ORDER

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

AT 7032.1

10/25/83

SUBJ: ATS OPERATIONAL REQUIREMENTS FOR NEXT GENERATION WEATHER RADAR (NEXRAD)

1. PURPOSE. This order promulgates the Air Traffic Service operational requirements for the Next Generation Weather Radar (NEXRAD).

2. DISTRIBUTION. This order is distributed to the branch level in the Washington headquarters, regional headquarters, Aeronautical Center and Technical Center.

3. BACKGROUND. FAA ORDER 7032.2A, dated October 13, 1982, establishes procedures for the formulation of air traffic operational requirements. A System Requirements Team (SRT) was formed and met in Norman, OK. The SRT drafted operational requirements that were subsequently approved by all air traffic division managers and signed by the Director, Air Traffic Service. Approved air traffic operational requirements become part of the Air Traffic System Plan. The Air Traffic System Plan supports the National Airspace System Plan (Brown Book). The SRT included Jim Norton, AAT-150, Chairman; Gene Wygal, AAT-330; Don Schardt, Lubbock Tower; Dan Boyle, ANM-507; Marty Natchipolsky, APM-310; Walter Rogers, ZLA CWSU; Chuck Higgins, ASO-510; Joyce Spires, ASW-510; Bill Cocker, Tampa Tower; Dal Sessions, Denver Tower; Bill Brant, ZKC; and Don Boston, ZID.

4. DEFINITION. The Next Generation Weather Radar will be a DOPPLER radar. The DOPPLER radar will detect and measure weather phenomena in both space and time. The preciseness of the measurements and the speed of the calculations will permit the detection and intensity measurement of precipitation, turbulence, hail, wind-shear, freezing levels, tornadoes, etc. NEXRAD's when installed are expected to interface with the Central Weather Processor (CWP) which will interface with en route, flight service station and other processing and display systems.

5. REQUEST FOR CHANGES. Suggested changes to this order should be addressed to AAT-1, for the attention of AAT-100, and contain complete justification/ rationale for the change.

6. APPLICATION. This order applies to all Air Traffic Service personnel and is for the guidance of all other organizational units.

7. ATS NEXRAD OPERATIONAL REQUIREMENTS. The Air Traffic Service will require the following from the NEXRAD and other associated equipment.

a. Area Coverage.

(1). En route coverage is required for the 48 conterminous states and the area extending outward from the U.S. coastline and international boundaries for 125 nautical miles (NMI). Also, coverage is required in the following geographic areas.

The Caribbean area within 125 NMI radius of points,
18° 20' N - 66° 10' W (San Juan)
23° 42' N - 75° 45' W (Georgetown, BH.)
21° 25' N - 71° 10' W (Grand Turk, BWI.)

The Hawaiian area within 125 NMI radius of points,
20° 00' N - 155° 40' W (Kamuela)
21° 08' N - 157° 10' W (Molokai)
21° 54' N - 159° 31' W (South Kauai)

The Alaskan area within 125 NMI radius of points,
55° 02' N - 131° 34' W (Annette Island)
58° 10' N - 135° 15' W (Juneau)
61° 10' N - 146° 00' W (Valdez)
61° 10' N - 150° 00' W (Anchorage)
58° 45' N - 156° 30' W (King Salmon)
55° 12' N - 162° 43' W (Cold Bay)
64° 49' N - 147° 51' W (Fairbanks)

(2). Terminal area coverage is required within 60 NMI radius of the Airport Reference Point (ARP) for selected terminal locations where radar approach control service is provided.

(3). Within the area of coverage, volume coverage is required. The volume coverage for NEXRAD must meet the following minimum requirements:

(a) En route, from 6000 feet above ground level (AGL) to 70,000 feet above mean sea level (MSL). En route geographic areas are defined in paragraph 7a(1).

(b) Terminal areas, from 15,000 feet above ground level (AGL), down to a base altitude of 200 feet AGL within the area from the ARP to 10 NMI, and down to a base altitude of 3,000 feet or the minimum IFR altitude (MIA), whichever is lower, within the area from 10 NMI to 60 NMI. Terminal geographic areas are defined in paragraph 7a(2).

b. Accuracy. The accuracy (horizontal and vertical) with which the weather phenomena is located and displayed must be within the following tolerances:

(1). En route coverage - 2,000 feet.

(2). Terminal coverage - 300 feet up to 5,000 feet AGL within 10 NMI of the ARP and 2,000 feet in all other areas.

c. Precipitation. Precipitation reflectivity (accuracy and resolution) for en route and terminal coverage is required for display in six levels, i.e., see Figure 1, NWS table for level one through level six precipitation. Figure 1 refers to D/RADEX and D/VIP. D/RADEX and D/VIP are radar processing devices used to determine precipitation intensity levels from radar returns. The following items shall be considered in determining precipitation reflectivity levels.

(1). Range.....0 to 70 dBz. (see Note 1.)

(2). Resolution.....to one dBz at all levels.

(3). Accuracy.....to within one dBz.

Note 1. dBz means decibels corrected for range.

d. Wind/Wind Shear. Wind shear detection is required in terminal areas. Winds (prevailing) and wind shears are to be measured along airport approaches and departure corridors in precipitation, clear air, and sea breezes. Winds (prevailing) are to be resolved to the nearest 10 degrees in direction and 2 knots in velocities over a range of 2 - 20 knots, and 10 percent over 20 knots. Wind shears are to be detectable over a range of shears having a threshold velocity gradient of 10 knots per 1,000 feet horizontally and 5 knots per 100 feet vertically. Low level winds and wind shear direction must be accurate to within 5 degrees and speed accuracy to 2 knots over a range of 2 - 20 knots, and 10 percent over 20 knots. Dedicated wind shear alerting devices shall be provided at associated terminal locations

e. Tornadoes/Mesocyclones. Mesocyclones are often precursors to tornado activity. Due to this relationship, detection, tracking, and display of tornadoes/mesocyclones must be provided. There must be positive identification and attention-getting indications of these conditions at the earliest possible moment for both en route and terminal operations. The indication for tornadoes/mesocyclones should be different from all other data received; e.g., hail, wind shear, thunderstorms, etc.

f. Fronts/Fine Lines. The NEXRAD system shall detect the location and movement of fronts and fine line phenomena along with associated turbulence and wind shears. Fine line phenomena are specific characteristics associated with a particular type front.

g. Hurricanes. Hurricane detection and tracking must be provided. The hurricane eye and wall should be identified and an attention-getting indication of these conditions displayed for both en route and terminal operations.

h. Thunderstorms. The NEXRAD system will indicate categories of thunderstorm severity. These categories shall consider such factors as, but not be limited to: turbulence, hail, strong winds, and wind shears. In addition, height data (tops) associated with the aforementioned factors as well as for the thunderstorm itself shall be provided.

Figure 1. DBZ RANGE FOR THE INTERNAL D/RADEX AND D/VIP LEVELS

Internal D/RADEX Level	DBZ Range	Corresponding VIP Level	DBZ Range
1	18-24	1	18-29
2	25-29		
3	30-34	2	30-40
4	35-37		
5	38-40		
6	41-42	3	41-45
7	43		
8	44-45		
9	46-47	4	46-49
10	48		
11	49		
12	50-52	5	50-56
13	53-54		
14	55-56		
15	57	6	57

i. TURBULENCE. Turbulence (vertical velocity) location and intensity in precipitation and clear air is required. The following turbulence intensity and accuracy measurements are needed.

(1). Intensity - 300 feet per minute to 4,000 feet per minute.

(2). Accuracy - ±200 feet per minute.

In addition, detection of wake vortices generated by aircraft is also required.

j. ICING/FREEZING/MELTING LEVELS. Weather conditions that are conducive to icing should be detected and displayed along with freezing/melting levels. The vertical accuracy for identification of these levels shall be ±500 feet.

k. Hail. There must be a position indication of hail, including location and the altitude(s) at which that activity is taking place.

l. Scan Rate. Data from each antenna scan shall be integrated into the display data base, remoted and available for display within 30 seconds after being obtained. The display data base shall be updated on a continuous basis as new data are acquired. Sampling scanning strategies (antenna rotation) shall be provided to permit attribute information over the full coverage volume to be acquired, remoted, and available for display every 2.5 minutes, except every minute for terminal operations within 10 NMI of the ARP and up to 5,000 feet AGL. This requirement determines that the data processing of NEXRAD weather phenomena must be fully automated.

m. Storm Prediction Plot. A current data base and historical data stored in the computer shall be used to predict the location, size, and intensity of hazardous convective storms at 5-minute intervals for up to 60 minutes. This information shall be available for display to the controller.

n. Communications. In the event of a failure of a primary NEXRAD at an ATC facility, an automatic data communications system (dial-up) shall be included in order to provide for NEXRAD coverage from an adjacent NEXRAD system.

o. Display. NEXRAD color weather phenomena, including alert features, must be capable of interfacing with HOST/Sector Suite flight data on controller displays (PPI, PVD, etc.). The weather and ATC information must have separate intensity controls. The center weather service unit (CWSU) meteorologist will have the capability of displaying and processing attributes of the NEXRAD data set within the full coverage volume for any NEXRAD. Operator controls for the controller and meteorologist must provide for individual and combination presentations of weather phenomena described in subparagraphs c. through k. above.

p. Mosaicking. Some ATC sectors or flight watch control stations control or provide service to aircraft over very large areas. These areas require data from more than one NEXRAD site. The display of more than one NEXRAD on a single display requires the mosaicking of the data, for a single comprehensive picture of the weather within a given geographical area.

q. Ground Clutter and Anomalous Propagation. The display of radar data must reliably indicate weather phenomena free of ground clutter and anomalous propagation.

R. J. Van Vuren
Director, Air Traffic Service

k. Hail. There must be a position indication of hail, including location and the altitude(s) at which that activity is taking place.

l. Scan Rate. Data from each antenna scan shall be integrated into the display data base, remoted and available for display within 30 seconds after being obtained. The display data base shall be updated on a continuous basis as new data are acquired. Sampling scanning strategies (antenna rotation) shall be provided to permit attribute information over the full coverage volume to be acquired, remoted, and available for display every 2.5 minutes, except every minute for terminal operations within 10 NMI of the ARP and up to 5,000 feet AGL. This requirement determines that the data processing of NEXRAD weather phenomena must be fully automated.

m. Storm Prediction Plot. A current data base and historical data stored in the computer shall be used to predict the location, size, and intensity of hazardous convective storms at 5-minute intervals for up to 60 minutes. This information shall be available for display to the controller.

n. Communications. In the event of a failure of a primary NEXRAD at an ATC facility, an automatic data communications system (dial-up) shall be included in order to provide for NEXRAD coverage from an adjacent NEXRAD system.

o. Display. NEXRAD color weather phenomena, including alert features, must be capable of interfacing with HOST/Sector Suite flight data on controller displays (PPI, PVD, etc.). The weather and ATC information must have separate intensity controls. The center weather service unit (CWSU) meteorologist will have the capability of displaying and processing attributes of the NEXRAD data set within the full coverage volume for any NEXRAD. Operator controls for the controller and meteorologist must provide for individual and combination presentations of weather phenomena described in subparagraphs c. through k. above.

p. Mosaicking. Some ATC sectors or flight watch control stations control or provide service to aircraft over very large areas. These areas require data from more than one NEXRAD site. The display of more than one NEXRAD on a single display requires the mosaicking of the data, for a single comprehensive picture of the weather within a given geographical area.

q. Ground Clutter and Anomalous Propagation. The display of radar data must reliably indicate weather phenomena free of ground clutter and anomalous propagation.

R. J. Van Vuren
Director, Air Traffic Service