26	OMA KOAX
7	COS	KPUX				27	PIA KILX
8	CRW	KRLX				28	PNS KMOB
9	CSG	KMXX				29	PVD KBOX
10	DAB	KMLB				30	ROA KFCX
11	FAY	KRAX				31	RST KARX
12	FSD	KFSD				32	RSW KTBW
13	FSM	KSRX				33	SAV KCLX
14	GRB	KGRB				34	SFO KMUX
15	GSP	KGSP				35	SGF KSGF
16	JAN	KDGX				36	SHV KSHV
17	LAN	KGRR				37	SPI KILX
18	LEX	KLVX				38	SUX KOAX
19	LIT	KLZK				39	TLH KTLH
20	LNK	KOAX				40	TRI KMRX

The following list shows the NEXRAD connections associated with the selections listed above.

1	KARX	RST		13	KGRR	LAN		25	KMXX	CSG	MGM	
2	KBLX	BIL		14	KGSP	AVL	GSP	26	KOAX	LNK	OMA	SUX
3	KBOX	PVD		15	KHTX	CHA		27	KPUX	COS		
4	KCAE	AGS	CAE	16	KILX	PIA	SPI	28	KRAX	FAY		
5	KCLX	SAV		17	KLIX	BTR		29	KRLX	CRW		
6	KCRI	FAA2	FAA3	18	KLVX	LEX		30	KSGF	SGF		
7	KDGX	JAN		19	KLZK	LIT		31	KSHV	MLU	SHV	
8	KDIX	FAA1		20	KMAF	MAF		32	KSRX	FSM		
9	KDVN	MLI		21	KMLB	DAB		33	KTBW	RSW		
10	KFCX	ROA		22	KMOB	MOB	PNS	34	KTLH	TLH		
11	KFSD	FSD		23	KMRX	TRI						
12	KGRB	GRB		24	KMUX	SFO						

TABLE 5
Single-Airport NEXRAD Selection List (Option 3)

This table lists recommended NEXRAD systems for MIAWS airports, with each NEXRAD limited to providing data to only one airport. In some cases, airports were forced to select NEXRAD systems further away. Some airports were permitted two NEXRAD sources since the NEXRAD systems did not conflict with the needs of any other airports.

1	FAA1	KDIX
2	FAA2	KCRI
3	FAA3	KTLX

1	AGS	KJGX	21	MAF	KMAF	KSJT	
2	AVL	KMRX	22	MGM	KBMX		
3	BIL	KBLX	23	MLI	KILX		
4	BTR	KLIX	24	MLU	KSHV		
5	CAE	KCAE	25	MOB	KMOB		
6	CHA	KHTX	KOHX	26	OMA	KDMX	
7	COS	KPUX	KFTG	27	PIA	KDVN	
8	CRW	KRLX		28	PNS	KEVX	
9	CSG	KMXX	KEOX	29	PVD	KBOX	KOKX
10	DAB	KMLB	KJAX	30	ROA	KFCX	
11	FAY	KRAX	KLTX	31	RST	KARX	KMPX
12	FSD	KFSD		32	RSW	KTBW	KAMX
13	FSM	KSRX	KINX	33	SAV	KCLX	
14	GRB	KGRB	KMKX	34	SFO	KMUX	KDAX
15	GSP	KGSP		35	SGF	KSGF	KEAX
16	JAN	KDGX		36	SHV	KPOE	
17	LAN	KGRR	KDTX	37	SPI	KLSX	
18	LEX	KLVX		38	SUX	KOAX	
19	LIT	KLZK		39	TLH	KTLH	KVAX
20	LNK	KUEX		40	TRI	KJKL	

The following list shows the NEXRAD connections associated with the selections listed above.

1	KAMX	RSW	21	KGRB	GRB	41	KMUX	SFO
2	KARX	RST	22	KGRR	LAN	42	KMXX	CSG
3	KBLX	BIL	23	KGSP	GSP	43	KOAX	SUX
4	KBMX	MGM	24	KHTX	CHA	44	KOHX	CHA
5	KBOX	PVD	25	KILX	MLI	45	KOKX	PVD
6	KCAE	CAE	26	KINX	FSM	46	KPOE	SHV
7	KCLX	SAV	27	KJAX	DAB	47	KPUX	COS
8	KCRI	FAA2	28	KJGX	AGS	48	KRAX	FAY
9	KDAX	SFO	29	KJKL	TRI	49	KRLX	CRW
10	KDGX	JAN	30	KLIX	BTR	50	KSGF	SGF
11	KDIX	FAA1	31	KLSX	SPI	51	KSHV	MLU
12	KDMX	OMA	32	KLTX	FAY	52	KSJT	MAF
13	KDTX	LAN	33	KLVX	LEX	53	KSRX	FSM
14	KDVN	PIA	34	KLZK	LIT	54	KTBW	RSW
15	KEAX	SGF	35	KMAF	MAF	55	KTLH	TLH
16	KEOX	CSG	36	KMKX	GRB	56	KTLX	FAA3
17	KEVX	PNS	37	KMLB	DAB	57	KUEX	LNK
18	KFCX	ROA	38	KMOB	MOB	58	KVAX	TLH
19	KFSD	FSD	39	KMPX	RST			
20	KFTG	COS	40	KMRX	AVL			

3. CONCLUSIONS

This report presented a number of NEXRAD selection options for the 40 planned MIAWS airports and three FAA test or maintenance facilities. Table 3 contained the baseline selection list in which airports acquire weather products from at least two NEXRAD systems. Tables 4 and 5 present more limited NEXRAD selection lists under different selection restrictions. In most cases, the recommended NEXRAD selections coincided with those appearing in the TSC reports. However, in some cases, preferring NEXRAD systems within close proximity of the airport produced NEXRAD selections that did not match TSC recommendations. It is expected that upcoming NEXRAD gust front detection capabilities and lower-cost phone lines associated with nearby NEXRAD systems will outweigh the TSC volumetric coverage selection criteria. Table 6 summarizes the three recommended NEXRAD selection options listed in Table 3 (Option 1), Table 4 (Option 2), and Table 5 (Option 3).

	AIRPORT	OPTION 1	OPTION 2	OPTION 3
1	FAA1	KDIX KDOX	KDIX	KDIX
2	FAA2	KCRI KTLX	KTLX	KCRI
3	FAA3	KCRI KTLX	KTLX	KTLX
1	AGS	KCAE KJGX	KCAE	KJGX
2	AVL	KGSP KMRX	KGSP	MKRX
3	BIL	KBLX	KBLX	KBLX
4	BTR	KLIX KPOE	KLIX	KLIX
5	CAE	KCAE KCLX	KCAE	KCAE
6	CHA	KHTX KOHX	KHTX	KHTX KOHX
7	COS	KPUX KFTG	KPUX	KPUX KFTG
8	CRW	KRLX KJKL	KRLX	KRLX
9	CSG	KMXX KEOX	KMXX	KMXX KEOX
10	DAB	KMLB KJAX	KMLB	KMLB KJAX
11	FAY	KRAX KLTX	KRAX	KRAX KLTX
12	FSD	KFSD	KFSD	KFSD
13	FSM	KSRX KINX	KSRX	KSRX KINX
14	GRB	KGRB KMKX	KGRB	KGRB KMKX
15	GSP	KGSP KCAE	KGSP	KGSP
16	HAN	KDGX KLIK	KDGX	KDGX
17	LAN	KGRR KDTX	KGRR	KGRR KDTX
18	LEX	KLVX KJKL	KLVX	KLVX
19	LIT	KLZK KSRX	KLZK	KLZK
20	LNK	KOAX KUEX	KOAX	KEUX
21	MAF	KMAF KSJT	KMAF	KMAF KSJT
22	MGM	KMXX KBMX	KMXX	KBMX
23	MLI	KDVN KILX	KDVN	KILX
24	MLU	KSHV KDGX	KSHV	KSHV
25	MOB	KMOB KLIK	KMOB	KMOB
26	OMA	KOAX KDMX	KOAX	KDMX
27	PIA	KILX KDVN	KILX	KDVN
28	PNS	KMOB KEVX	KMOB	KEVX
29	PVD	KBOX KOKX	KBOX	KBOX KOKX
30	ROA	KFCX KRAX	KFCX	KFCX
31	RST	KARX KMPX	KARX	KARX KMPX
32	RSW	KTBW KAMX	KTBW	KTBW KAMX
33	SAV	KCLX KJAX	KCLX	KCLX
34	SFO	KMUX KDAX	KMUX	KMUX KDAX
35	SGF	KSGF KEAX	KSGF	KSGF KEAX
36	SHV	KSHV KPOE	KSHV	KPOE
37	SPI	KILX KLSX	KILX	KLSX
38	SUX	KOAX KFSD	KOAX	KOAX
39	TLH	KTLH KVAX	KTLH	KTLH KVAX
40	TRI	KMRX KJKL	KMRX	KJKL

TABLE 6
MIAWS NEXRAD Selection Options

This table summarizes the NEXRAD selection lists in Tables 3, 4, and 5.

Option 1

Limit two NEXRAD selections per airport.
Requires connections to 59 NEXRAD systems.

Option 2

Limit one NEXRAD selection per airport.
Requires connections to 34 NEXRAD systems.

Option 3

Limit one airport connection per NEXRAD.
Requires connections to 58 NEXRAD systems.

APPENDIX A

MIAWS AIRPORTS

The following list maps the identifiers of 40 airports scheduled to receive MIAWS with the airport names. In addition, FAA-operated test and maintenance sites are defined for the FAA Program Support Facility in Oklahoma City and the FAA Technical Center in Atlantic City.

1	FAA1	FAA TECHNICAL CENTER, ATLANTIC CITY, NJ
2	FAA2	FAA TRAINING ACADEMY, OKLAHOMA CITY, OK
3	FAA3	FAA PROGRAM SUPPORT FACILITY, OKLAHOMA CITY, OK
1	AGS	AUGUSTA RGNL AT BUSH FIELD AIRPORT, AUGUSTA, GA
2	AVL	ASHEVILLE REGIONAL AIRPORT, ASHEVILLE, NC
3	BIL	BILLINGS LOGAN INTL AIRPORT, BILLINGS, MT
4	BTR	BATON ROUGE METROPOLITAN, RYAN FIELD AIRPORT, BATON ROUGE, LA
5	CAE	COLUMBIA METROPOLITAN AIRPORT, COLUMBIA, SC
6	CHA	LOVELL FIELD AIRPORT, CHATTANOOGA, TN
7	COS	CITY OF COLORADO SPRINGS MUNI AIRPORT, COLORADO SPRINGS, CO
8	CRW	YEAGER AIRPORT, CHARLESTON, WV
9	CSG	COLUMBUS METROPOLITAN AIRPORT, COLUMBUS, GA
10	DAB	DAYTONA BEACH INTL AIRPORT, DAYTONA BEACH, FL
11	FAY	FAYETTEVILLE REGIONAL/GRANNIS FIELD AIRPORT, FAYETTEVILLE, NC
12	FSD	JOE FOSS FIELD AIRPORT, SIOUX FALLS, SD
13	FSM	FORT SMITH REGIONAL AIRPORT, FORT SMITH, AR
14	GRB	AUSTIN STRAUBEL INTERNATIONAL AIRPORT, GREEN BAY, WI
15	GSP	GREENVILLE-SPARTANBURG INTL AIRPORT, GREER, SC
16	JAN	JACKSON INTERNATIONAL AIRPORT, JACKSON, MS
17	LAN	CAPITAL CITY AIRPORT, LANSING, MI
18	LEX	BLUE GRASS AIRPORT, LEXINGTON, KY
19	LIT	ADAMS FIELD AIRPORT, LITTLE ROCK, AR
20	LNK	LINCOLN MUNI AIRPORT, LINCOLN, NE
21	MAF	MIDLAND INTERNATIONAL AIRPORT, MIDLAND, TX
22	MGM	MONTGOMERY RGNL (DANNELLY FIELD) AIRPORT, MONTGOMERY, AL
23	MLI	QUAD CITY INTL AIRPORT, MOLINE, IL
24	MLU	MONROE REGIONAL AIRPORT, MONROE, LA
25	MOB	MOBILE REGIONAL AIRPORT, MOBILE, AL
26	OMA	EPPLEY AIRFIELD AIRPORT, OMAHA, NE
27	PIA	GREATER PEORIA REGIONAL AIRPORT, PEORIA, IL
28	PNS	PENSACOLA REGIONAL AIRPORT, PENSACOLA, FL
29	PVD	THEODORE FRANCIS GREEN STATE AIRPORT, PROVIDENCE, RI
30	ROA	ROANOKE REGIONAL/WOODRUM FIELD AIRPORT, ROANOKE, VA
31	RST	ROCHESTER INTERNATIONAL AIRPORT, ROCHESTER, MN
32	RSW	SOUTHWEST FLORIDA INTL AIRPORT, FORT MYERS, FL
33	SAV	SAVANNAH INTERNATIONAL AIRPORT, SAVANNAH, GA
34	SFO	SAN FRANCISCO INTERNATIONAL AIRPORT, SAN FRANCISCO, CA
35	SGF	SPRINGFIELD-BRANSON REGIONAL AIRPORT, SPRINGFIELD, MO
36	SHV	SHREVEPORT REGIONAL AIRPORT, SHREVEPORT, LA
37	SPI	CAPITAL AIRPORT, SPRINGFIELD, IL
38	SUX	SIOUX GATEWAY AIRPORT, SIOUX CITY, IA
39	TLH	TALLAHASSEE REGIONAL AIRPORT, TALLAHASSEE, FL
40	TRI	TRI-CITIES REGIONAL TN/VA AIRPORT, BRISTOL/JOHNSON/KINGSPORT, TN

APPENDIX B

NATIONWIDE NEXRAD SYSTEMS

The following list maps the identifiers of all United States NEXRAD systems with names and locations.

1	KABR	ABERDEEN, SD / ABERDEEN
2	KABX	ALBUQUERQUE, NM / ALBUQUERQUE
3	KAKQ	NORFOLK, VA / WAKEFIELD
4	KAMA	AMARILLO, TX / AMARILLO
5	KAMX	MIAMI, FL / RICHMOND HEIGHTS
6	KAPX	NCL MICHIGAN, MI / GAYLORD
7	KARX	LA CROSSE, WI / LA CROSSE
8	KATX	SEATTLE, WA / STANDWOOD
9	KBBX	BEALE AFB, CA / OROVILLE
10	KBGM	BINGHAMTON, NY / JOHNSON CITY
11	KBHX	EUREKA / BUNKER HILL), CA / EUREKA
12	KBIS	BISMARCK, ND / BISMARCK
13	KBIX	KEESLER AFB OPS TRNG, MS / D'IBERVILLE
14	KBLX	BILLINGS, MT / BILLINGS
15	KBMX	BIRMINGHAM, AL / CALERA
16	KBOX	BOSTON, MA / TAUNTON
17	KBRO	BROWNSVILLE, TX / BROWNSVILLE
18	KBUF	BUFFALO, NY / CHEEKTOWAGA
19	KBYX	KEY WEST, FL / KEY WEST
20	KCAE	COLUMBIA, SC / WEST COLUMBIA
21	KCBW	CARIBOU, ME / HOULTON
22	KCBX	BOISE, ID / BOISE
23	KCCX	STATE COLLEGE, PA / STATE COLLEGE
24	KCLE	CLEVELAND, OH / CLEVELAND
25	KCLX	CHARLESTON, SC / CHARLESTON
26	KCRI	OSF REDUNDANT (R), OK / NORMAN
27	KCRP	CORPUS CHRISTI, TX / CORPUS CHRISTI
28	KCXX	BURLINGTON, VT / COLCHESTER
29	KCYS	CHEYENNE, WY / CHEYENNE
30	KDAX	SACRAMENTO, CA / SACRAMENTO
31	KDDC	DODGE CITY, KS / DODGE CITY
32	KDFX	LAUGHLIN AFB, TX / BRACKETVILLE
33	KDGX	BRANSON, MS / BRANSON
34	KDIX	PHILADELPHIA, PA / PHILADELPHIA
35	KDLH	DULUTH, MN / DULUTH
36	KDMX	DES MOINES, IA / JOHNSTON
37	KDOX	DOVER AFB, DE / ELLENDALE STATE FOREST
38	KDTX	DETROIT, MI / DETROIT
39	KDVN	QUAD CITIES, IA / DAVENPORT
40	KDYX	DYESS AFB, TX / MORAN
41	KEAX	PLEASANT HILL, MO / PLEASANT HILL
42	KEMX	TUCSON, AZ / EMPIRE MOUNTAIN
43	KENX	ALBANY, NY / ALBANY
44	KEOX	FT RUCKER, AL / ECHO

45 KEPZ EL PASO, NM / SANTA TERESA
46 KESX LAS VEGAS, NV / LAS VEGAS
47 KEVX EGLIN AFB, FL / RED BAY
48 KEWX AUSTIN/SAN ANTONIO, TX / NEW BRAUNFELS
49 KEYX EDWARDS AFB, CA / BORON
50 KFCX ROANOKE, VA / COLES KNOB
51 KFDR ALTUS AFB, OK / FREDERICK
52 KFDX CANNON AFB, NM / FIELD
53 KFFC ATLANTA, GA / PEACHTREE CITY
54 KFSD SIOUX FALLS, SD / SIOUX FALLS
55 KFSX FLAGSTAFF (R), AZ / FLAGSTAFF
56 KFTG DENVER, CO / FRONT RANGE AP
57 KFWS DALLAS/FT WORTH, TX / FORT WORTH
58 KGGW GLASGOW, MT / GLASGOW
59 KGJX GRAND JUNCTION (R), CO / GRAND JUNCTION
60 KGLD GOODLAND, KS / GOODLAND
61 KGRB GREEN BAY, WI / GREEN BAY
62 KGRK FT HOOD, TX / GRANGER
63 KGRR GRAND RAPIDS, MI / GRAND RAPIDS
64 KGSP GREER , SC / GREENVILLE/SPARTANBURG
65 KGWX COLUMBUS AFB, MS / GREENWOOD
66 KGYX PORTLAND, ME / GRAY
67 KHDX HOLLOMAN AFB, NM / RUIDOSO
68 KHGX HOUSTON, TX / HOUSTON
69 KHNX SAN JOAQUIN VALY, CA / HANFORD
70 KHPX FT CAMPBELL, KY / TRENTON
71 KHTX NORTHEAST ALABAMA, AL / NE ALABAMA
72 KICT WICHITA, KS / WICHITA
73 KICX CEDAR CITY (R), UT / CEDAR CITY
74 KILN CINCINNATI, OH / WILMINGTON
75 KILX LINCOLN, IL / LINCOLN
76 KIND INDIANAPOLIS, IN / INDIANAPOLIS
77 KINX TULSA, OK / INOLA
78 KIWA PHOENIX, AZ / WILLIAMS AFB
79 KIWX NORTHERN INDIANA, IN / SYRACUSE
80 KJAN JACKSON, MS / JACKSON
81 KJAX JACKSONVILLE, FL / JACKSONVILLE
82 KJGX ROBINS AFB, GA / JEFFERSONVILLE
83 KJKL JACKSON, KY / JACKSON
84 KLBB LUBBOCK, TX / LUBBOCK
85 KLCH LAKE CHARLES, LA / LAKE CHARLES
86 KLIK SLIDELL, LA / SLIDELL
87 KLNK NORTH PLATTE, NE / NORTH PLATTE
88 KLOT CHICAGO, IL / CHICAGO
89 KLRX ELKO (R), NV / ELKO
90 KLSX ST LOIS, MO / ST LOUIS
91 KLTX WILMINGTON, NC / SHALLOTTE
92 KLVX LOUISVILLE, KY / FORT KNOX
93 KLWX STERLING, VA / STERLING
94 KLZK LITTLE ROCK, AR / LITTLE ROCK

95 KMAF MIDLAND/ODESSA, TX / MIDLAND
 96 KMAX MEDFORD (R), OR / MEDFORD
 97 KMBX MINOT AFB, ND / DEERING
 98 KMHX MOREHEAD CITY, NC / NEWPORT
 99 KMKX MILWAUKEE, WI / DOUSMAN
 100 KMLB MELBOURNE, FL / MELBOURNE
 101 KMOB MOBILE, AL / MOBILE
 102 KMPX MINNEAPOLIS, MN / CHANHASSEN
 103 KMQT MARQUETTE, MI / NEGAUNEE
 104 KMRX KNOXVILLE, TN / MORRISTOWN
 105 KMSX MISSOULA (R), MT / MISSOULA
 106 KMTX SALT LAKE CITY (R), UT / SALT LAKE CITY
 107 KMUX SAN FRANCISCO, CA / MCQUEEN'S RIDGE
 108 KMVX FARGO/GRAND FORKS, ND / GRAND FORKS
 109 KMXX MAXWELL AFB, AL / CARRVILLE
 110 KNKX SAN DIEGO, CA / SAN DIEGO
 111 KNQA MEMPHIS, TN / MILLINGTON NAS
 112 KOAX OMAHA, NE / VALLEY
 113 KOHX NASHVILLE, TN / OLD HICKORY
 114 KOKX BROOKHAVEN, NY / UPTON
 115 KOTX SPOKANE, WA / SPOKANE
 116 KPAH PADUCAH, KY / WEST PEDUCAH
 117 KPBZ PITTSBURGH, PA / MOON TOWNSHIP
 118 KPDT PENDLETON, OR / PENDLETON
 119 KPOE FT POLK, LA / FT POLK
 120 KPUX PUEBLO, CO / PUEBLO
 121 KRAX RALEIGH/DURHAM, NC / RALEIGH/DURHAM
 122 KRGX RENO (R), NV / RENO
 123 KRIW RIVERTON/LANDER, WY / RIVERTON
 124 KRLX CHARLESTON, WV / CHARLESTON
 125 KRTX PORTLAND, OR / PORTLAND
 126 KSFX POCATELLO, ID / POCATELLO
 127 KSGF SPRINGFIELD, MO / SPRINGFIELD
 128 KSHV SHREVEPORT, LA / SHREVEPORT
 129 KSJT SAN ANGELO, TX / SAN ANGELO
 130 KSOX SANTA ANA MTS, CA / SANTA ANA MOUNTAINS
 131 KSRX WESTERN ARKANSAS, AR / WESTERN ARKANSAS
 132 KTBW TAMPA, FL / TAMPA BAY AREA
 133 KTFX GREAT FALLS, MT / GREAT FALLS
 134 KTLH TALLAHASSEE, FL / TALLAHASSEE
 135 KTLX NORMAN, OK / OKLAHOMA CITY
 136 KTWX TOPEKA, KS / WABAUNSEE COUNTY
 137 KTYX FT DRUM, NY / MONTAGUE
 138 KUDX RAPID CITY, SD / RAPID CITY
 139 KUEX GRAND ISLAND, NE / WEBSTER CNTY NR BLUE HILL
 140 KVAX MOODY AFB, GA / SOUTH STOCKTON
 141 KVBX VANDENBERG AFB, CA / ORCUTT
 142 KVNK VANCE AFB, OK / CHEROKEE
 143 KVTX ANGELES, CA / OXNARD
 144 KYUX YUMA (R), AZ / YUMA

145 LPLA LAJES AB, AZR / SANTA BARBARA
146 PABC BETHEL FAA (R), AK / BETHEL
147 PACG SITKA FAA (R), AK / BIORKA ISLAND
148 PAEC NOME FAA (R), AK / NOME
149 PAHG ANCHORAGE FAA (R), AK / KENAI
150 PAIH MIDDLETON ISLAND (R), AK / MIDDLETON ISLAND
151 PAKC KING SALMON FAA (R), AK / KING SALMON
152 PAPD FAIRBANKS FAA (R), AK / FAIRBANKS
153 PGUA ANDERSEN AFB, GU / ANDERSEN AFB
154 PHKI SOUTH KAUAI FAA (R), HI / KAUAI
155 PHKM KAMUELA/KOHALA APT (R), HI / KAMUELA
156 PHMO MOLOKAI FAA (R), HI / MOLOKAI
157 PHWA SOUTH SHORE FAA (R), HI / NAALEHU
158 RKJK KUNSAN AB, KO / KUNSAN AB
159 RKSG CAMP HUMPHREYS, KO / CAMP HUMPHREYS
160 RODN KADENA AB, JA / KADENA AB
161 TJUA SAN JUAN FAA (R), PR / SAN JUAN

GLOSSARY

FAA	Federal Aviation Administration
HRVIL	High Resolution Vertically Integrated Liquid
MIAWS	Medium Intensity Airport Weather System
MIT/LL	MIT Lincoln Laboratory
NAS	National Airspace System
NEXRAD	Next Generation Weather Radar
NMI	Nautical Miles
NWS	National Weather Service
ROC	Radar Operations Center
TSC	Technology Service Corporation

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