National Weather Service Radar Code User's Guide

Silver Spring, Maryland
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U. S. DEPARTMENT OF COMMERCE
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INTRODUCTION

The National Weather Service adopted the current radar reporting code on February 28, 1978. Since then, all NWS radar observations except those from the four FAA Air Route Traffic Control Centers (ARTCC's) have been encoded in the manner described in this user's guide. The ARTCC's report in a code that is entirely digital. This code is described in the first edition of the NWS Digital Radar Code User's Guide dated January 1977, and in FMH No. 7, Weather Radar Observations, National Weather Service Part C, Section IV, Issue No. 4-WSH, March 1978. The new code has two major sections. The first section is the SD part of the observation in which the echoes are reported in an azimuth and range format. This section is nearly identical to the old radar code. The second section is the digital section. It replaced the old MDR code.

An automated radar summary chart is being produced by computer using the coded radar observations. This chart is more timely and accurate than the old hand-drawn chart.

Three teletypewriter plots, or paper doll messages, are also made based on the radar observations. One is a plot of the current intensities. The other two are 3- and 4-hour intensity sums.

This user's guide contains not only a detailed description of the radar reporting code, but also descriptions of the automated radar summary chart and the teletypewriter plots.

I. RADAR CODE

The radar code is made up of two major sections: an SD section and a digital section. The SD section is the first part of the observation. This gives radar data in an azimuth-range format that can easily be used with a minimum of processing. A brief description of the SD section of the radar code follows. There are nine basic parts.

SD Section

1. Echo Configuration. The echo configuration is described by one of the following contractions:

AREA	An area of related echoes.
LN	A line of convective echoes.
CELL(S)	Isolated convective echo or echoes.
LYR	An elevated layer of stratiform echoes.
FINE LN	A fine line, a narrow nonprecipitation echo pattern that is associated with a meteorological discontinuity.
EYE	A hurricane or tropical storm eye.
CNTR	A hurricane or tropical storm center.
SPRL BAND AREA	A hurricane spiral band area.

2. Areal Coverage. The areal coverage in tenths is encoded with a one- or two-digit number.

3. Precipitation Type. The precipitation type is reported using symbols from the following list:

SYMBOL	PRECIPITATION	SYMBOL	PRECIPITATION
R	Rain	SW	Snow Shower
RW	Rain Shower	L	Drizzle
ZR	Freezing Rain	ZL	Freezing Drizzle
ZRW	Freezing Rain Shower	IP	Ice Pellets
S	Snow	IPW	Ice Pellet Shower
		A	Hail

The letter "T" is put before the precipitation symbol if thunder is occurring with the precipitation.

4. Intensity. Echo intensity is reported using symbols from the following table:

Intensity Symbol	Echo Intensity	Precipitation Intensity	RAINFALL RATE (IN./HR. Stratiform	Convective
-	Weak	Light	Less than 0.1	Less than 0.2
	Moderate	Moderate	0.1 - 0.5	0.2 - 1.1
+	Strong	Heavy	0.5 - 1.0	1.1 - 2.2
++	Very Strong	Very Heavy	*	2.2 - 4.5
X	Intense	Intense	*	4.5 - 7.1
XX	Extreme	Extreme	*	More than 7.1
U	Unknown	Unknown	Unknown	Unknown

*Stratiform rain with an intensity of very heavy, intense, or extreme does not occur. Rainfall rates for these intensities are therefore omitted here.

5. Intensity Trend. The intensity trend is reported using the following symbols:

SYMBOL	TREND
-	Decreasing
NC	No Change
+	Increasing
NEW	Newly Developed

6. Echo Locations. Echoes are located relative to the radar position. Directions are in degrees relative to true north. Distances are in nautical miles. Directions and distances are reported in groups of one direction and one distance. The direction is reported first, followed by the distance. They are separated by a solidus (/).

Example of a direction-distance group reporting a direction of 134 degrees and a distance of 145 nautical miles:

134/145

If the area covered by echoes is irregularly shaped, the direction and distance to salient points on its perimeter are reported. If the echoes are arranged in a line or rectangular area, the width is reported along with direction-distance groups along the axis. When the area of echoes is circular or when an isolated cell is being reported, the direction and distance to the center is reported. In this case, the diameter of the area or cell is also reported.

7. Movement. Both the direction and speed of movement are reported. The direction is reported in tens of degrees relative to true north. Speed is in knots. Movements are encoded in groups of five characters. The first character is the letter "A," "C," or "L." "A" indicates area movement, "C" cell movement, and "L" line movement. The next two characters are the direction of movement in tens of degrees. The last two characters are the speed.

Examples: An area moving from 240 degrees at 30 knots:

A2430

Cells moving from 90 degrees at 10 knots:

C0910

8. Echo Tops. The heights of representative echo tops are reported in hundreds of feet. The locations of tops are reported in the direction-distance format. If the echo tops are uniform, the letter "U" is entered before the height. When tops data are encoded, the highest top is indicated by the contraction "MT." Other tops are identified by the word "TOP."

Examples: A maximum top of 43,000 feet located at 75 degrees and 42 nautical miles from the radar:

MT 430 AT 75/42

A top of 28,000 feet located at 305 degrees and 93 nautical miles from the radar:

TOP 280 AT 305/93

9. Remarks. Appropriate remarks or operational status contractions are the last entry in the SD section of the observation. The following remarks are encoded whenever the associated weather phenomenon is observed:

HOOK -- Hook echo. The contraction "HOOK" is encoded along with a direction-distance group locating the hook.

HAIL -- Radar-indicated hail. Whenever hail is reported in the precipitation type group, the remark "HAIL" is also included along with one or more direction-distance groups to locate the hail.

LEWP -- Line Echo Wave Pattern. The contraction "LEWP" is encoded along with sufficient direction-distance groups to delineate the wave pattern.

VAULT -- Echo-free vault or bounded weak echo region. The word "VAULT" is encoded along with a direction-distance group locating the vault.

MALF -- Mostly aloft precipitation.

PALF -- Partly aloft precipitation.

When the contractions "MALF" or "PALF" are used, the remark "BASE" and the height of the base are also included. See the instructions for the remark "BASE" for instructions on the encoding of the "MALF," "PALF," and "BASE" remarks.

BASE -- Base of precipitation aloft. When the contractions "MALF" or "PALF," or the configuration "LYR" is reported, the remark "BASE" is added along with the height of the base in hundreds of feet.

Example of partly aloft precipitation with a base of 4,000 feet:

PALF BASE 40

MLTLVL -- Melting Level. The contraction "MLTLVL" along with height in hundreds of feet is reported whenever the melting level is observed.

The following operational status contractions are encoded when appropriate:

PPINE -- Equipment performance normal in PPI mode; no precipitation echoes observed; surveillance continuing.

PPIOM -- Equipment inoperative or out of service for preventive maintenance. A date-time group (GMT) to indicate the estimated time when operation will be resumed follows the contraction.

PPINA -- Observation omitted or not available for reasons other than those above. When feasible, a date-time group (GMT) to indicate the estimated time when observations will again be available follows the contraction.

ROBEPS -- Radar operating below performance standards.

ARNO -- A-scope or A/R indicator inoperative.

RHINO -- Radar cannot be operated in the RHI mode. Height data is unavailable.

Digital Section

The digital section of the observation follows the SD section. An upward pointing arrow indicates the beginning of the digital section. The only information included in the digital section is information on echo locations and intensities. At first, this seems like a duplication of reporting. In fact, it is not. The digital section contains a more detailed description of the echo locations and intensities than the SD section. By examining the SD section, a person can only determine the general outline of the area of precipitation and its maximum or predominate intensity. However, if a person plotted the digital part of the observation, he or she could get a more detailed picture of the intensity pattern within the area.

The digital section is based on a grid system. Each box in this grid is identified by two letters. The first identifies the row and the second, the column. The radar is always located in grid box "MM." For a more detailed description of the grid, see the section of this guide entitled "The Grid."

The maximum observed intensity is reported for each grid box containing echoes of moderate or greater intensity. If light intensity is the greatest intensity observed in a grid box, it is reported only if more than 20 percent of the grid box is covered.

Intensities are reported with code numbers. The following table gives these numbers and the corresponding intensities and rainfall rates. The code numbers for the known intensities (1-6) are the VIP level numbers for these intensities.

Code Number	Echo Intensity	Precipitation Intensity	RAINFALL RATE (IN./HR.) Stratiform	Convective
0	None	None	0.0	0.0
1	Weak	Light	0.0 - 0.1	0.0 - 0.2
2	Moderate	Moderate	0.1 - 0.5	0.2 - 1.1
3	Strong	Heavy	0.5 - 1.0	1.1 - 2.2
4	Very Strong	Very Heavy	*	2.2 - 4.5
5	Intense	Intense	*	4.5 - 7.1
6	Extreme	Extreme	*	More than 7.1
8**	Unknown	Unknown	Unknown	Unknown
9**	Unknown	Unknown	Unknown	Unknown

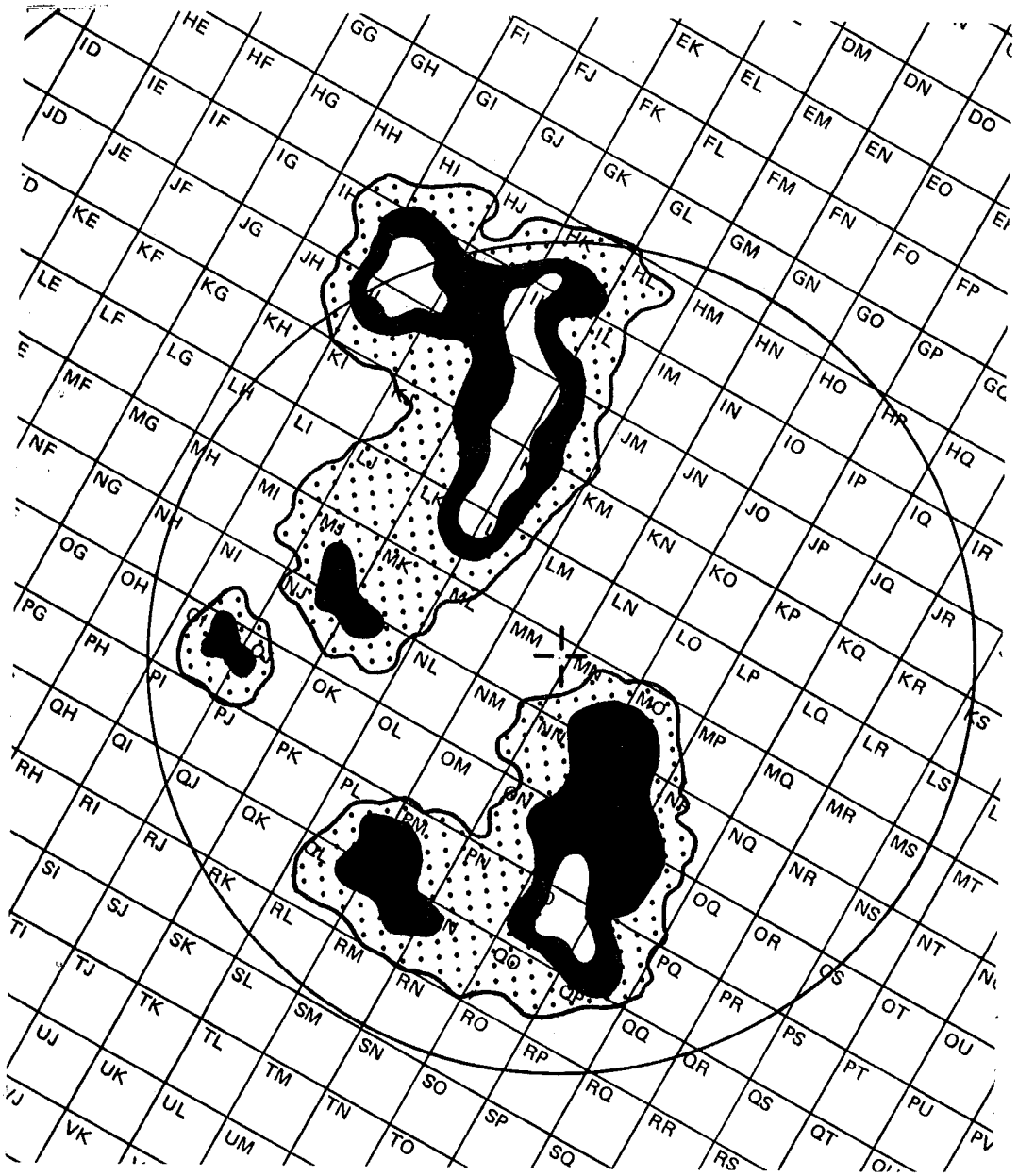
*Stratiform rain with an intensity of very heavy, intense, or extreme does not occur. Rainfall rates for these intensities are, therefore, omitted here.

**The code number 8 is used if an unknown intensity echo is known or believed associated with severe weather. The number 9 is used with all other unknown intensity echoes.

Data entered in the digital section of the observation is encoded in one or more groups. Each group starts with a two-letter grid box identifier. This identifies the most westerly grid box in the row containing the echoes. The first number following the grid box identifier is the intensity code number in the identified box. Any following numbers are the intensities in the following grid boxes in the row. A separate data group is encoded for each row containing echoes. Rows are encoded from north to south.

There will be times when echoes are reported in the SD part of the observation but not in the digital. This will most often happen when echoes are observed beyond 125 nautical miles from the radar. The SD part of the observation includes echoes observed to the maximum range of the radar. The digital section, however, is usually limited to a 125-nautical mile range. When there are no data to be reported in the digital section, the section is simply omitted.

Example: Figure 1 shows echoes on a radarscope. The range circle is at 125 nautical miles. The dotted areas represent weak echo intensities; the black, moderate; and the white, strong.



ABC 1933 AREA 6TRW+/NC 339/165 15/125 159/13Ø 215/115
269/115 A2325 MT 37Ø AT 351/75 TOP 34Ø AT 179/8Ø
↑HJ231 II3332 JH23333 KJ233 LI1133 MI122ØØ22 NI222Ø1222
OI22ØØØ232 PL22133 QL222120

Figure 1.--Echoes on a radarscope and the coded observation.

The complete observation as it is transmitted on teletypewriter circuits looks like this:

ABC 1933 AREA 6TRW+/NC 339/165 15/125 159/13Ø 215/115
269/115 A2325 MT 37Ø AT 351/75 TOP 34Ø AT 179/8Ø
↑HJ231 II3332 JH23333 KL233 LI1133 MI122ØØ22 NI222Ø1222
OI22ØØØ232 PL22133 QL222120

Notice that the end of the SD and the start of the digital sections can easily be identified by the upward pointing arrow that starts the digital section.

If we break this observation into its parts, we can see how the data is encoded:

ABC -- Radar station's call sign or identifier.

1933 -- Time in Greenwich Mean Time, 1933 GMT.

AREA -- Echo configuration, an area of echoes.

6TRW+/NC -- This group contains data on the areal coverage, precipitation type, echo intensity, and intensity trend.

The "6" indicates that 6/10 of the area is covered by echoes. The precipitation type is identified as thundershowers by the letters "TRW." The symbol "+" shows that the echo intensity is strong. The solidus (/) separates the intensity from the intensity trend. The letters "NC" indicate that the echoes are unchanged in intensity.

339/165 15/125 159/13Ø 215/115 269/115 --

This series of five direction-distance groups locates the echoes. Each group locates one point. In this case, the area is outlined by the points.

A2325 -- Movement group. The letter "A" indicates that the movement of the entire area is being reported. The area is moving from 230 degrees at 25 knots.

MT 37Ø AT 351/75 --

Highest echo top. The highest echo top is 37,000 feet. It is located at 351 degrees and 75 nautical miles from the radar.

TOP 34Ø AT 179/8Ø --

This remark is the report of an echo top that is lower than the highest top. This top is 34,000 feet and is located at 179 degrees and 80 nautical miles from the radar.

↑ -- Upward pointing arrow indicating the beginning of the digital section of the observation.

HJ231 II3332 JH23333 KJ233 LI1133 MI122ØØ22 NI222Ø1222 OI22ØØØ232 PL22133 QL222120 --

Digital section of the observation. Each group represents one row of grid boxes containing echoes. By examining the first group (HJ231), we see that grid box HJ contains moderate echo intensity echoes; box HK, strong; and box HL, weak. All the other groups are encoded using the same format.

If you compare the drawing of the echoes with the coded observation, you will notice that grid boxes HH, HI, and IH are not encoded in the digital section. This is because the boxes are more than 125 nautical miles from the radar. However, this activity is reported in the SD section.

You will also notice that some grid boxes contain small amounts of weak intensity echoes but are not encoded. This is because these boxes are less than 20 percent covered by echoes. Grid boxes KI and OM are among these boxes.

II. THE GRID

The grid used with the digital section of the radar code is a subgrid of the Limited Fine Mesh I (LFM-I) grid. The LFM grid and the radar code grid have correct north-south orientation at 105°W longitude. East and west of 105°, the grid becomes skewed in respect to true north. The skewing is greatest in the northeastern United States.

The radar code grid has one-fourth the mesh length of the LFM-I. The corners of the LFM grid boxes are also the corners of every fourth radar code grid box. The radar code grid boxes are therefore about 22 nautical miles (41 kilometers) on a side and have an area of about 484 square nautical miles (1,681 square kilometers).

The grid boxes are located with respect to the radar sites. All grid boxes are identified by two letters. The first letter identifies the row and the second, the column. Rows are lettered from north to south and columns from west to east. The radar antenna is always located in grid box MM, but often is not in the center of box MM.

Figures 11 through 157 show the digital radar code grid for the 56 NWS Network Radars, 67 NWS Local Warning Radars, 22 FAA Air Route Traffic Control Radars, and 2 U.S. Air Force Radars.

Figure 158 is a map of the U.S. showing radar coverage by the NWS Network Radars. The range circles are 125 nautical miles.

The following is a list of the NWS Network, NWS Local Warning, FAA Air Route Traffic Control, and U.S. Air Force Radars.

NATIONAL WEATHER SERVICE NETWORK RADARS

Alliance, Nebraska
Amarillo, Texas
Apalachicola, Florida
Athens, Georgia
Atlantic City, New Jersey
Binghamton, New York
Bristol, Tennessee
Brownsville, Texas
Brunswick, Maine
Buffalo, New York
Cape Hatteras, North Carolina
Centreville, Alabama
Charleston, South Carolina
Chatham, Massachusetts
Cincinnati, Ohio
Daytona Beach, Florida
Des Moines, Iowa
Detroit, Michigan
Evansville, Indiana
Fargo, North Dakota
Galveston, Texas
Garden City, Kansas
Grand Island, Nebraska
Hondo, Texas
Huron, South Dakota
Jackson, Mississippi
Kansas City, Missouri
Key West, Florida
Lake Charles, Louisiana
Limon, Colorado
Little Rock, Arkansas
Longview, Texas
Marseilles, Illinois
Medford, Oregon
Memphis, Tennessee
Miami, Florida
Midland, Texas
Minneapolis, Minnesota
Missoula, Montana
Monett, Missouri
Nashville, Tennessee
Neenah, Wisconsin
New York City, New York
Oklahoma City, Oklahoma
Patuxent River, Maryland
Pensacola, Florida
Pittsburgh, Pennsylvania
Sacramento, California
Slidell, Louisiana
Stephenville, Texas
St. Louis, Missouri
Tampa, Florida
Volens, Virginia
Waycross, Georgia
Wichita, Kansas
Wilmington, North Carolina

FAA/ARTC RADARS

Albuquerque, New Mexico
Amarillo, Texas
Ashton, Idaho
Battle Mountain, Nevada
Boise, Idaho
Boron, California
Cedar City, Utah
El Paso, Texas
Klamath Falls, Oregon
Las Vegas, Nevada
Lovell, Wyoming
Mesa Rica, New Mexico
Mt. Laguna, California
Paso Robles, California
Phoenix, Arizona
Rock Springs, Wyoming
Salem, Oregon
Salt Lake City, Utah
San Pedro, California
Seattle, Washington
Silver City, New Mexico
Spokane, Washington

U.S. AIR FORCE RADARS

Laughlin AFB, Texas
Loring AFB, Maine

NATIONAL WEATHER SERVICE LOCAL WARNING RADARS

Abilene, Texas
Akron, Ohio
Albany, New York
Alpena, Michigan
Atlanta, Georgia
Augusta, Georgia
Austin, Texas
Baton Rouge, Louisiana
Beckley, West Virginia
Billings, Montana
Bismarck, North Dakota
Burlington, Vermont
Charleston, West Virginia
Charlotte, North Carolina
Cheyenne, Wyoming
Cleveland, Ohio
Columbia, Missouri
Columbia, South Carolina
Columbus, Georgia
Columbus, Ohio
Concordia, Kansas
Corpus Christi, Texas
Duluth, Minnesota
Erie, Pennsylvania
Fort Smith, Arkansas
Fort Wayne, Indiana
Goodland, Kansas
Harrisburg, Pennsylvania
Hartford, Connecticut
Houghton Lake, Michigan
Huntsville, Alabama
Indianapolis, Indiana
Jackson, Kentucky
Las Vegas, Nevada
Los Angeles, California
Louisville, Kentucky
Lubbock, Texas
Macon, Georgia
Madison, Wisconsin
Marquette, Michigan
Meridian, Mississippi
Mobile, Alabama
Moline, Illinois
Montgomery, Alabama
Muskegon, Michigan
Norfolk, Nebraska
North Platte, Nebraska
Omaha, Nebraska
Phoenix, Arizona
Portland, Oregon
Raleigh, North Carolina
Rapid City, South Dakota
Rochester, Minnesota
San Angelo, Texas
San Juan, Puerto Rico
Shreveport, Louisiana
Sioux Falls, South Dakota
Springfield, Illinois
Topeka, Kansas
Tulsa, Oklahoma
Victoria, Texas
Waco, Texas
Waterloo, Iowa
West Palm Beach, Florida
Wichita Falls, Texas
Williston, North Dakota
Worcester, Massachusetts

III. PLOTTING A RADAR OBSERVATION

Many users of radar data will want to plot the observations. It is possible to plot only the SD or the digital sections, but plotting both sections will give a much more complete picture of the precipitation pattern.

Plotting radar observations is a relatively straightforward procedure. Using the SD section of the observation, you can outline the area containing the echoes. Echo tops can also be located and plotted. Some remarks are encoded with direction-distance groups. These remarks can easily be located and plotted. The other data in the SD section are reported without locations. It can be plotted anywhere desired.

To plot the digital section of the observation, you need a map with a grid marked on it.* Plot the digital groups one at a time. Find the grid box identified by the two letters which start the first group. Plot the first number in that grid box. Any following numbers should be plotted in the following grid boxes in the row. Repeat this procedure for every digital group. The result will be a map of intensities and location. Examples follow. They are based on the following observation:

ABC 1933 AREA 6TRW+/NC 339/165 15/125 159/13Ø 215/115
269/115 A2325 MT 37Ø AT 351/75 TOP 34Ø AT 179/8Ø
↑HJ231 II3332 JH23333 KJ233 LI1133 MI122ØØ22 NI222Ø1222
ÖI22ØØØ232 PL22133 QL222120

This is the same observation that is encoded in the radar code chapter of the User's Guide. Figures 2, 3, and 4 show the observation plotted three ways. Once with only the SD section plotted, again with the digital section plotted, and a third time with both the digital and SD sections plotted.

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*Requests for maps should be addressed to:

National Weather Service
Chief, Technical Procedures Branch, W111
8060 13th Street
Silver Spring, Maryland 20910

Please specify the type of map desired by referring to the appropriate figure number in all requests. Single paper copies are available without charge to all users. Plastic copies for non-governmental users incur a fee. Additional details are available from the above office.

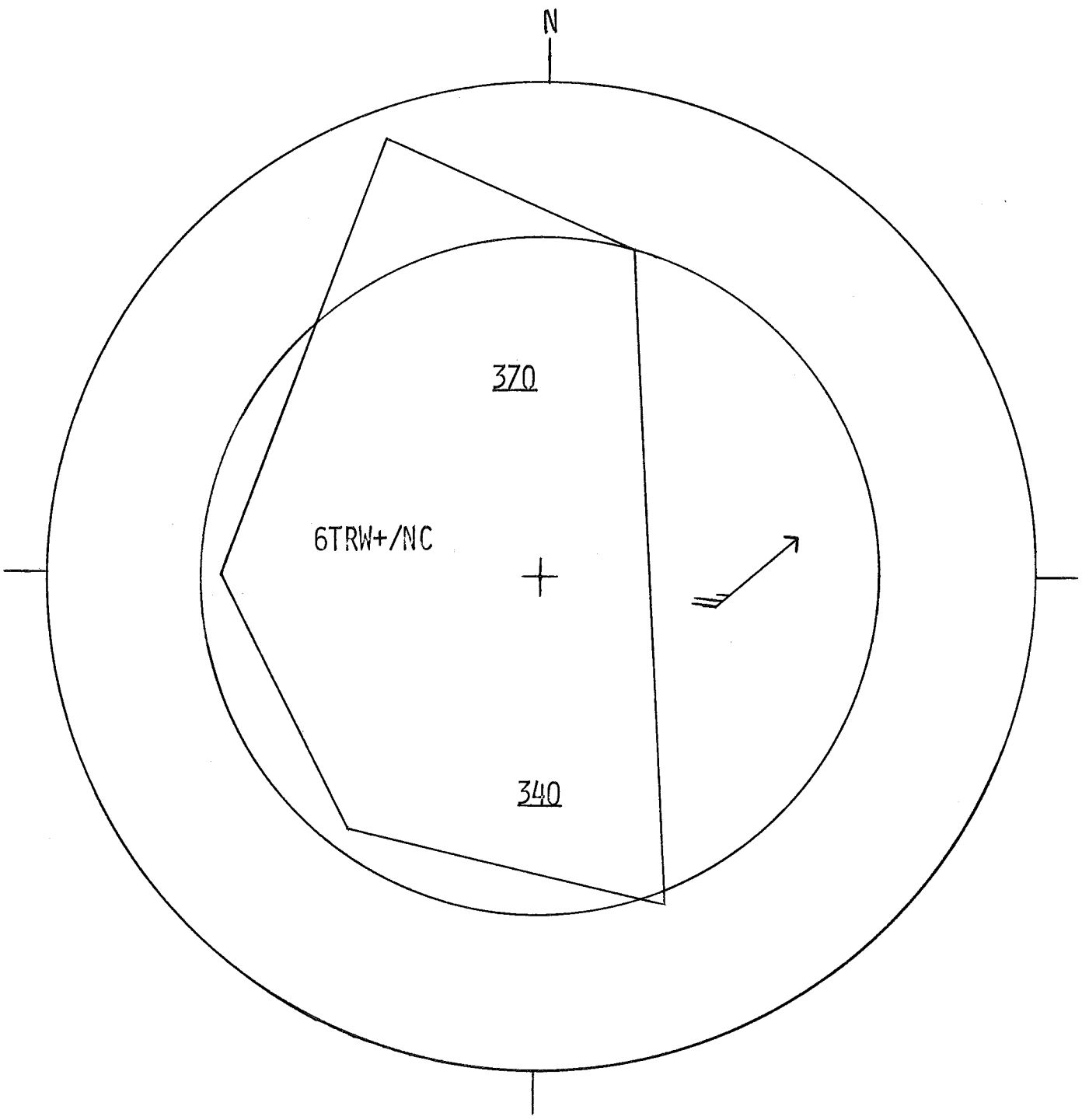

Figure 2.--The SD section of the observation plotted. The range circles are at 125 and 180 nautical miles.

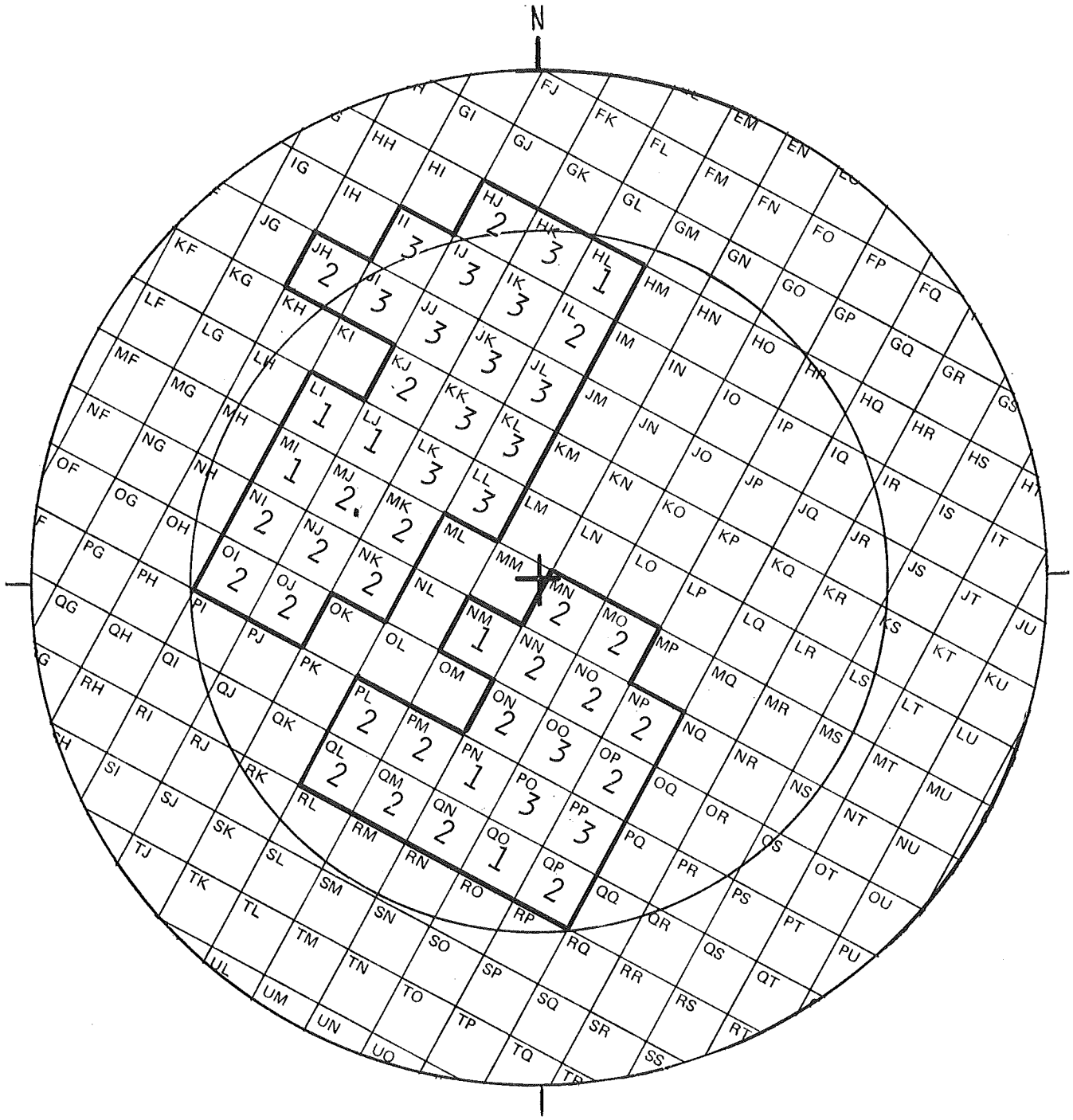

Figure 3.--The digital section of the observation plotted. The range circles are at 125 and 180 nautical miles.

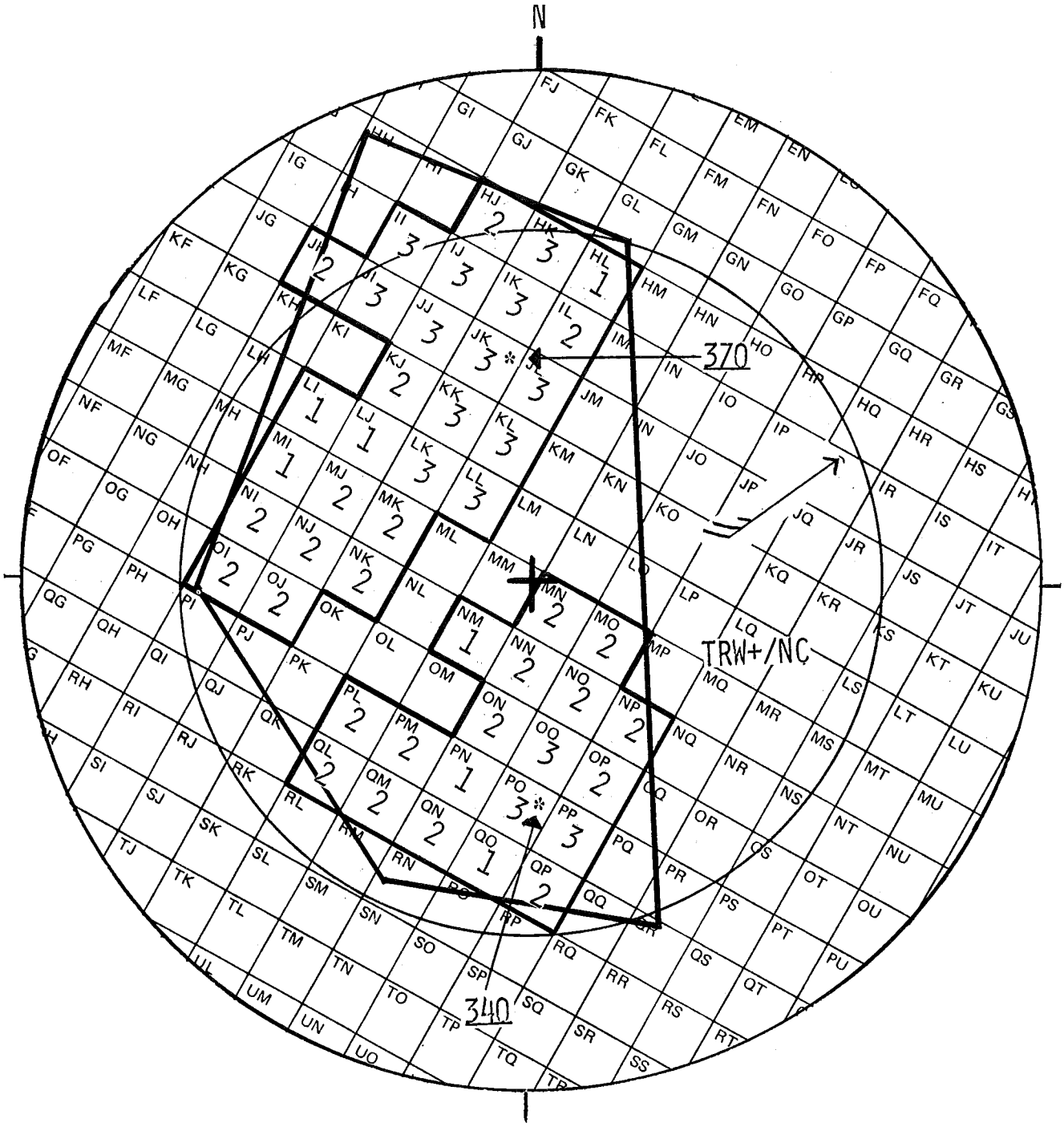

Figure 4.--The entire observation (SD and digital sections) plotted. The range circles are at 125 and 180 nautical miles.

IV. THE TELETYPEWRITER INTENSITY PLOT

A plot of the 22 x 22 nautical mile resolution radar-intensity groups is available on request/reply teletypewriter. The type of message is often called a paper doll. To use this message, a clear plastic overlay must be placed over the teletypewriter plot. These overlays are available from the same source as the maps* -- see section III. Six teletypewriter plots are prepared, one each for the Northeast, Southeast, North Central, South Central, Northwest, and Southwest United States. The headers are SDUS21-26 KWBC, respectively, and are available as an RC request.

An overlay of the entire nation has been prepared as shown in figure 5. The rectangles on the overlay can contain up to 25 intensity digits (i.e., five by five). This grid is used to aline the overlay over the teletypewriter plot. The teletypewriter plot must be placed under this overlay to add a geographical background. Figure 6 shows a teletypewriter plot of echo intensities for the South Central United States with an overlay in proper position. Known intensities plotted range from 0 to 6 (see table, page 6); 8's and 9's represent unknown intensities (i.e., those reported beyond 125 nautical miles from the radar station). Eight's are echoes known or believed to be associated with severe weather, while 9's are subjectively believed to be of "lesser" intensity. Although 8's and 9's do not offer exacting intensity measurements, they do indicate that there is some activity going on. R's are plotted in areas where radars are out for maintenance and the region has not been covered by another reporting radar. M's indicate a region where no radar coverage is available. Check the teletype sequences again for late transmitted observations in areas covered by M's.

One plus character (+) will appear near the top right of the message. Two numbers are associated with it. A second + is located at the lower left side of the bulletin. This information will allow the user to correctly aline the overlay with the teletypewriter plot as shown in figure 6. The approximate dot geography incorporated into the teletype message will also help to properly aline the overlay. The numbers correspond to the rows and columns appearing on the borders of the plastic overlay. The column is specified first, followed by the row, and separated by a comma. The grid on the overlay helps to locate the plus characters on the teletypewriter plot correctly on the overlay.

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*When requesting a paper doll plastic overlay, specify whether 8, 6, or 4.4 teletype lines are printed per inch in the vertical direction.

By examining the teletypewriter plot with the overlay in proper position, a user can locate the areas of precipitation and can determine their intensities. As an aid in doing this, the teletypewriter plot may be manually contoured. Users should remember that the teletypewriter plot only gives information on echo locations and intensities. To get information on other echo parameters, users will have to go to other sources, such as the Radar Summary Chart or the hourly radar observations.

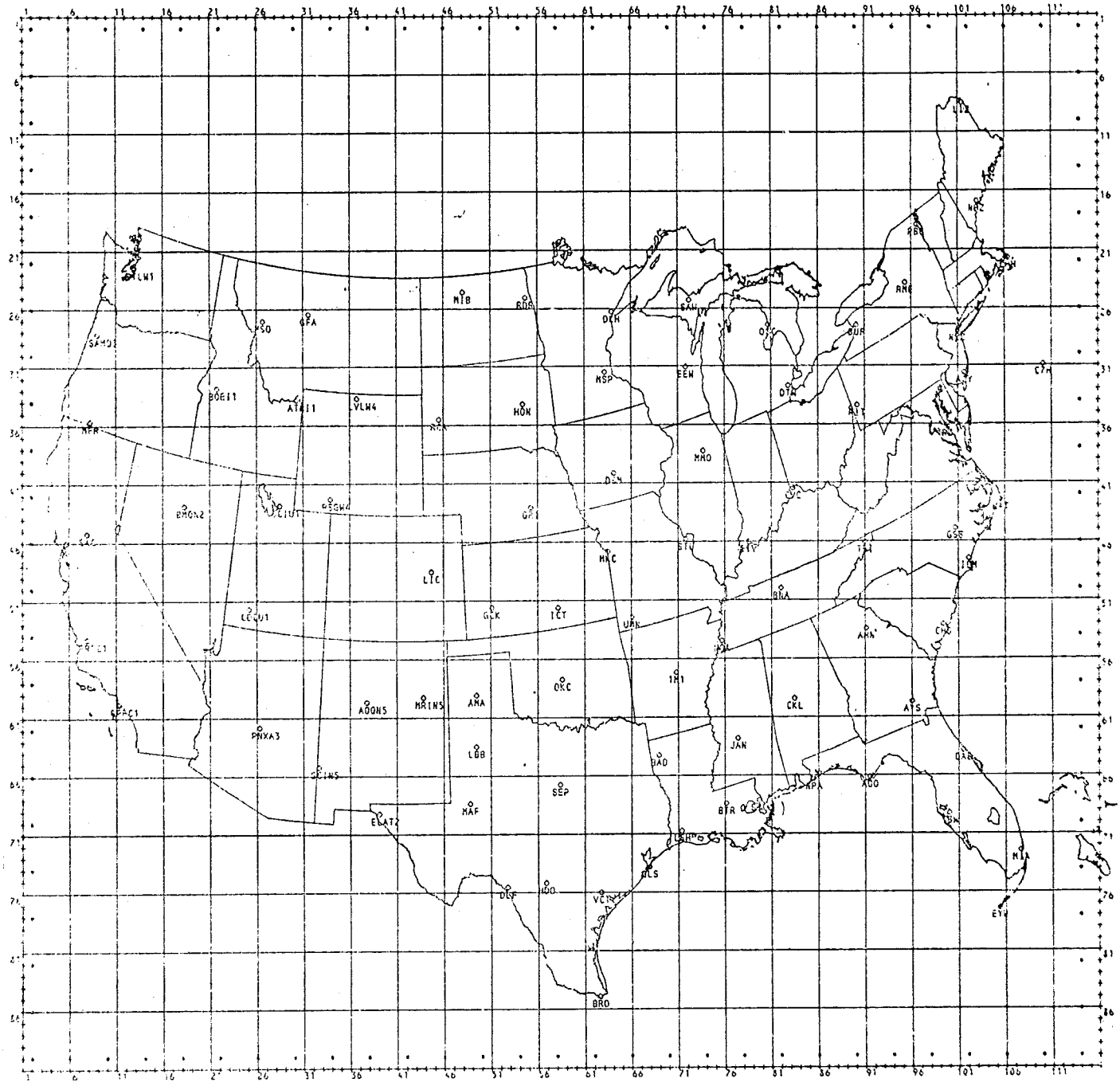

Figure 5.--Overlay for use with the teletypewriter plot of the digital radar code.

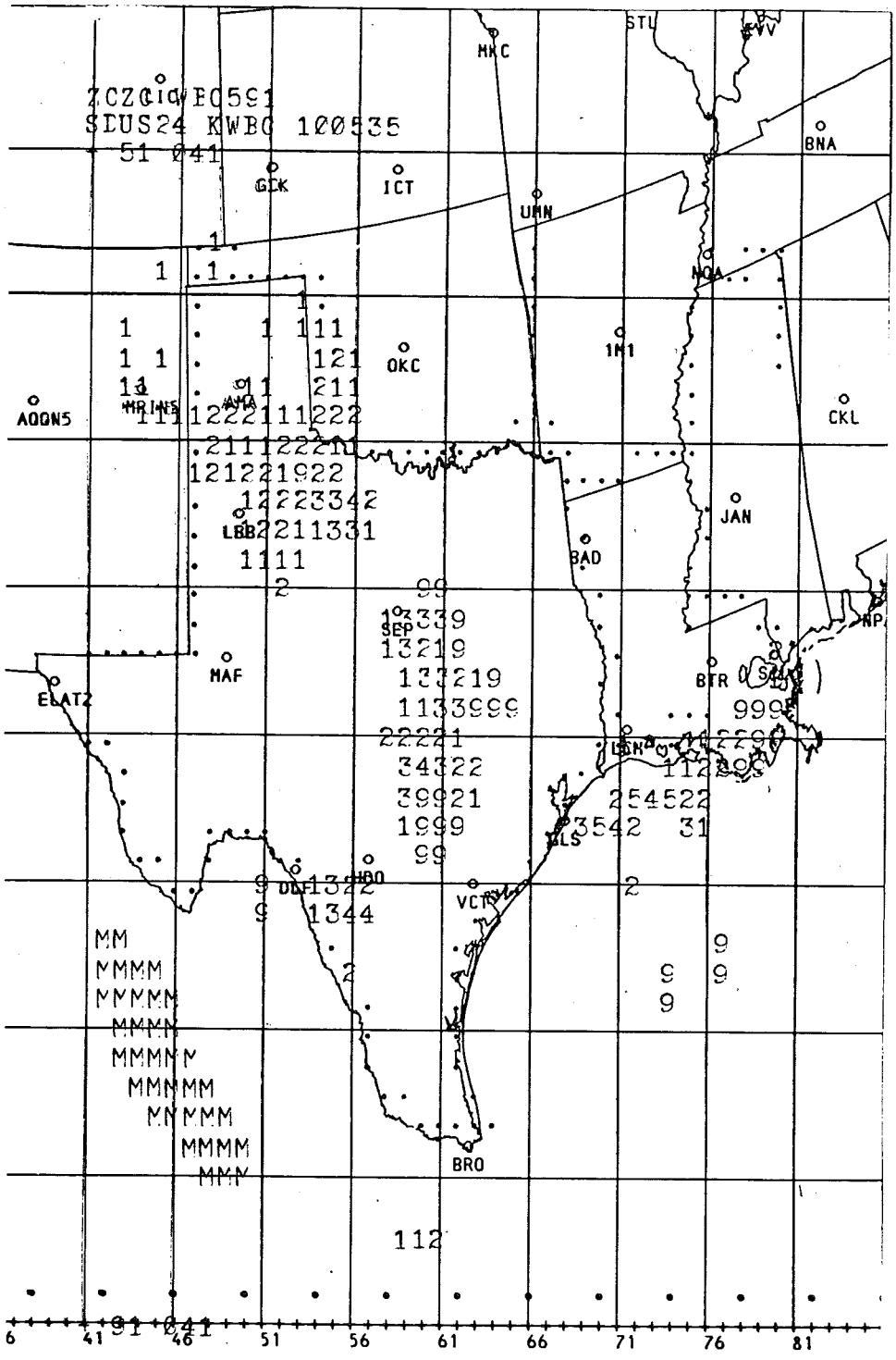

Figure 6.--Teletypewriter plot of echo intensities for the South Central United States with an overlay in proper position.

V. THREE- AND FOUR-HOURLY SUMS OF DIGITAL RADAR DATA

Three- and four-hourly sums of digital radar data are available hourly on Request/Reply. The sums appear in fixed-area regional sections with the headers SDUS40-SDUS53 KWBC (3 hour) and SDUS60-SDUS73 KWBC (4 hour); use the RC request for access. Registration marks are provided in the upper right and lower left of the teletype bulletin with accompanying coordinates. These permit registration of the bulletin with the overlays currently in use for interpretation of the SDUS21-SDUS26 KWBC hourly digital data.

The cumulative intensities will be represented by a single alphabetic character. "A" represents a cumulative sum of 1, "B" 2, "C" 3, and so forth. Thus, "R" is the maximum accumulation for 3-hour sums (18), and "X" is the limit for 4-hour sums (24). In the event that 1 or more hours of data are not available for a grid box, a dot (.) will be printed in that location. It is, therefore, possible to have a 3-hour sum, but not a 4-hour sum if a portion of the first hour's data to be summed is not available. If the radar is out for maintenance, a "Z" will be printed in those locations covered only by that radar. Blank spaces represent no echoes. In the event that no echoes cover an entire bulletin, a message with the statement "NO ECHOES" will be transmitted.

The 4-hourly sums are also available each hour on the Harris KCRT System with the headers 4HRA through 4HRN. These plots are formulated similarly to the Request/Reply messages. The overlays to be used for these bulletins are the same as those currently used for viewing the teletypewriter hourly digital radar intensity plots in bins 4DRA through 4DRN.

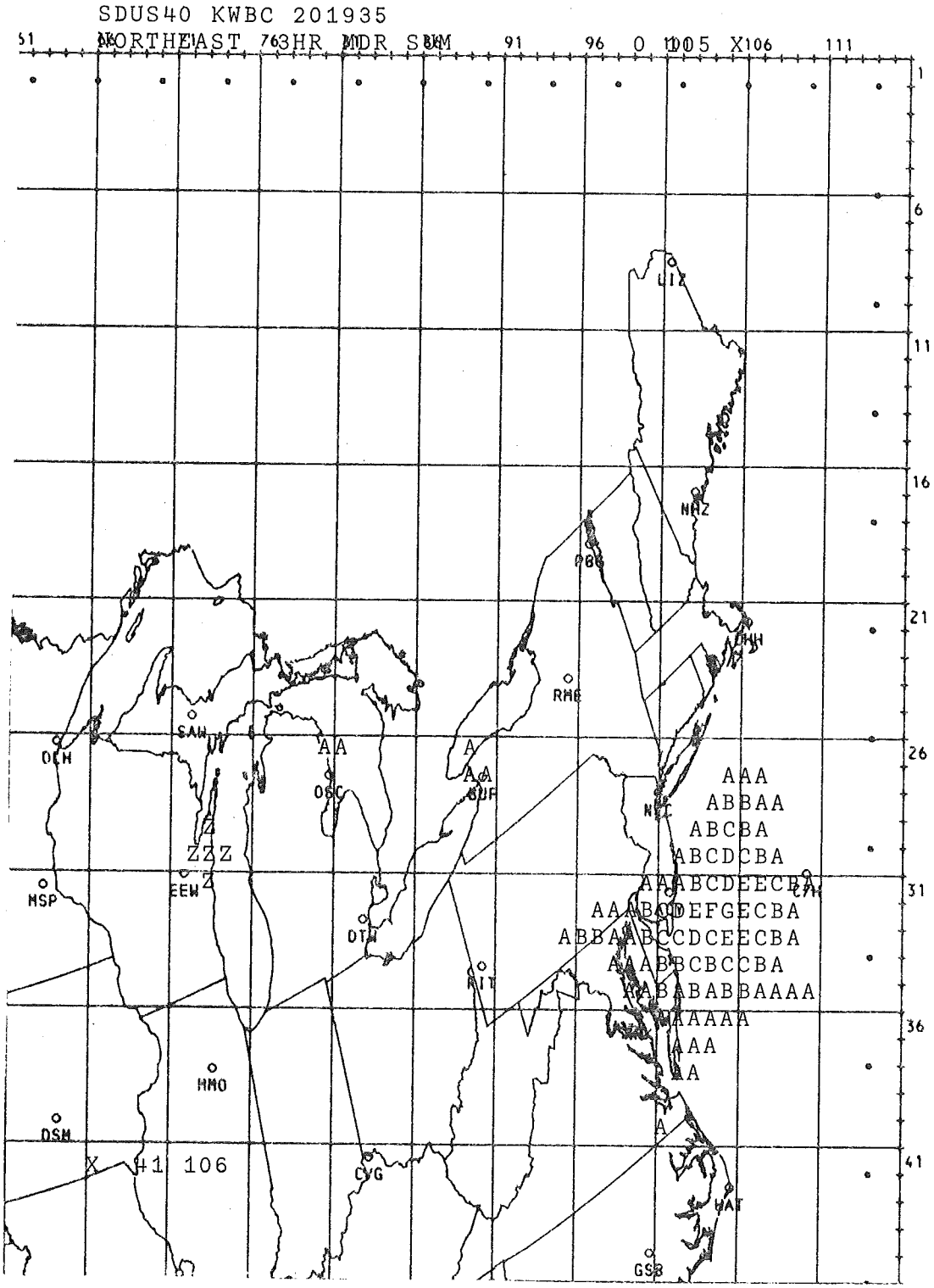

Figure 7.--Three-hour sums with the overlay in place.

VI. THE AUTOMATED RADAR SUMMARY CHART

1. Introduction. The Automated Radar Summary (ARS) Chart is produced by the NOAA Computer System at Suitland, Maryland, and transmitted directly to the facsimile circuits. Encoded radar reports are collected from the RAWARC circuits by the Communications Computer System in Suitland. The reports collected are then transmitted to the IBM 360/195 Computer System for processing. The output of the IBM 360/195 Computer System is sent by direct link to the Communications Computer System where it is scheduled for transmission on the NAFAX, NAMFAX, and DIFAX circuits.

2. Content. The following information is displayed on the Automated Radar Summary Chart -- an example of which is in figure 8.

   a. Shaded areas give an indication of precipitation extent. The contours for echo intensity levels 1, 3, and 5 are drawn to differentiate areas in which various levels (from weak to extreme) of precipitation activity is taking place. See chapter I on intensity.

   b. The height of echo tops is plotted as an underlined three-digit number in hundreds of feet (i.e., 340). The height of echo bases are plotted similarly to tops except that the three digits will be overlined (i.e., $\overline{170}$). A line extending from the top or base to a small plotted square signifies the location at which the information is appropriate.

   c. Echo movements are plotted as arrows. An arrow without tail flags indicates cell movement. Associated with these arrows is a two-digit speed-of-movement in knots (i.e., ⟶20). Arrows with tail flags (⟸⟶) indicate area or line movement. The tail flags indicate the speed. One flag for each 10 knots and a half flag for 5 knots. Stationary echoes will have the letters "LM" plotted nearby. This is a contraction for little movement.

   d. Remarks such as HAIL or HOOK and the weather type designator will appear on the chart. See section I, paragraphs 3 and 9, for a list of these weather types and remarks. In addition, the intensity trend will follow the precipitation type where appropriate (+ is used for increasing and - for decreasing). The intensity is not plotted on the ARS Chart since it is evident from the echo contouring. Lines with coverage of 0.8 or greater will have associated with them a solid designator at the extreme limits of the line.

e. The status of the radar is also available. For instance, if the radar station transmitted PPINE, NE will appear on the ARS Chart for that observation; if PPIOM is transmitted, OM will appear; and if PPINA is transmitted, NA will appear (without the station call letters to indicate that a transmission was received). Alternate radars will report during network radar outages. A list of network radars and alternates is contained in the Weather Radar Observations Manual, FMH #7, NWS Part C, Section III, Issue 20.

f. A convention provides for a station's call letters and the letters NA (Not Available) being plotted at the appropriate geographical location of the station when no data are received for processing within certain time limits. Check for the station's hourly observation in the event it doesn't appear on the chart.

g. Since several stations may report the occurrence of weather in an area, data conflicts can occur. Offset plotting of all pertinent data will be used to reduce conflict or redundancy to a minimum and to improve the legibility of the chart. Nevertheless, some conflicts will remain. In the event that data such as tops, movements, or remarks conflict for plotting space on the ARS Chart, the data are ranked for retention. If the conflict is between several tops, the highest top will be plotted. Likewise, when several movements conflict, the movement with the highest speed will be plotted. When precipitation-type intensity trend groups conflict, the groups with increasing intensity are ranked first, followed by those with no change in intensity and, last, by groups with decreasing intensity. There is also a ranking among precipitation types. THUNDER-STORMS rank high with such things as RAIN SHOWERS and DRIZZLE ranking lower. REMARKS such as HOOK, LEWP, and HAIL rank highest of all. Whenever a conflict exists in intensities reported in one location, the highest intensity is retained for contouring on the chart.

h. Severe weather watch boxes are available on the chart. Weather watch numbers are associated with each box. A label area at the bottom of the chart will indicate the valid time (the time until the weather watch will be valid). The second character after the W (as in WT062) will indicate the type of box. T will be printed for tornado watch boxes, while S will indicate severe thunderstorm watch boxes (i.e., WS063). Boxes associated with hurricanes will be coded with the second alphabetic digit varying from A to Z as necessary for each hurricane (i.e., WA064, WB065, etc.). Also, check RAWARC teletype

transmissions for any weather watch boxes that have not been plotted on the chart.

i. A legend is being provided on the ARS Chart to help people interpret it. It covers the above items. Figure 8 is an example of the automated chart. When the computer-produced chart is not available because of computer failure, a manually-produced chart may be sent as a backup. The manually-produced chart may be incomplete due to time limitations; other sources of data should be consulted (i.e., the latest hourly surface observation). Status information about NMC operations adversely affecting product delivery is plotted on the ARS Chart over Canada.

The automation of the hourly Radar Summary Chart has made substantially earlier dissemination possible. It must be remembered that this chart can provide only a portion of the description of the weather activity that is taking place. Other available observations and forecasts should be consulted to better clarify existing and future conditions.

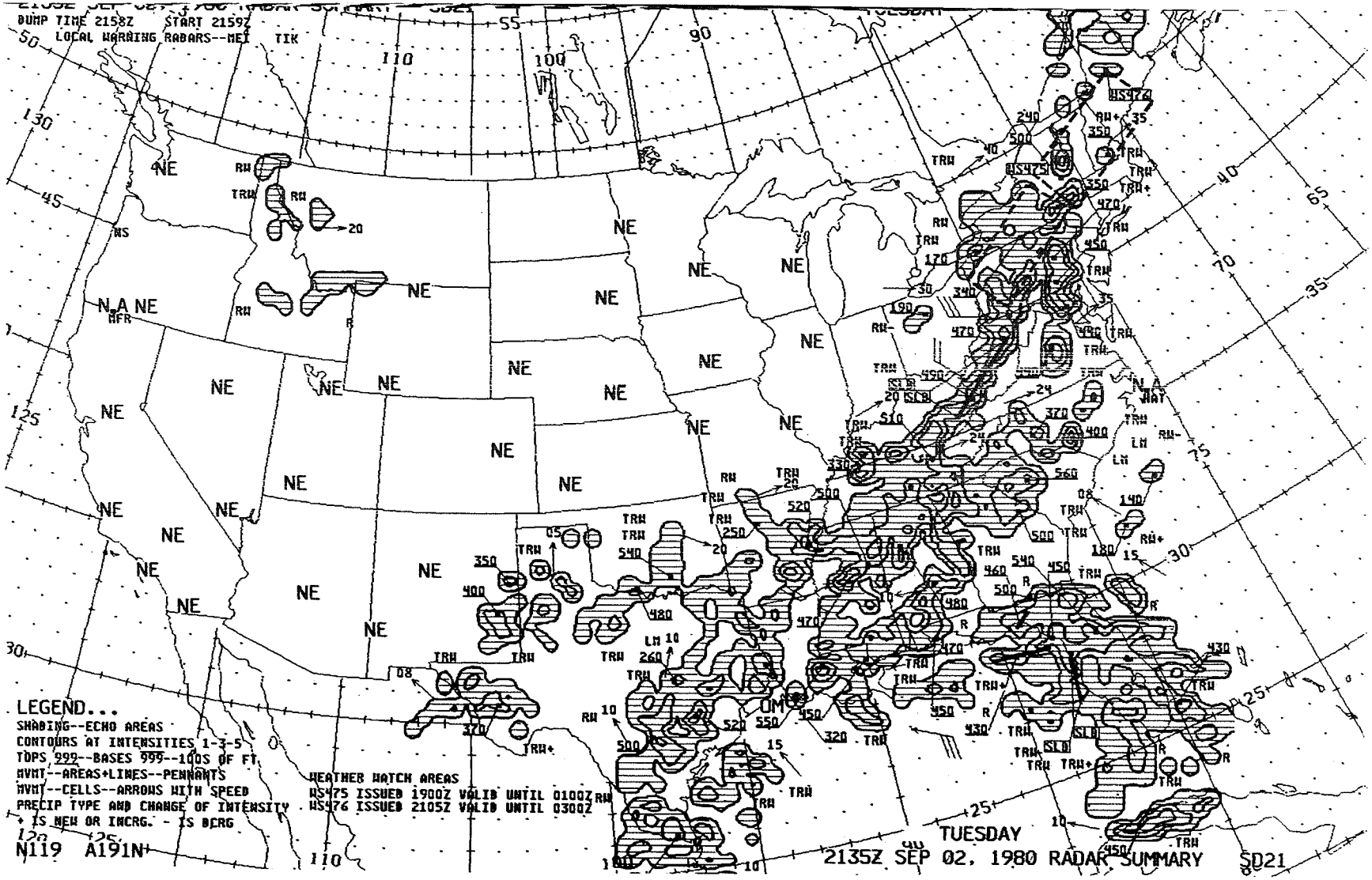

Figure 8.--The Automated Radar Summary Chart.

VII. THE AFOS AUTOMATED RADAR SUMMARY CHART

1. Introduction. A version of the Automated Radar Summary Chart (ARS) has been developed for AFOS. Similar in content to the ARS, it is produced at NMC according to the same ARS schedule and transmitted through the Gateway System to the National Distribution Circuit (NDC).

2. Use. The AFOS product is very similar to the facsimile version; however, it is divided into two separate overlays for two reasons. The first has to do with limitations on the number of blocks of data allowed for an individual AFOS graphics product; the second concerns the display and overlay of either composited radar reflectivities or tops, movements, and remarks with other AFOS graphics. The reflectivities may be displayed by keying 9ØR; tops, movements, and remarks require keying 9ØS. (See figure 9.) This capability extends the utility of the radar data by allowing intercomparisons of different types of data sets or radar observations at two separate times. Use of the overlay capability with two chronologically sequential radar reflectivities (for instance, the 1735Z and 1835Z products) in conjunction with the use the AFOS overlay intensity controls allows the operator a primitive but useful sense of animation. It makes possible a more precise estimate of the echo tracks. Additionally, the reflectivities may be useful in conjunction with the surface chart or other conventional products in delineating specific areas in which precipitation has already begun. (See figure 10.)

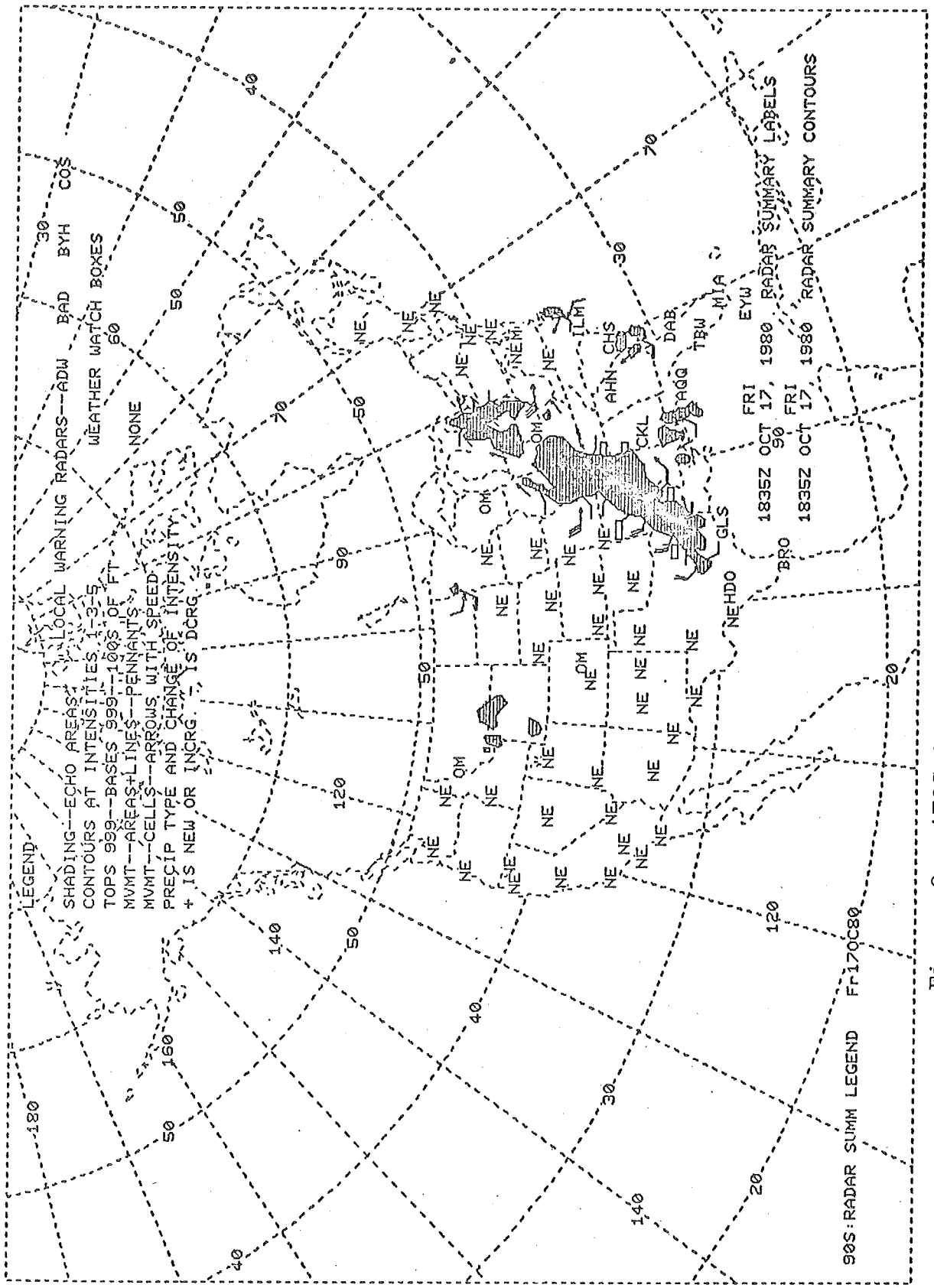

Figure 9.--AFOS Automated Radar Summary Chart.

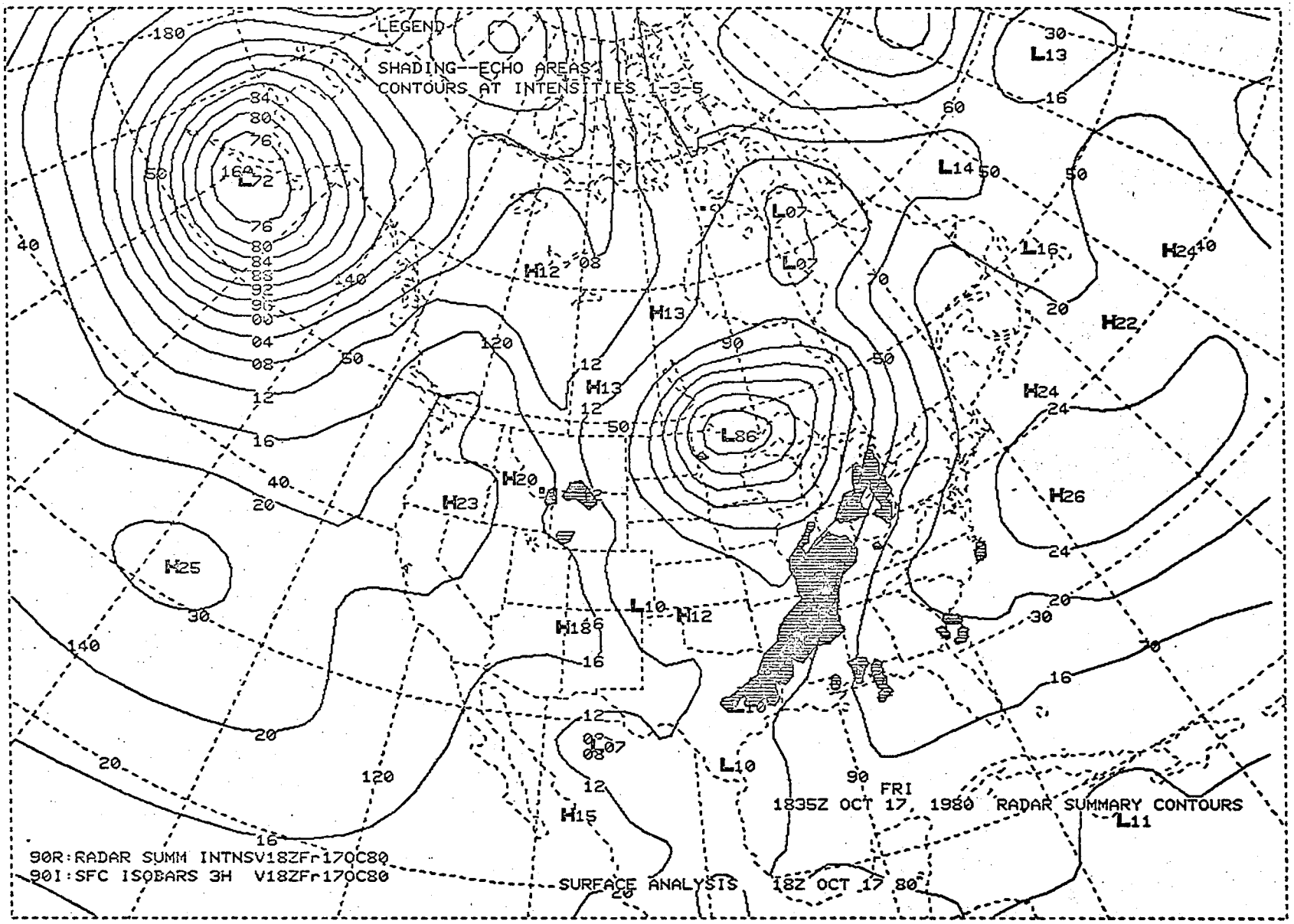

Figure 10.--AFOS Automated Radar Summary Chart overlaid with surface isobars.

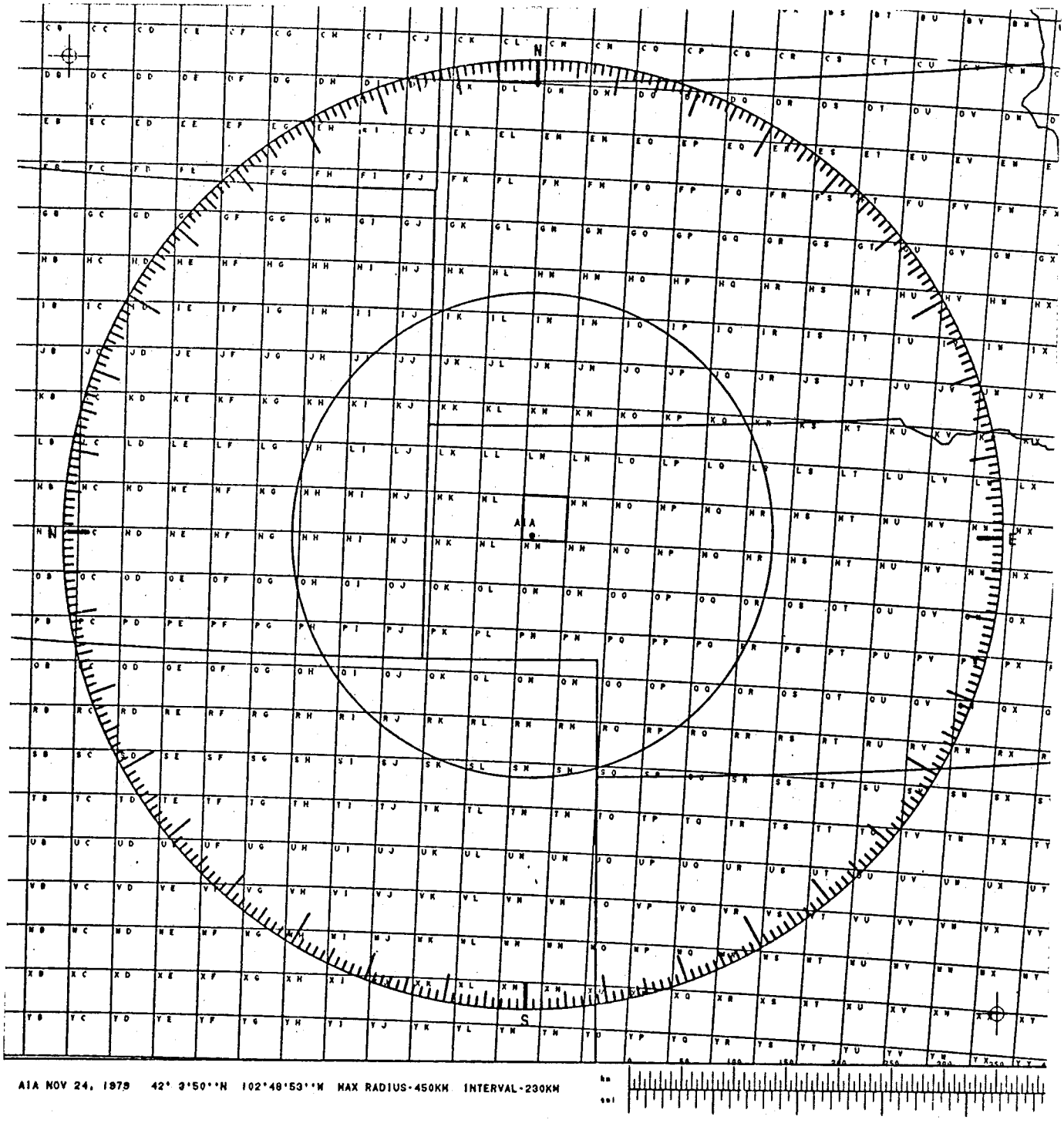

Figure 11.--450 kilometer radar code grid for Alliance, Nebraska.

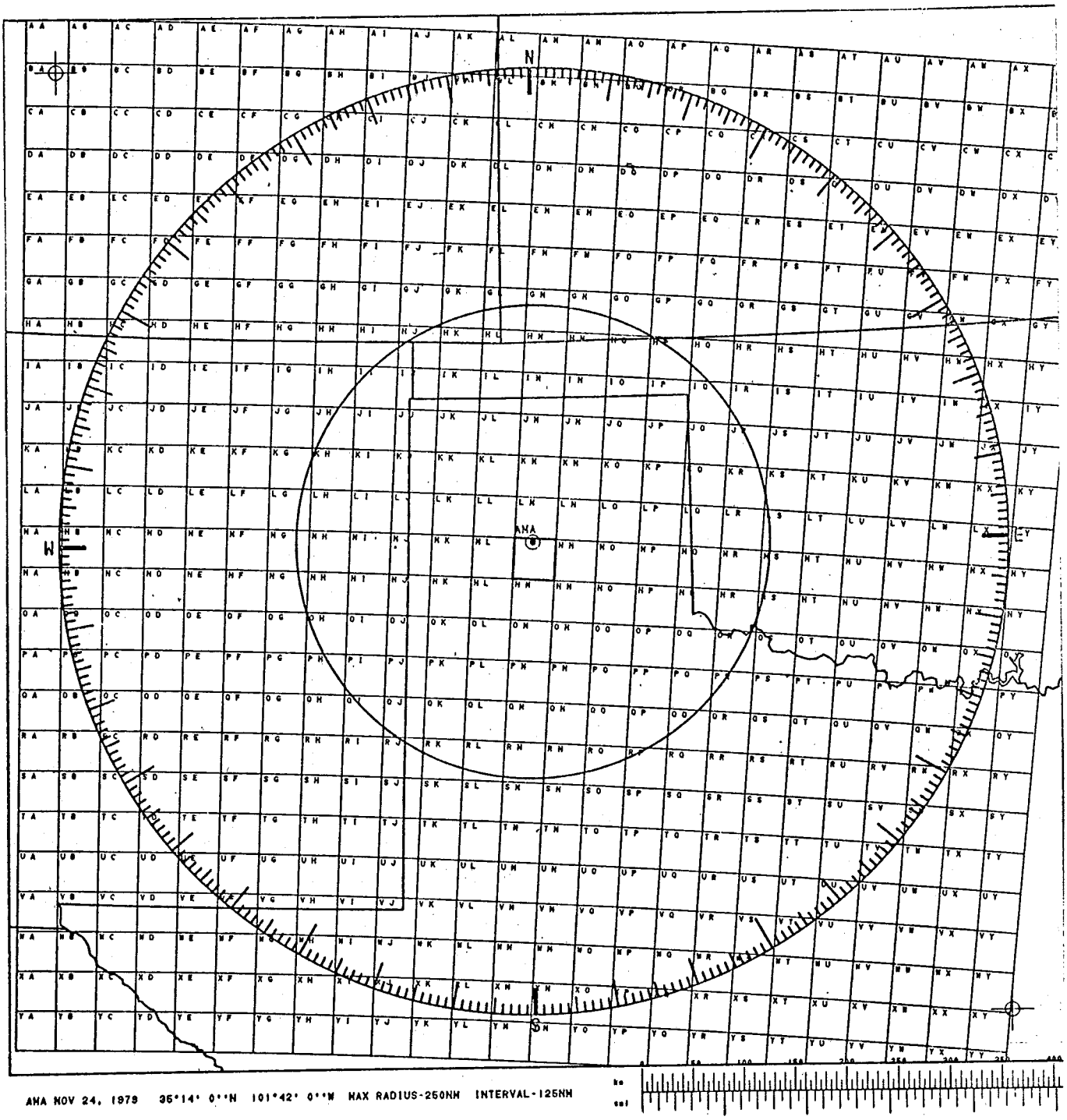

Figure 12.--250 nautical mile radar code grid for Amarillo, Texas.

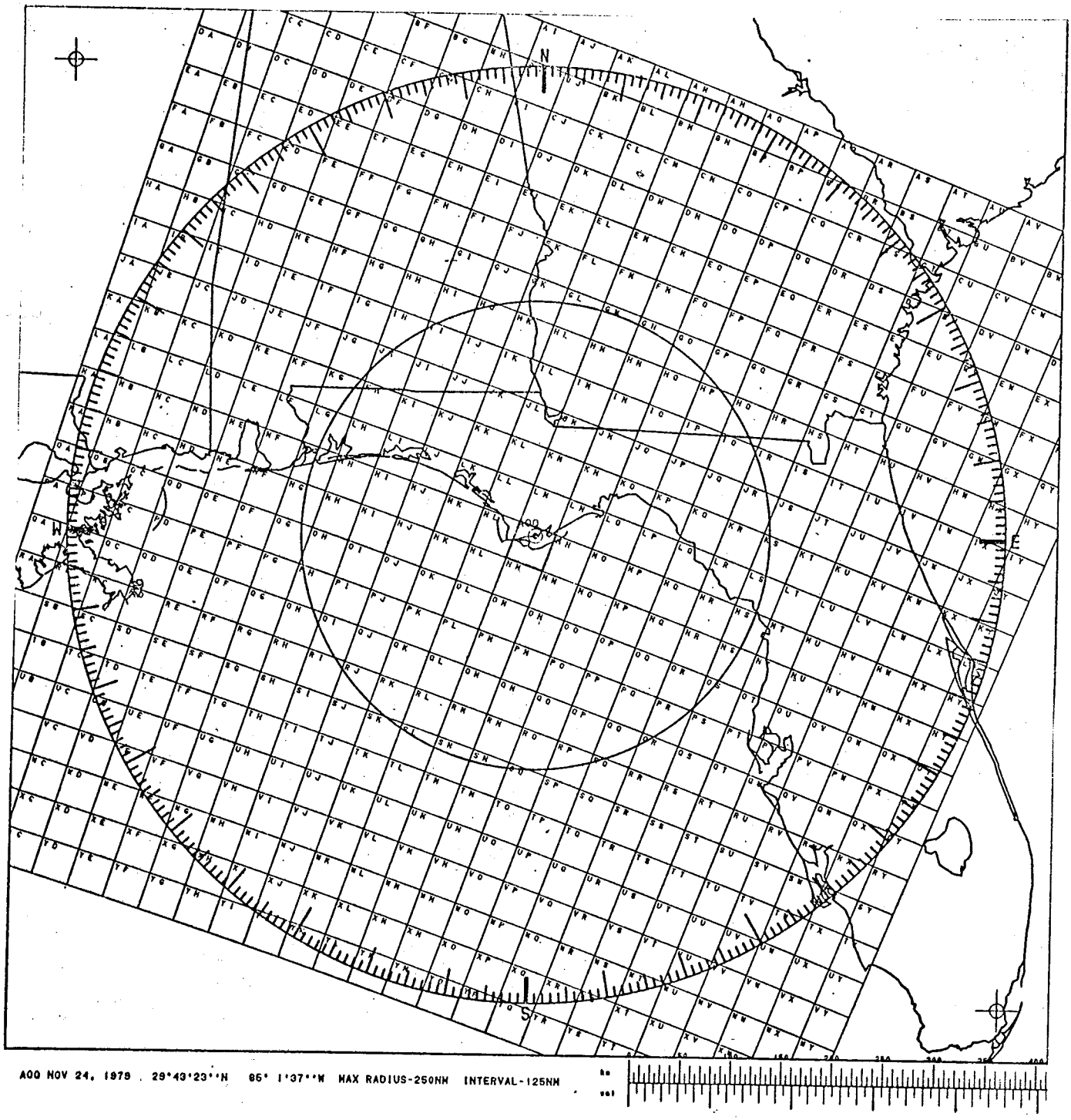

Figure 13.--250 nautical mile radar code grid for Apalachicola, Fla.

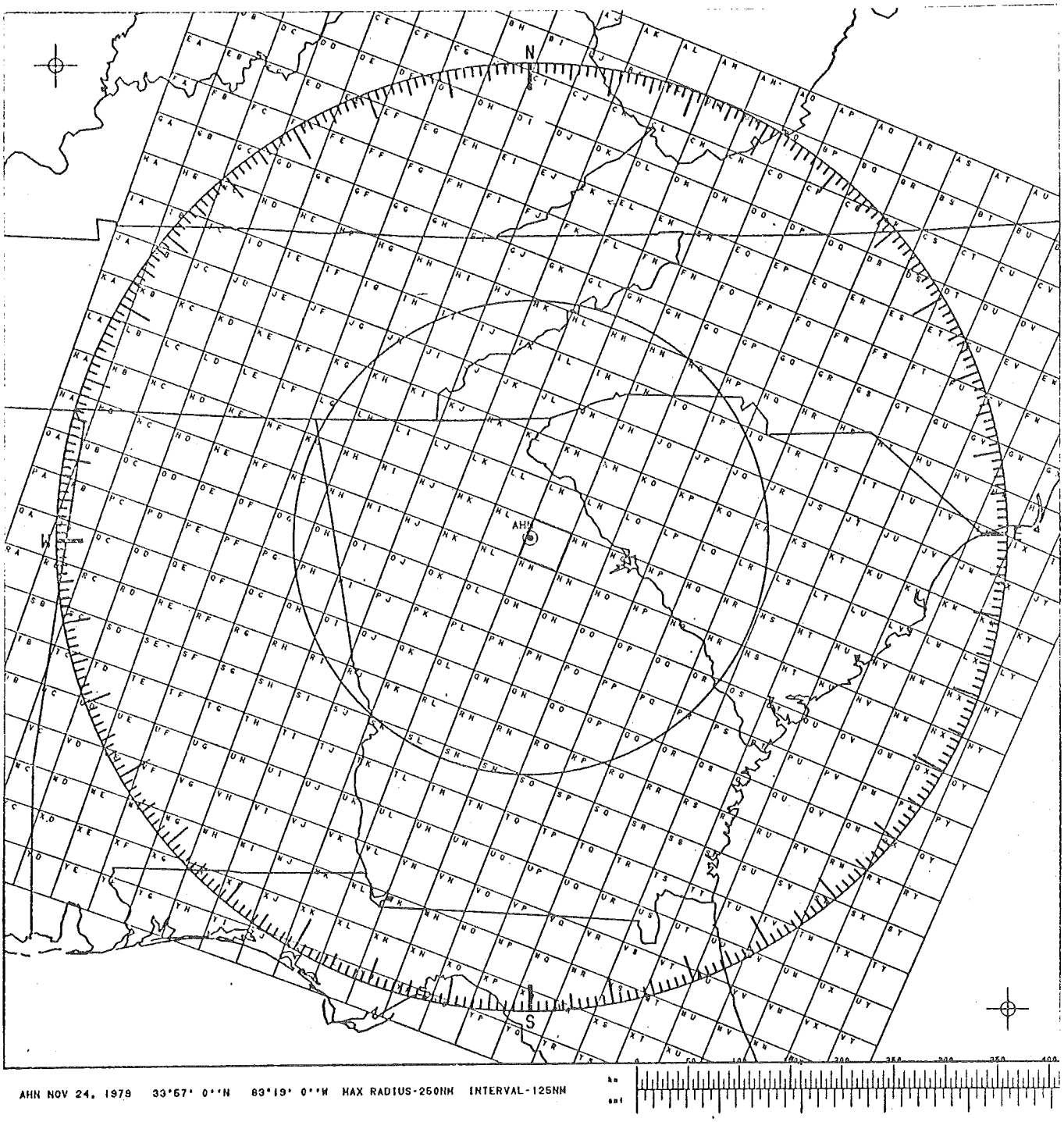

Figure 14.--250 nautical mile radar code grid for Athens, Georgia.

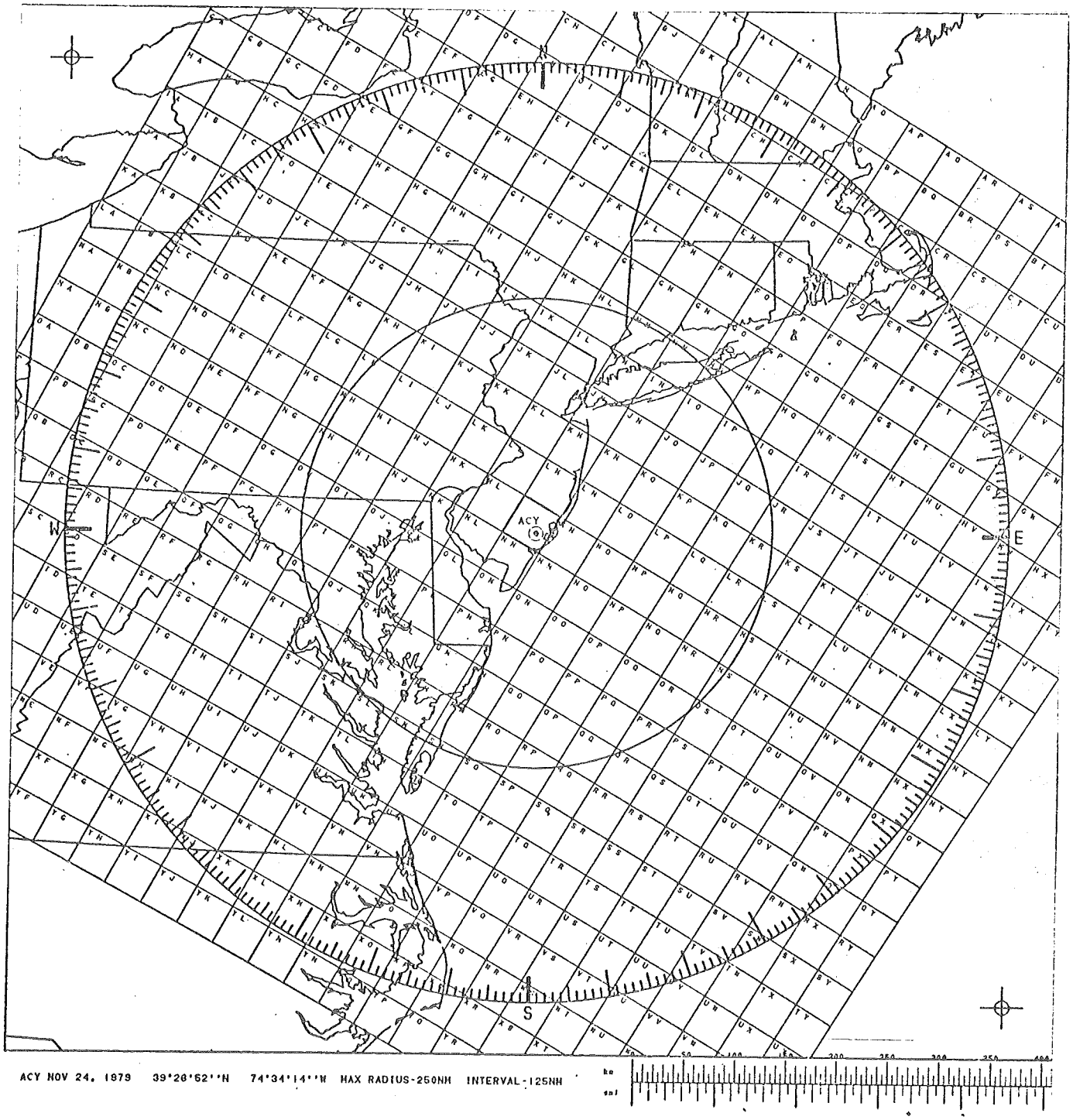

Figure 15.--250 nautical mile radar code grid for Atlantic City, N.J.

BGM
WSR-88

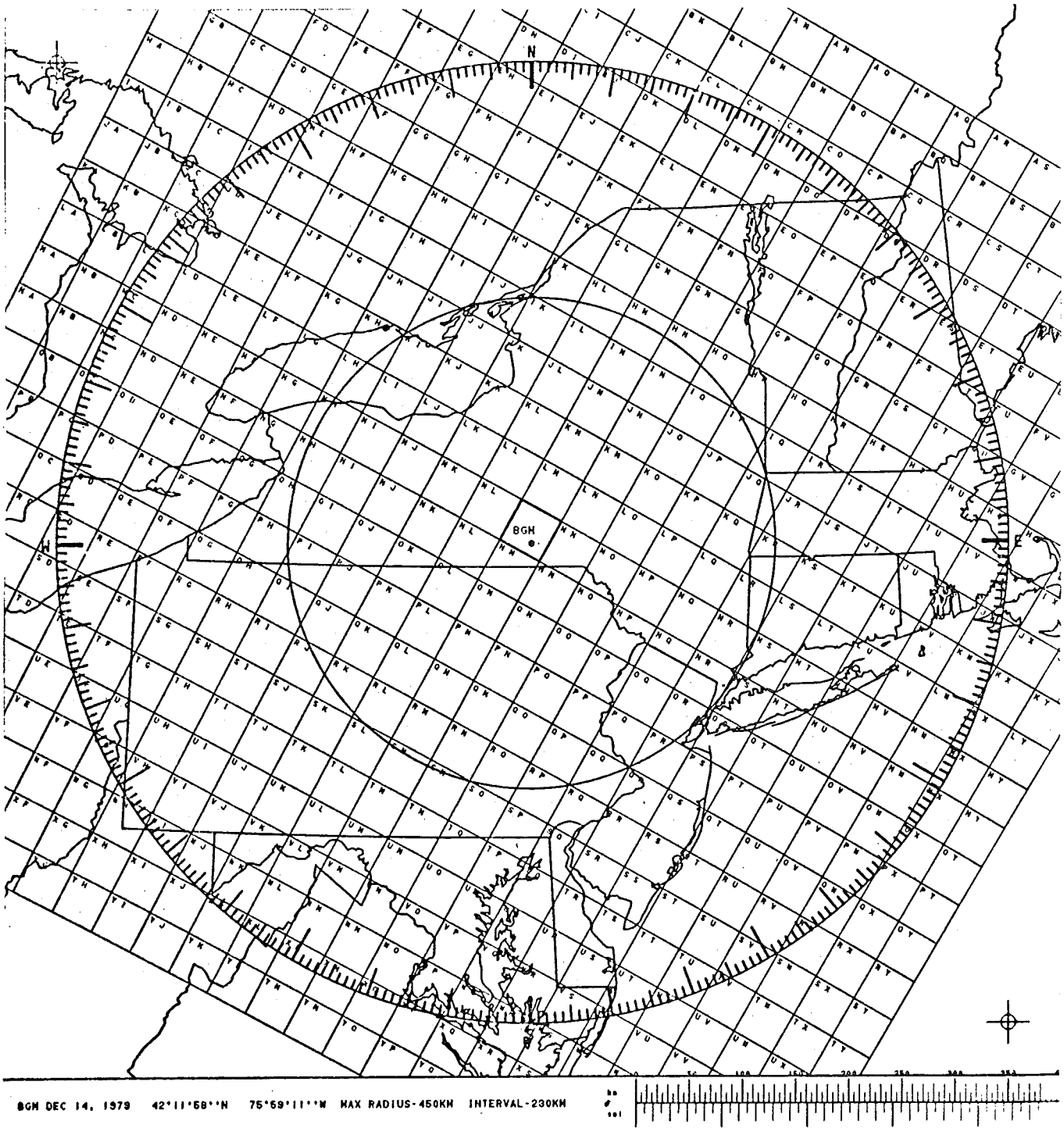

Figure 16.--450 kilometer radar code grid for Binghamton, New York.

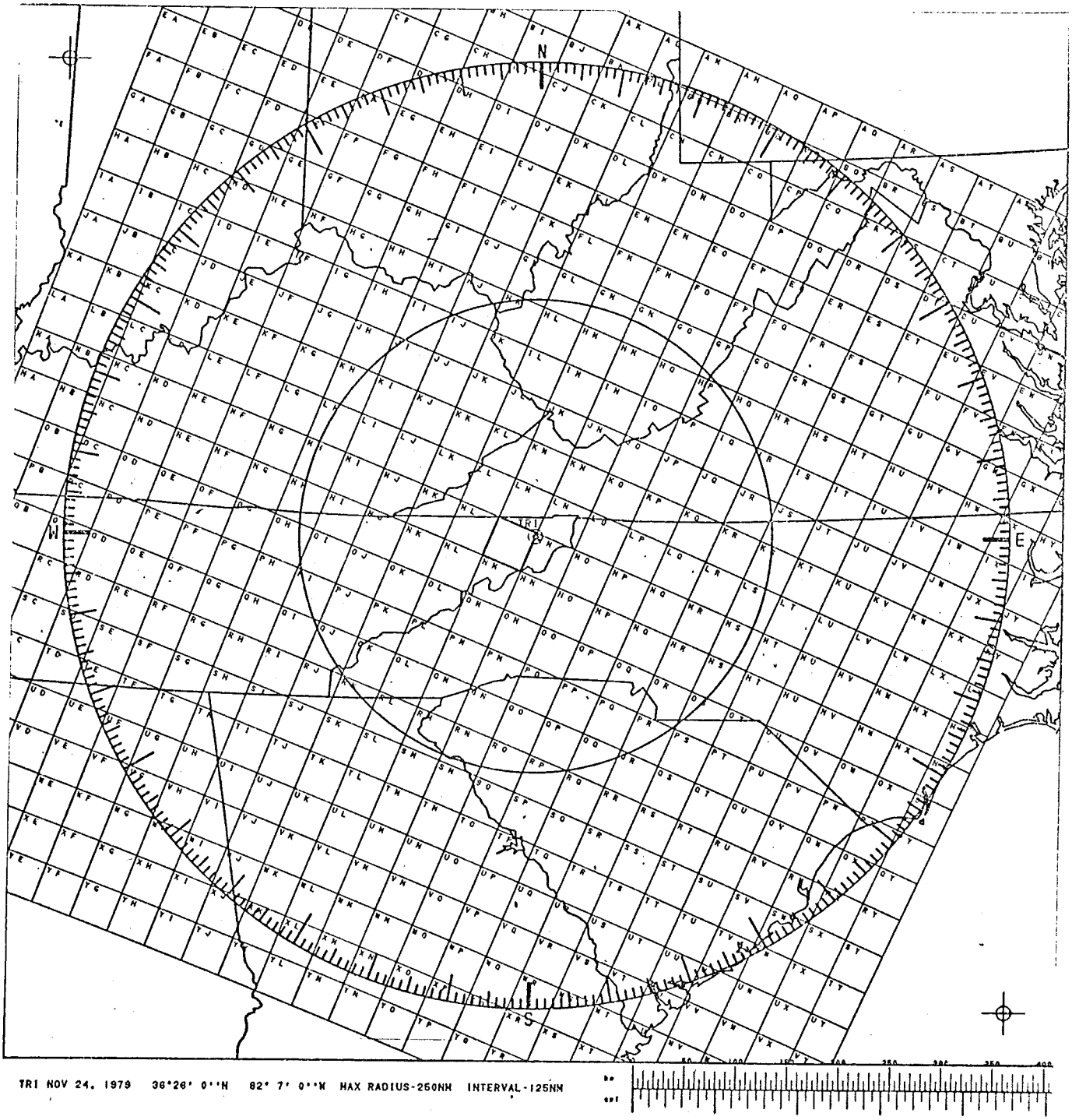

Figure 17.--250 nautical mile radar code grid for Bristol, Tenn.

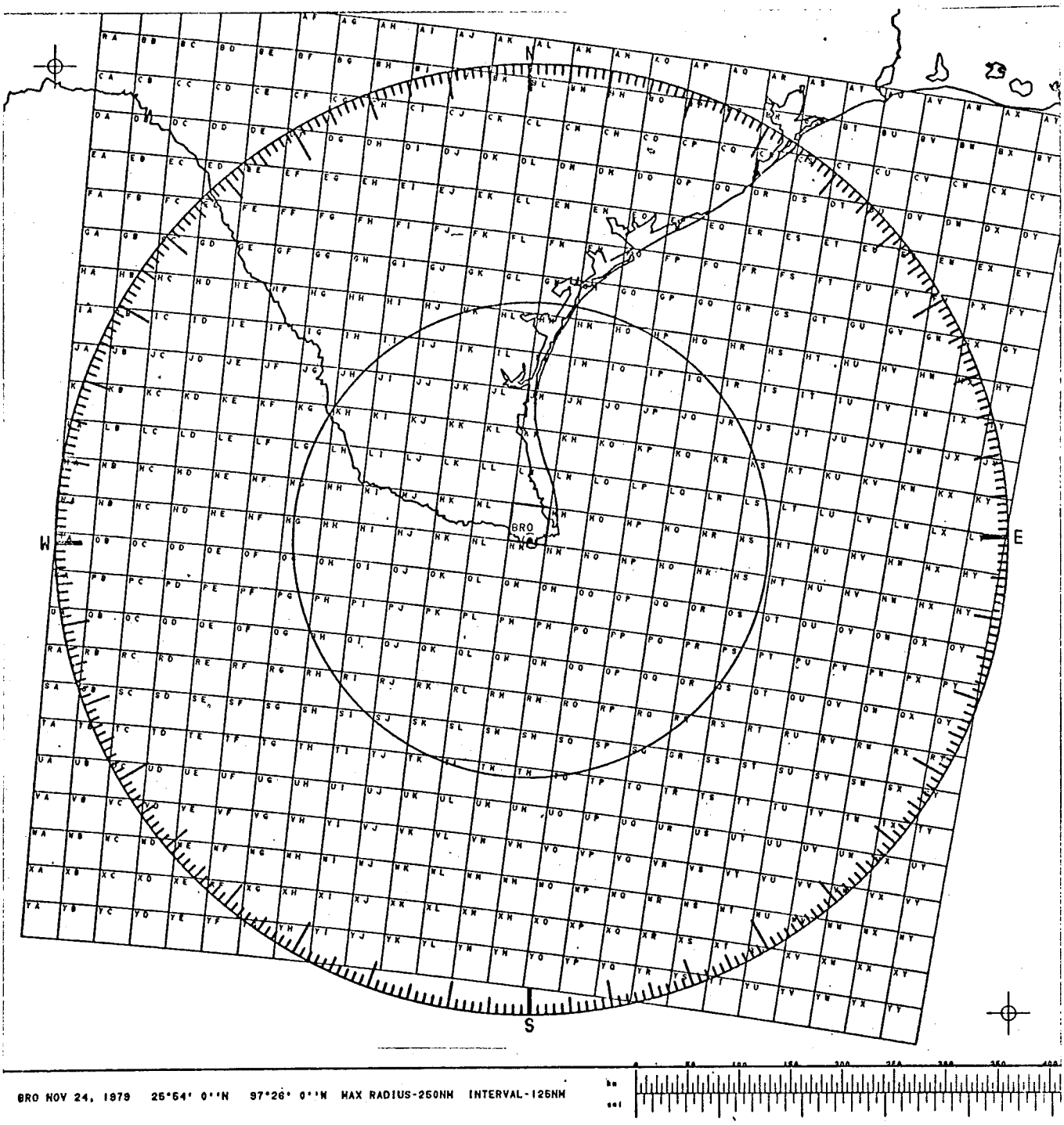

Figure 18.--250 nautical mile radar code grid for Brownsville, Tex.

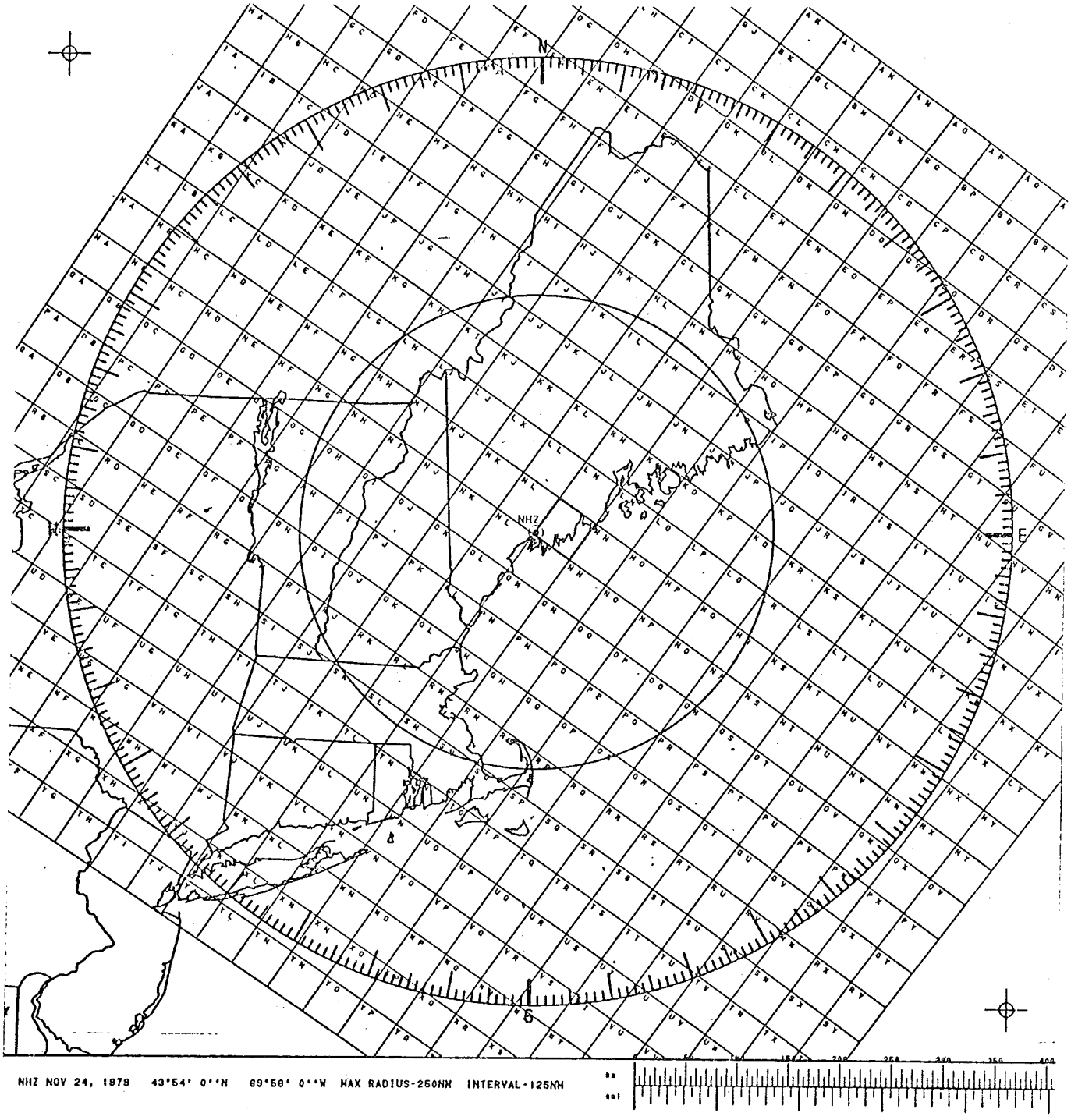

Figure 19.--250 nautical mile radar code grid for Brunswick, Maine.

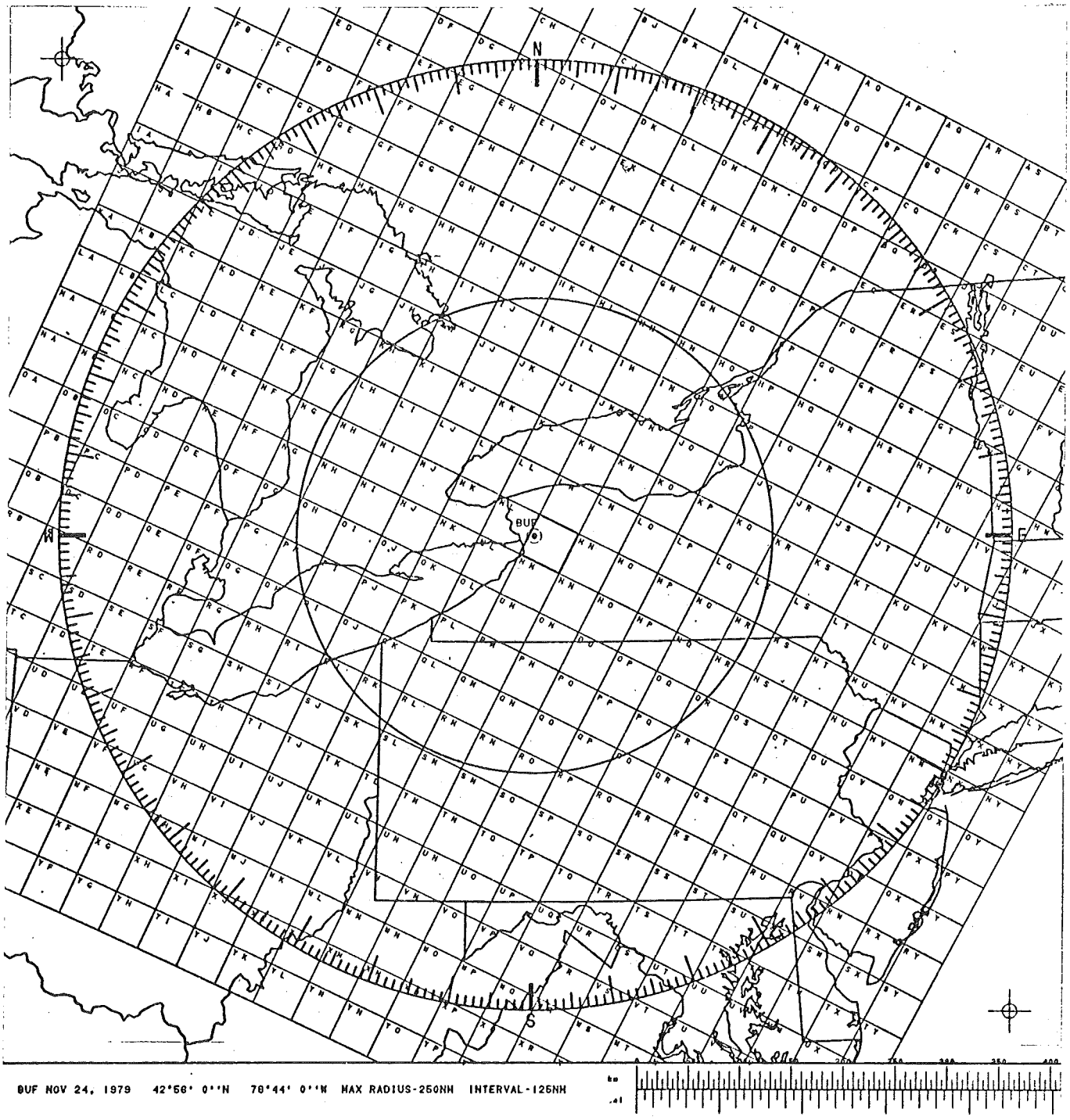

Figure 20.--250 nautical mile radar code grid for Buffalo, New York.

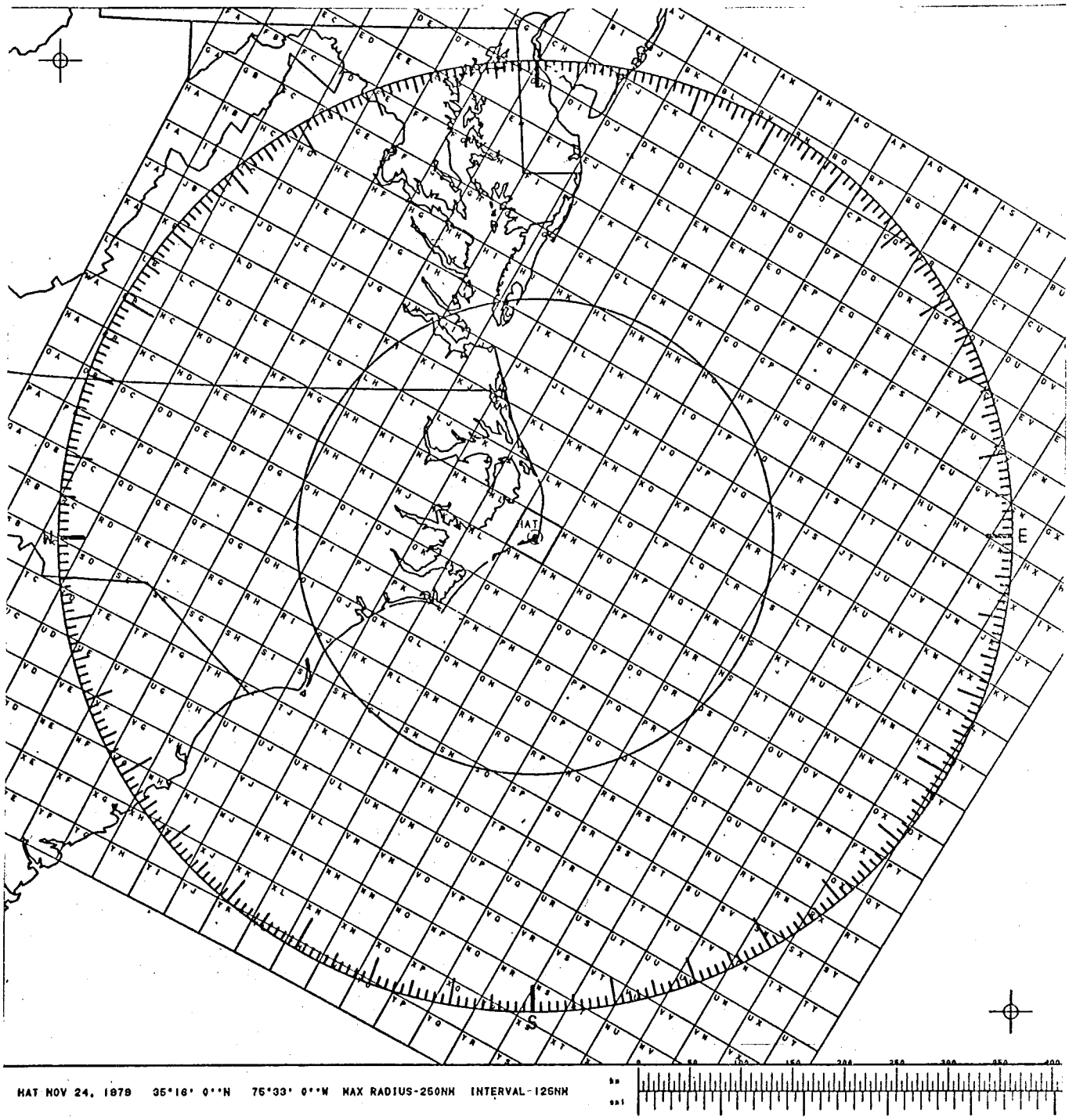

Figure 21.--250 nautical mile radar code grid for Cape Hatteras, N.C.

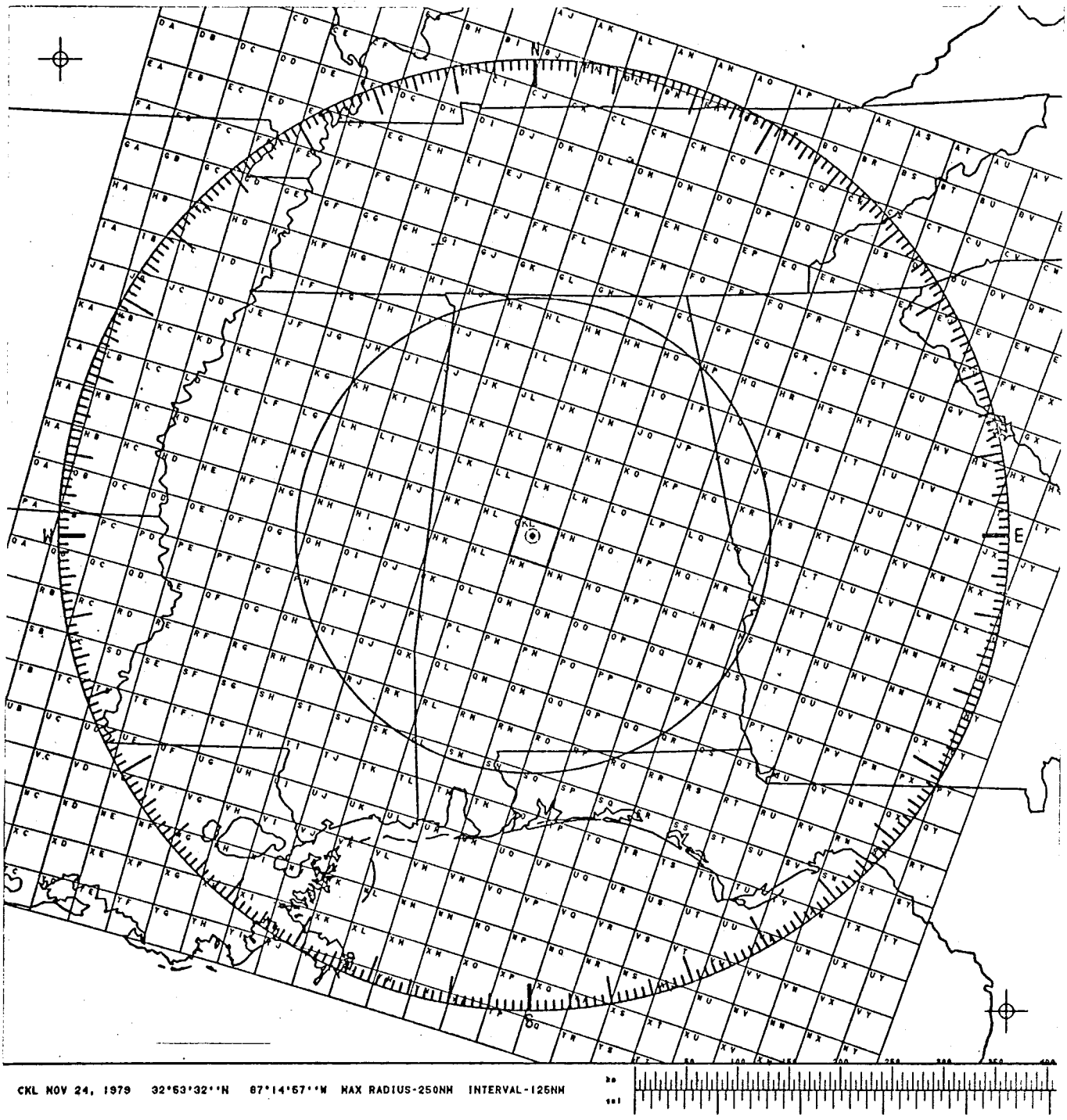

Figure 22.--250 nautical mile radar code grid for Centreville, Ala.

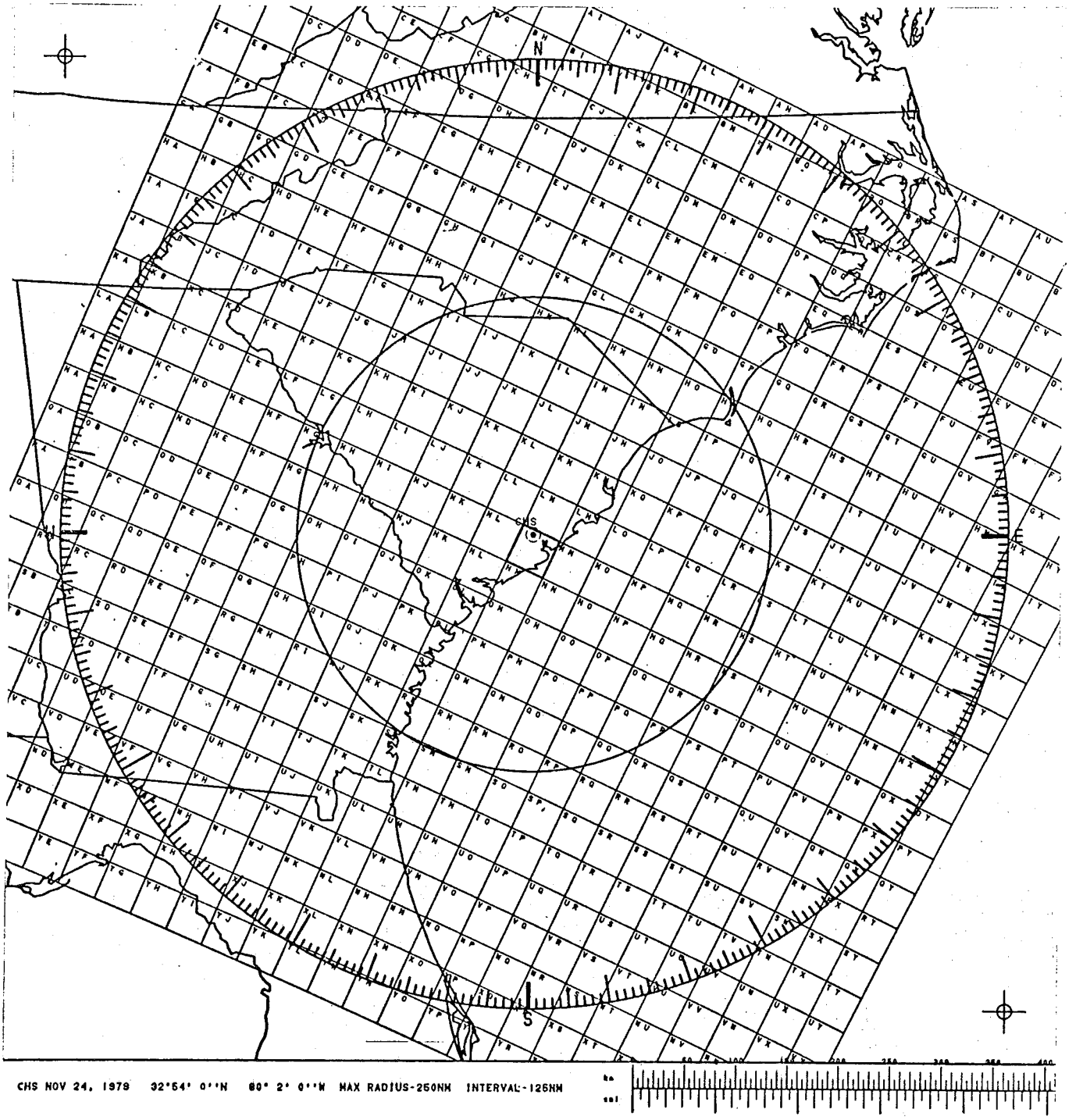

Figure 23.--250 nautical mile radar code grid for Charleston, S.C.

CHH
WSR-74
wrong GRD

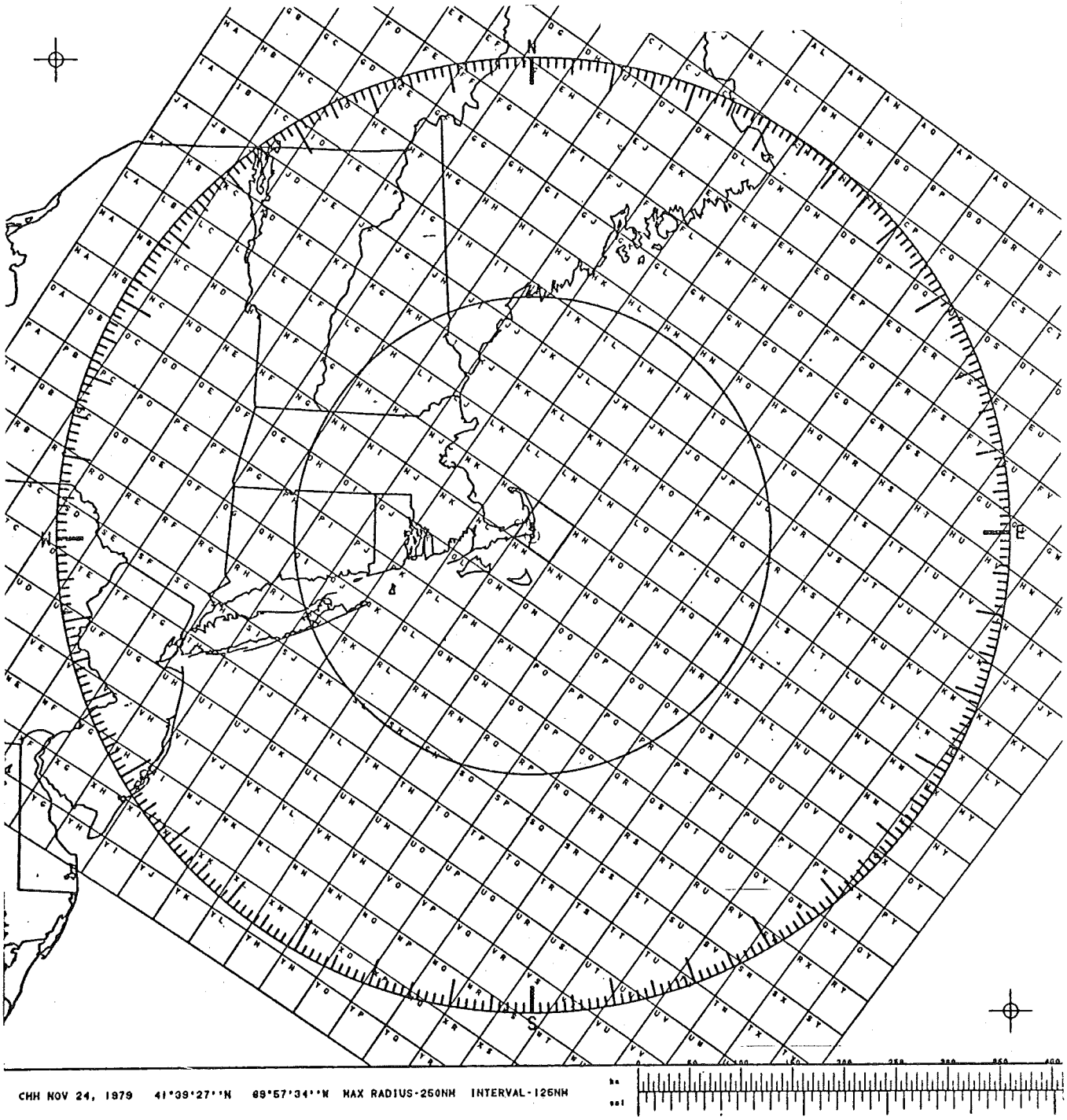

Figure 24.--250 nautical mile radar code grid for Chatham, Mass.

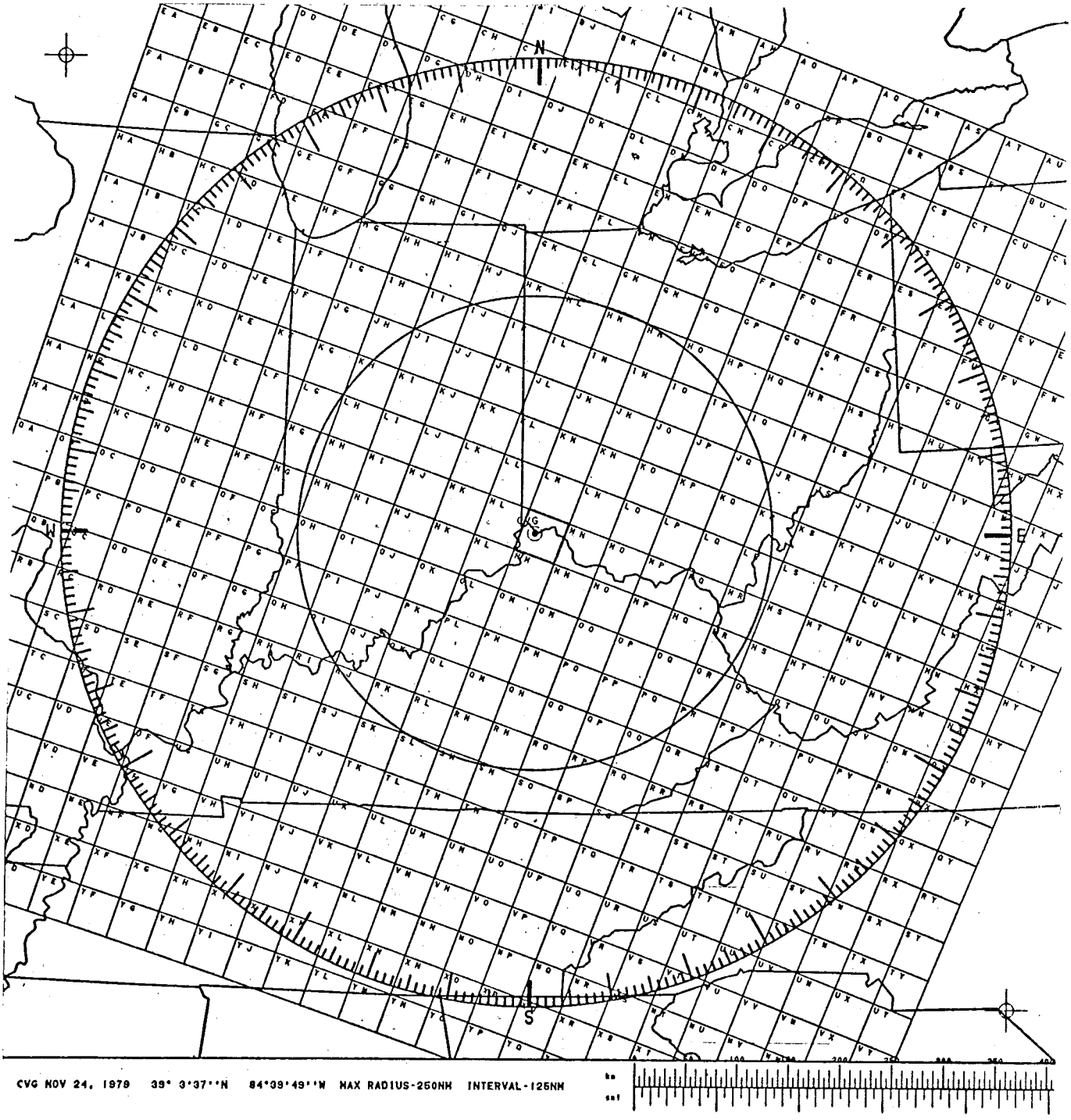

Figure 25.--250 nautical mile radar code grid for Cincinnati, Ohio.

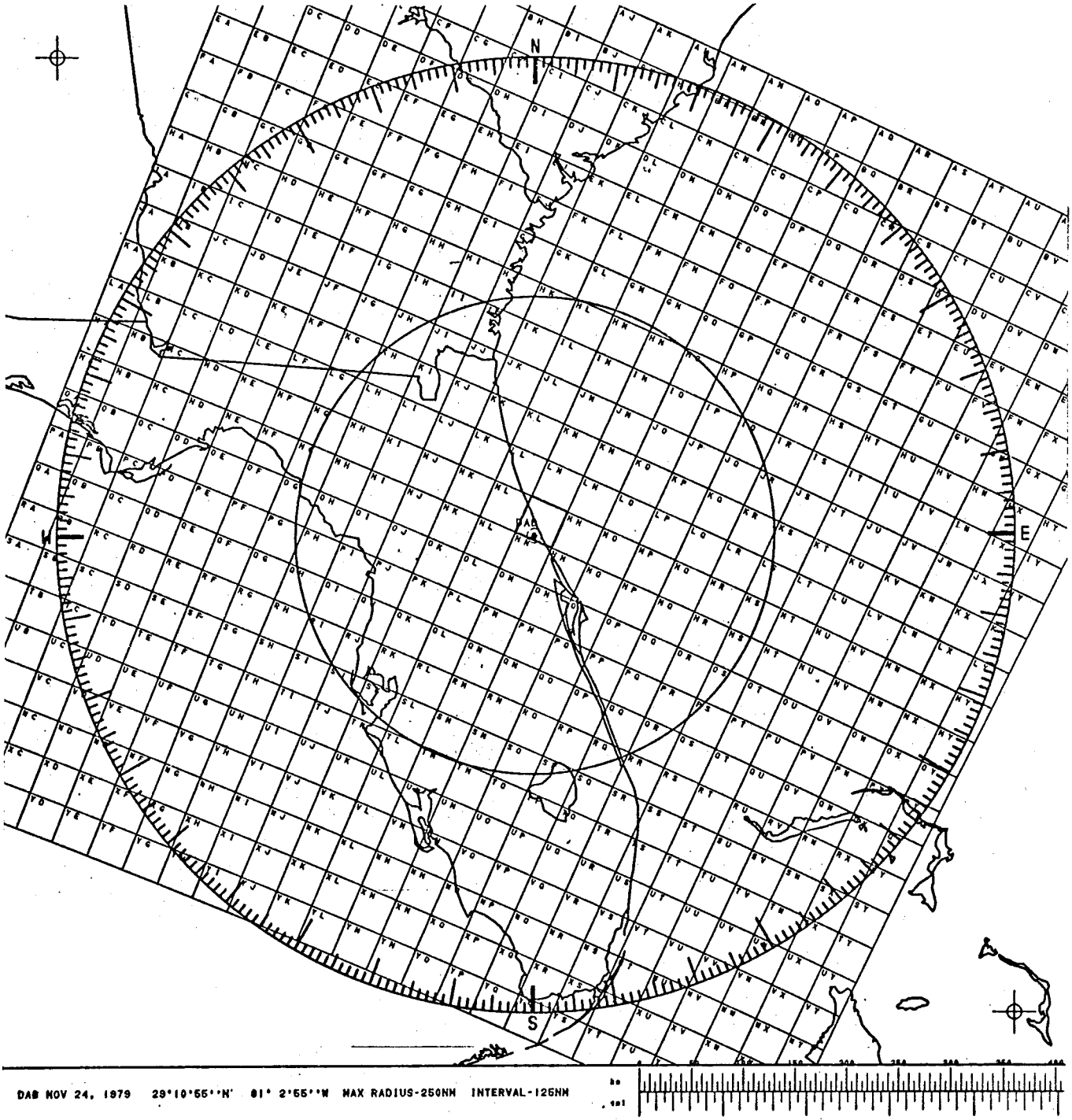

Figure 26.--250 nautical mile radar code grid for Daytona Beach, Fla.

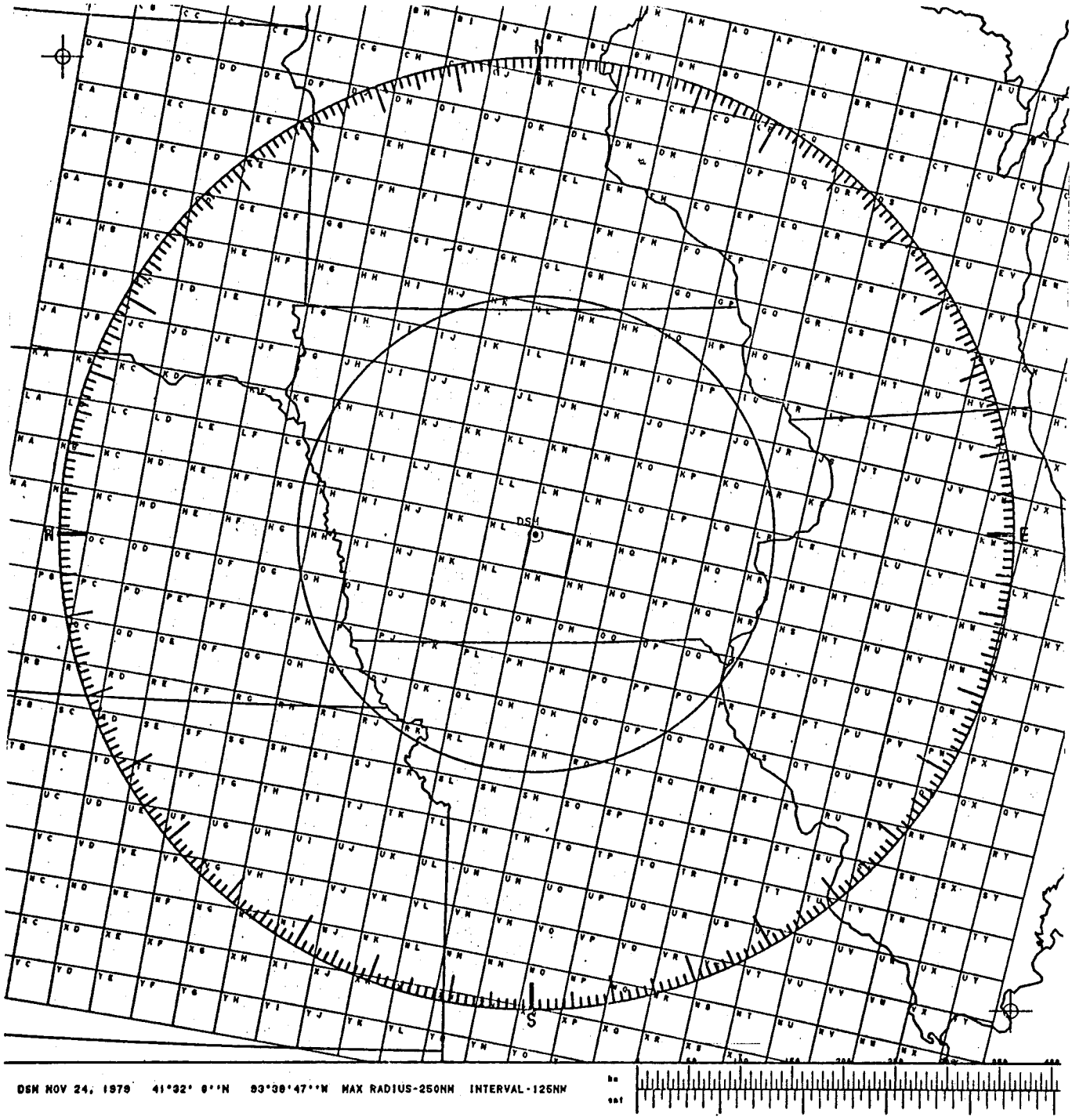

Figure 27.--250 nautical mile radar code grid for Des Moines, Iowa.

DTW
WSR-74
wrong grid

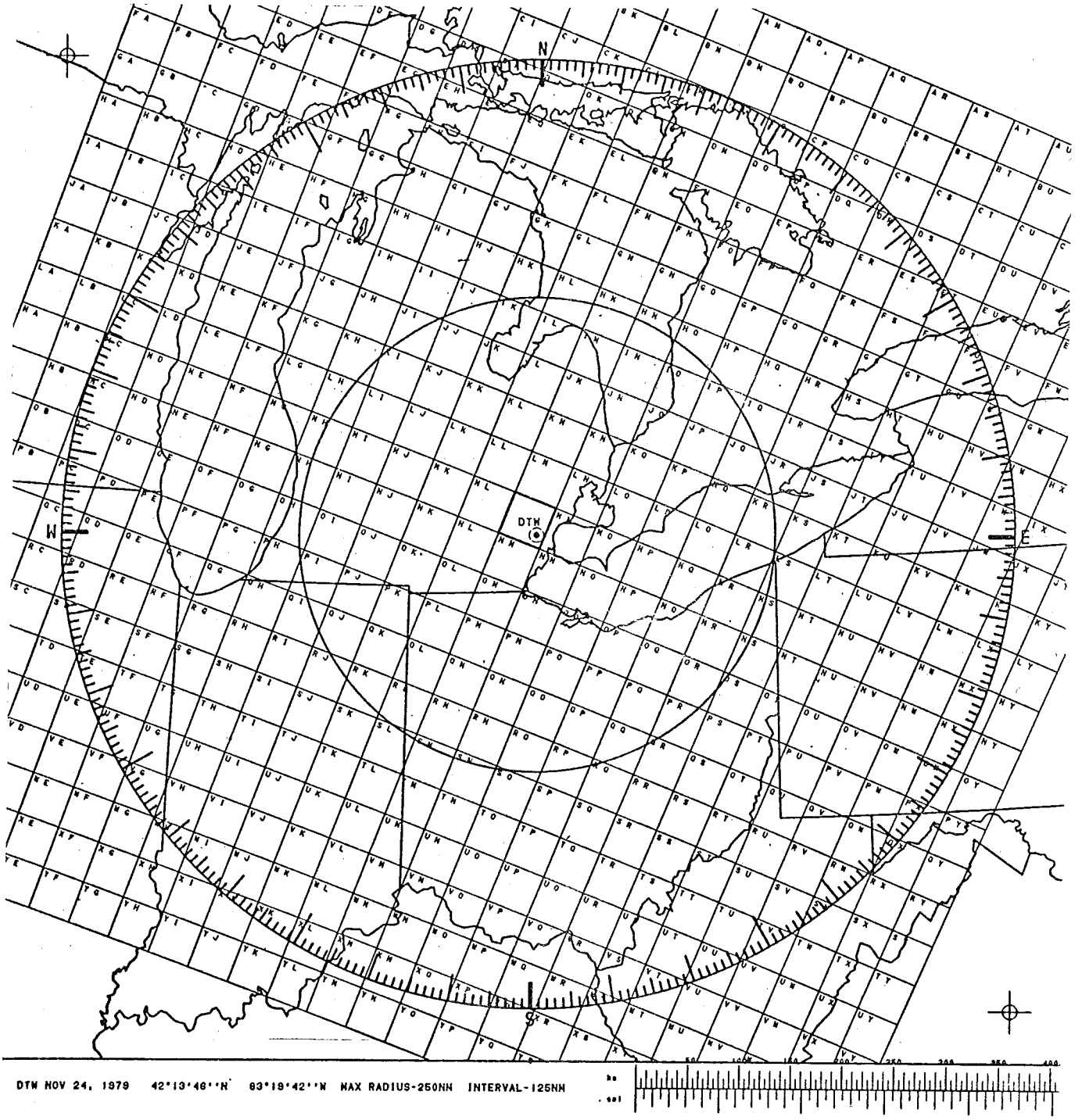

Figure 28.--250 nautical mile radar code grid for Detroit, Mich.

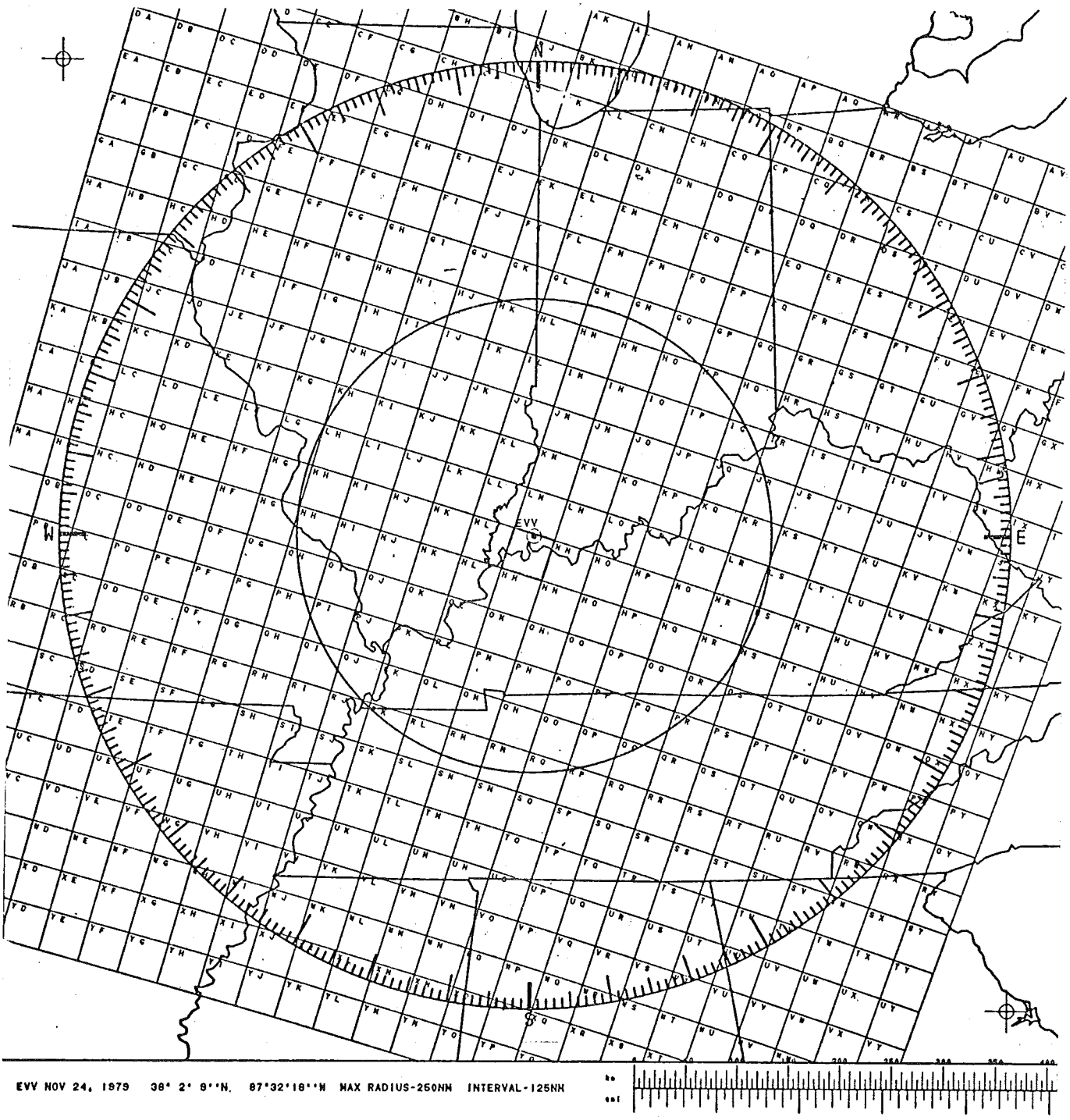

Figure 29.--250 nautical mile radar code grid for Evansville, Ind.

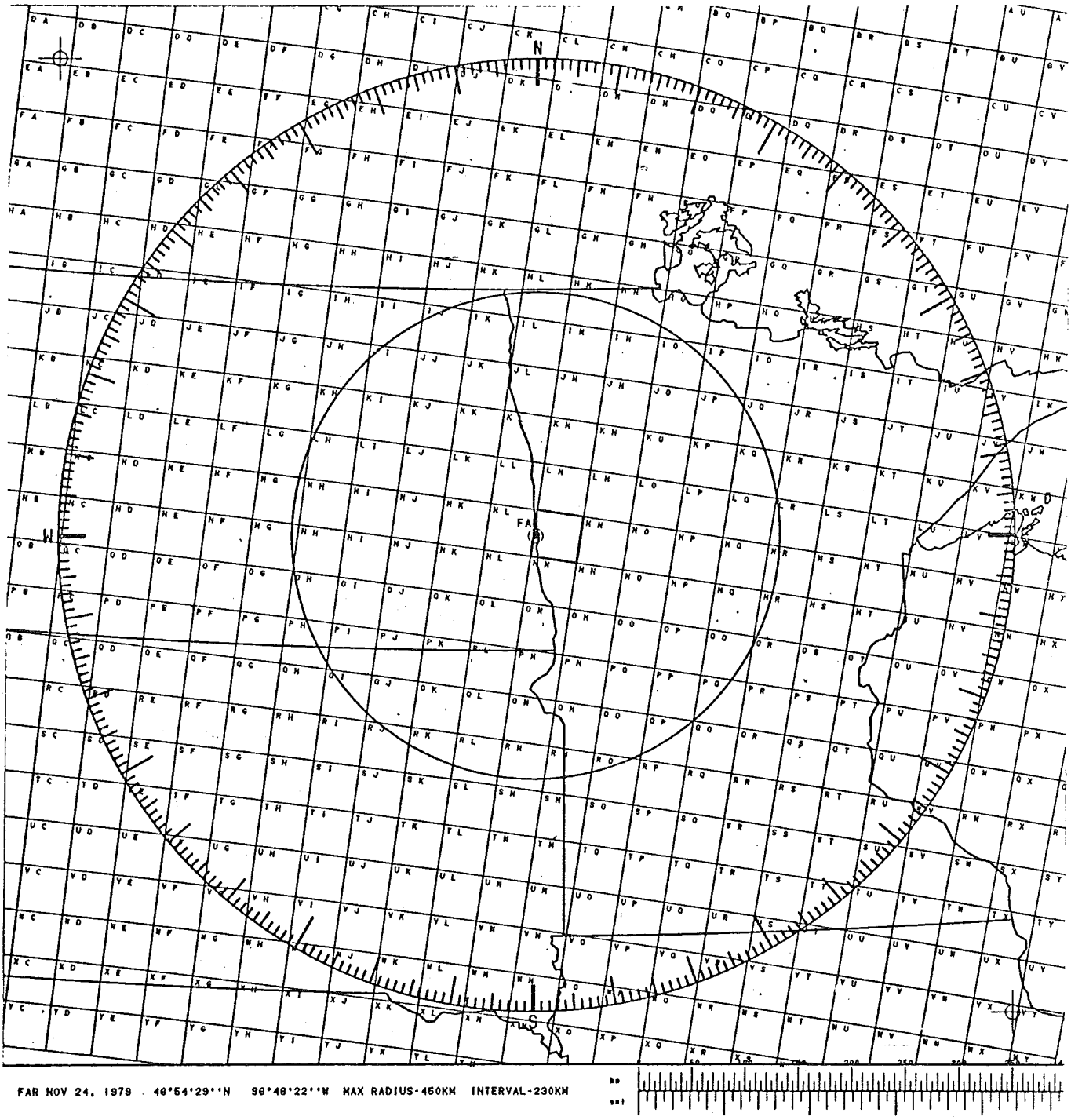

Figure 30.--450 kilometer radar code grid for Fargo, North Dakota.

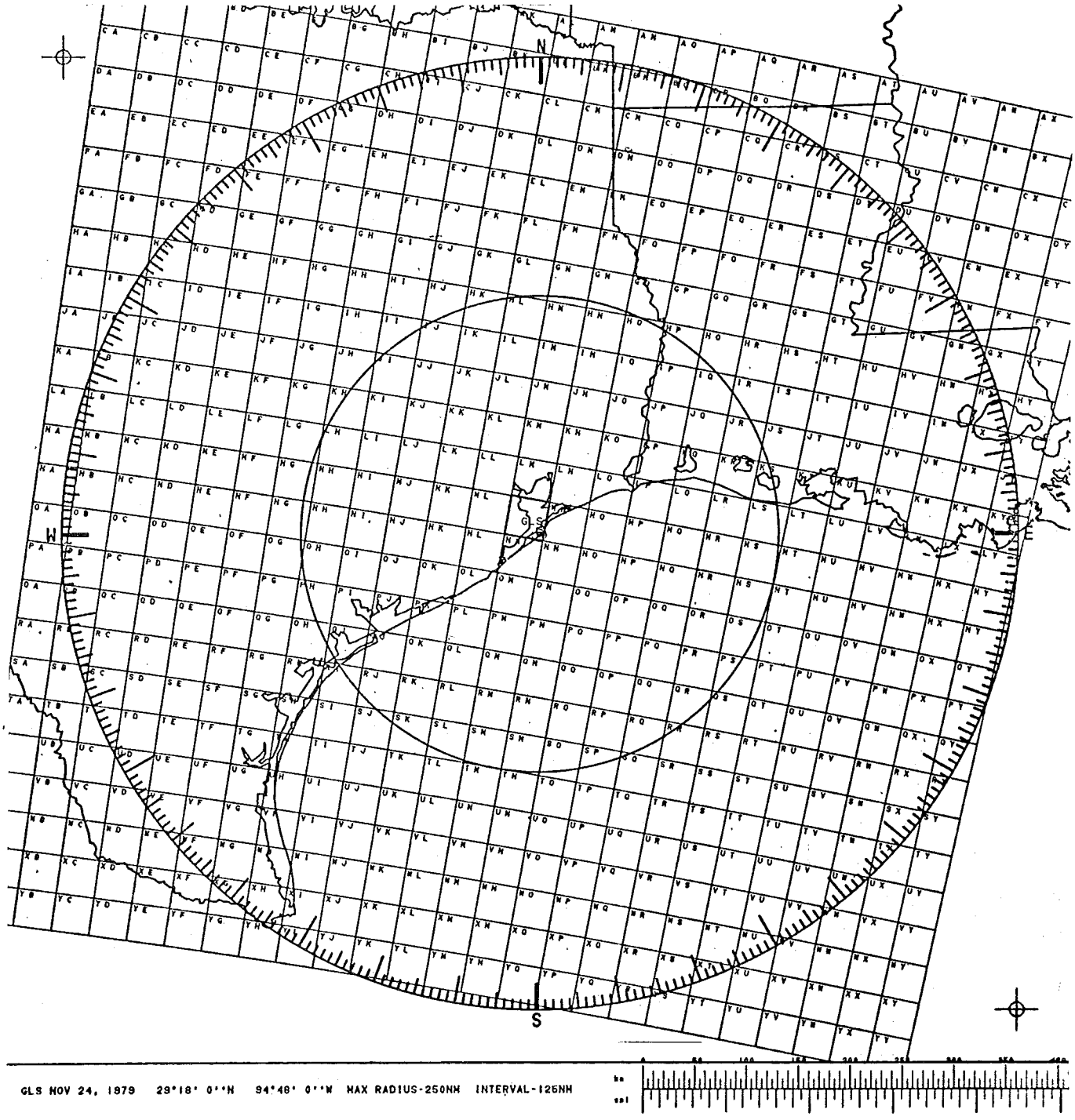

Figure 31.--250 nautical mile radar code grid for Galveston, Texas.

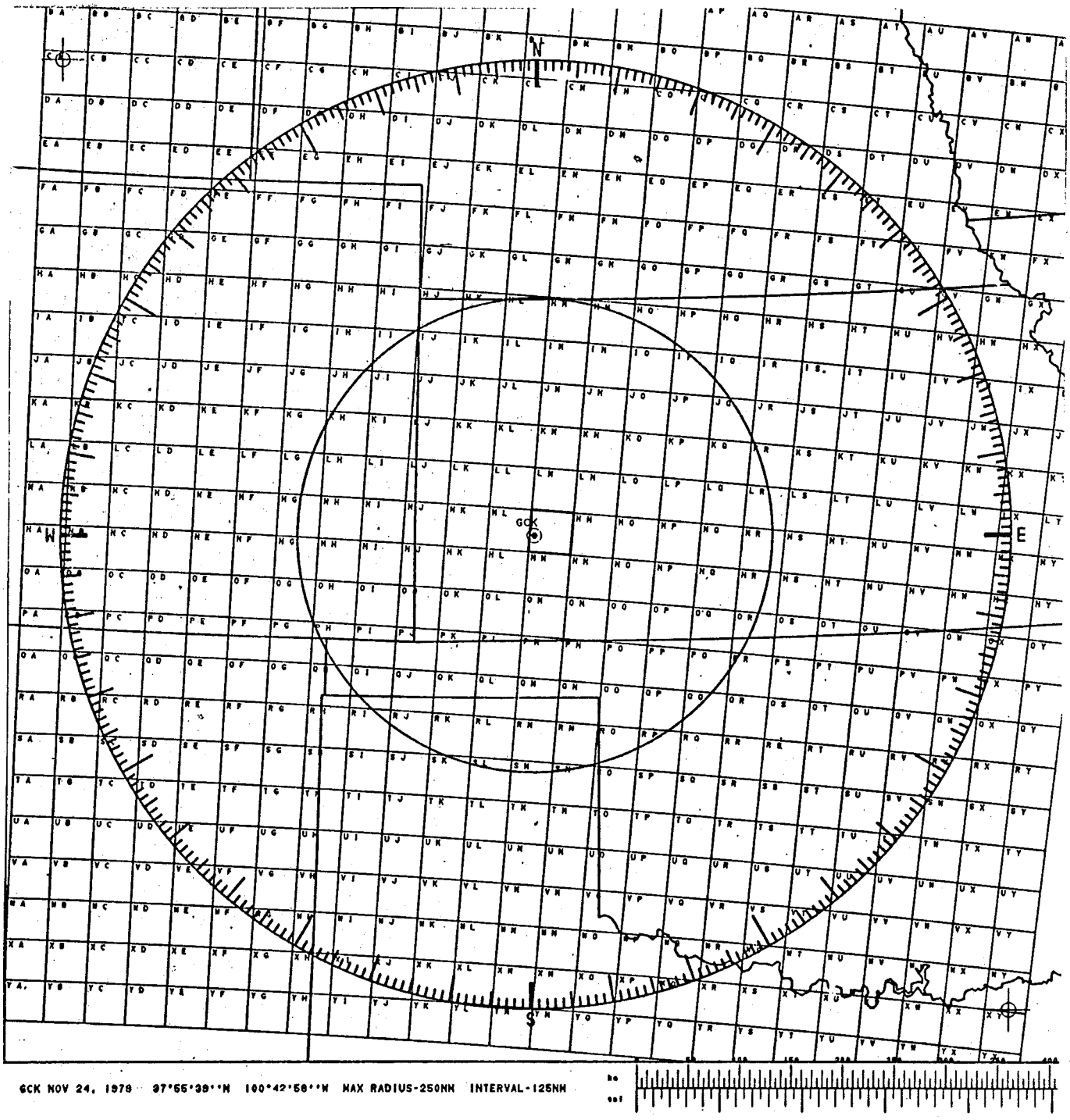

Figure 32.--250 nautical mile radar code grid for Garden City, Kans.

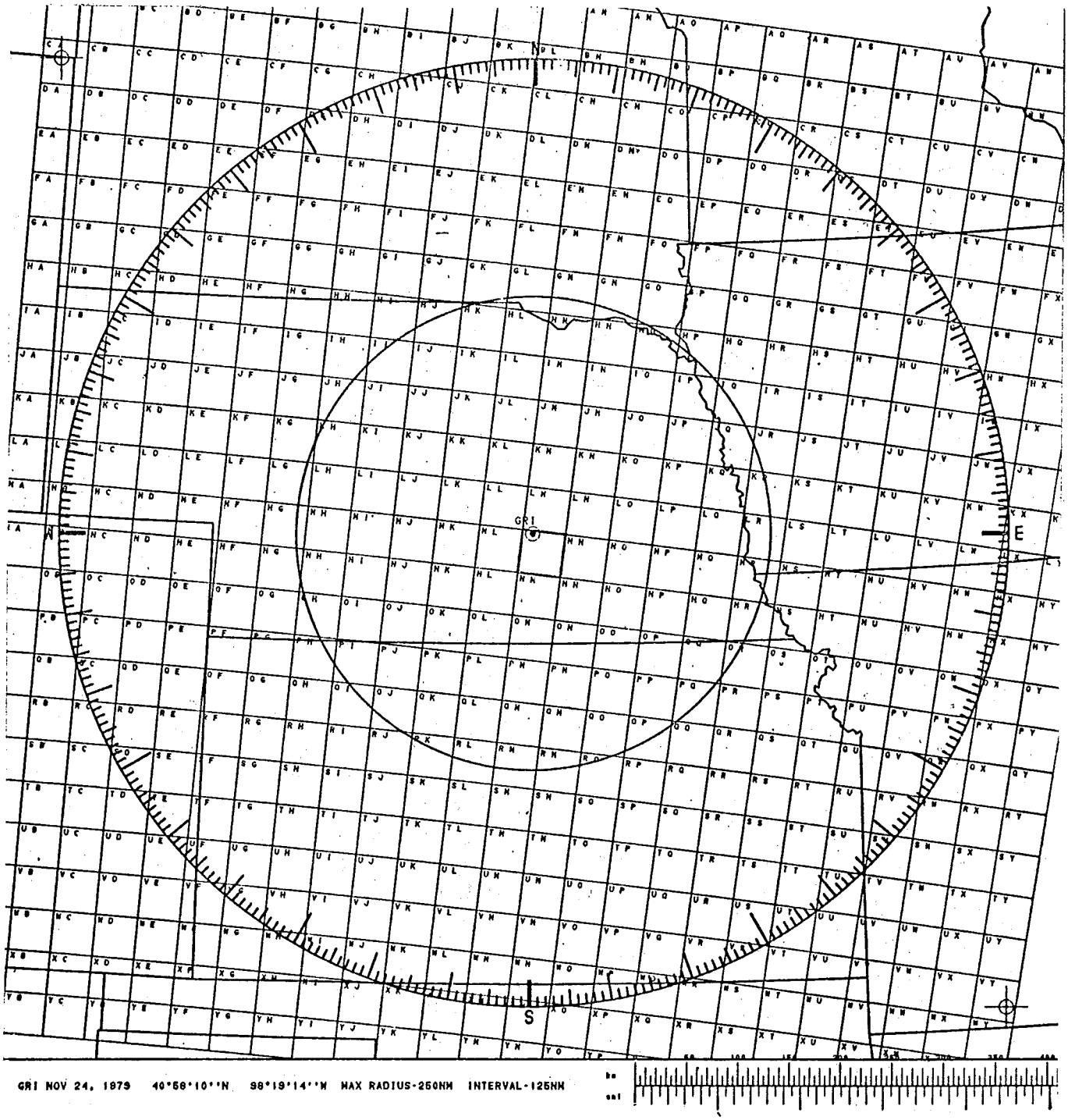

Figure 33.--250 nautical mile radar code grid for Grand Island, Nebr.

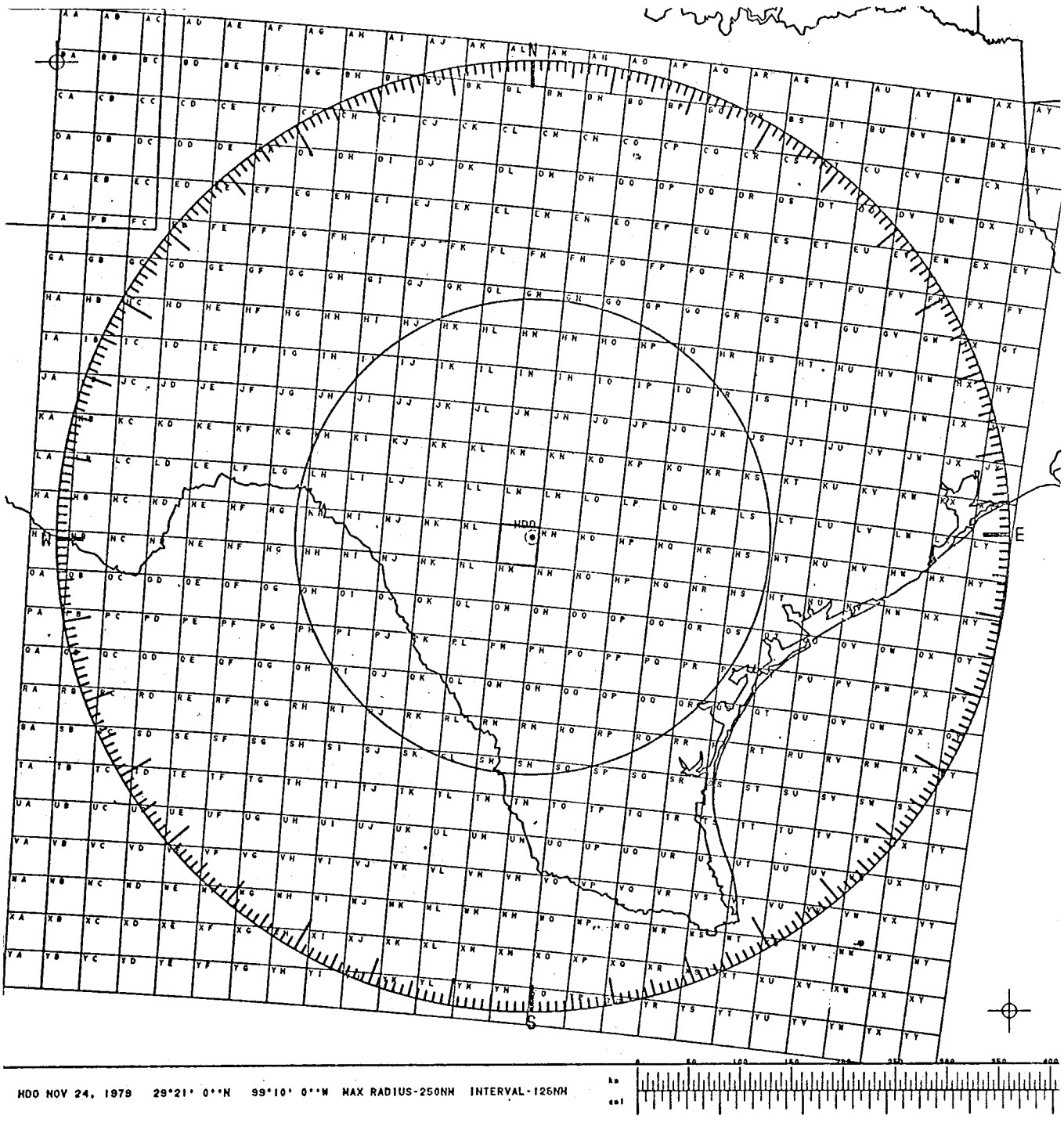

Figure 34.--250 nautical mile radar code grid for Hondo, Texas.

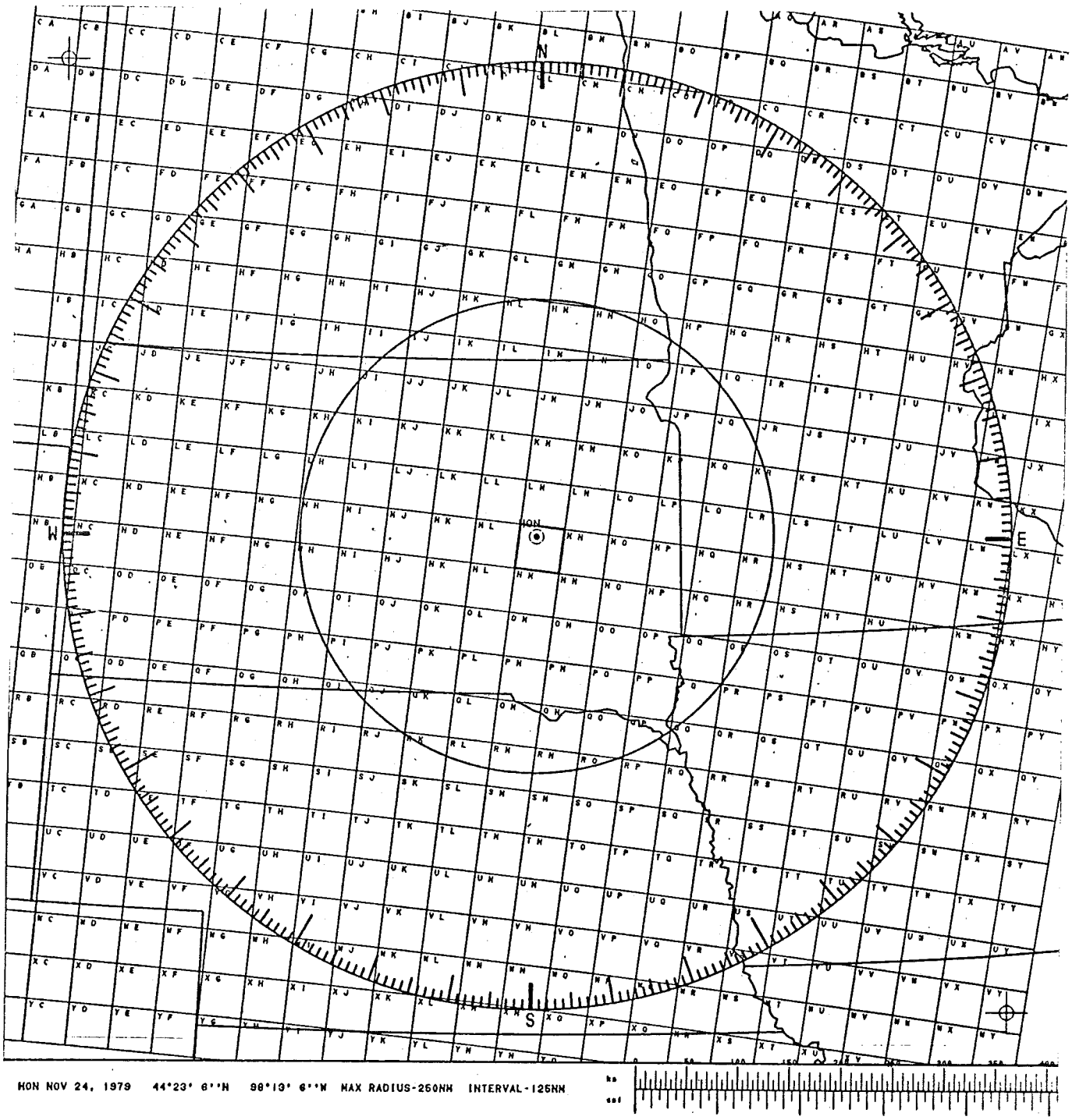

Figure 35.--250 nautical mile radar code grid for Huron, S. Dak.

JAN
WSR-88

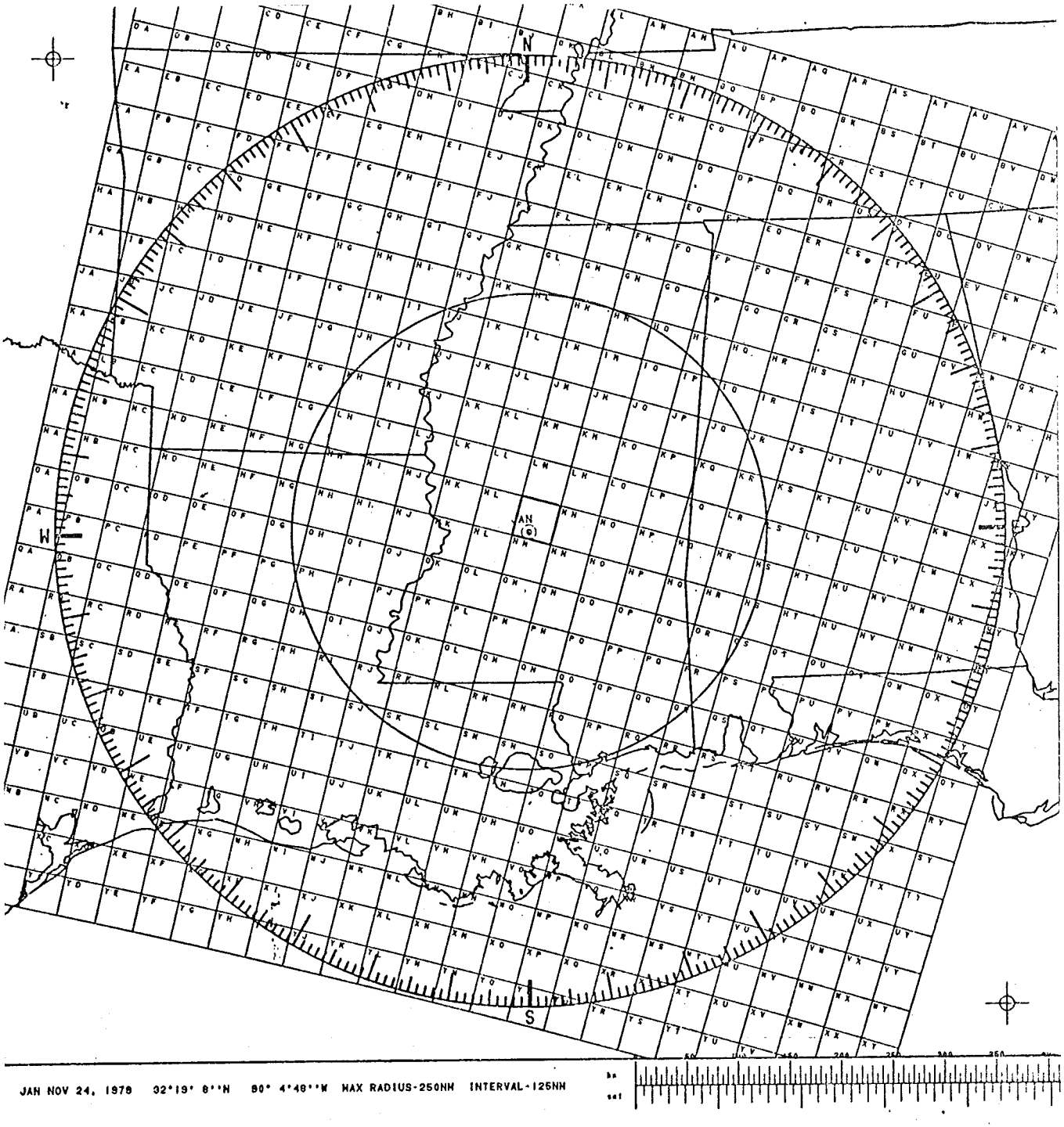

Figure 36.--250 nautical mile radar code grid for Jackson, Miss.

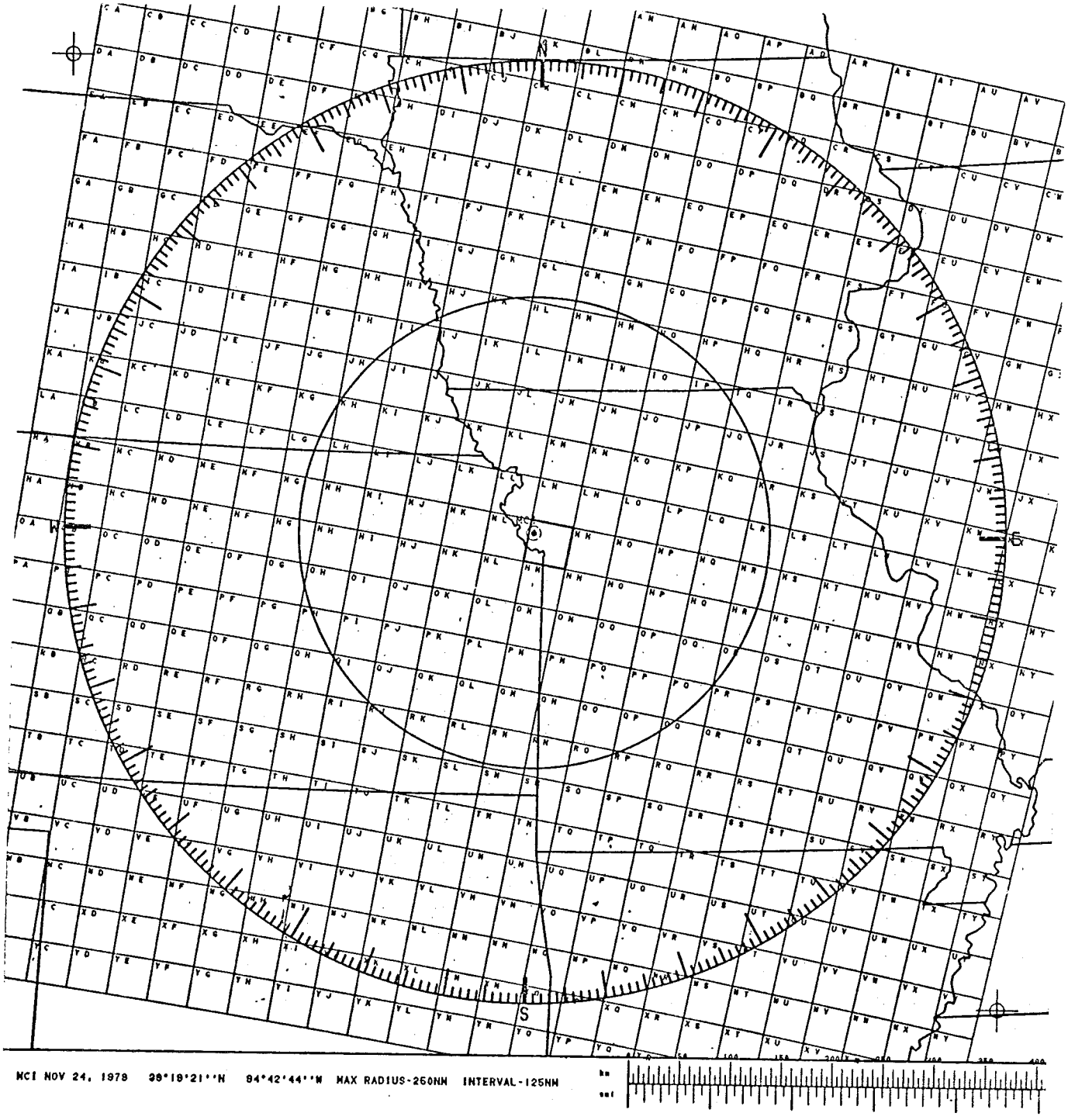

Figure 37.--250 nautical mile radar code grid for Kansas City, Mo.

EYW
WSR-74
Wrong grid

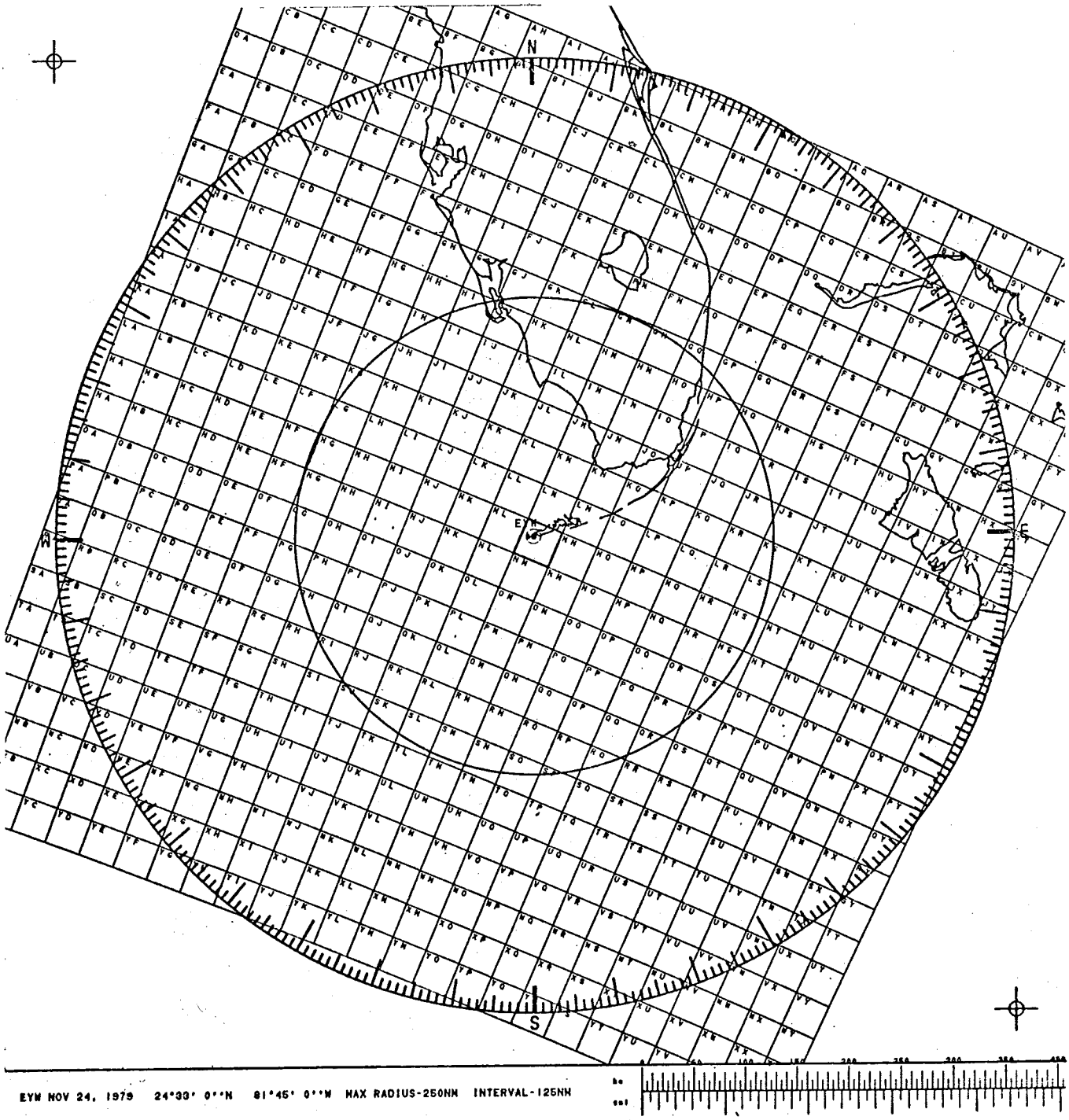

Figure 38.--250 nautical mile radar code grid for Key West, Fla.

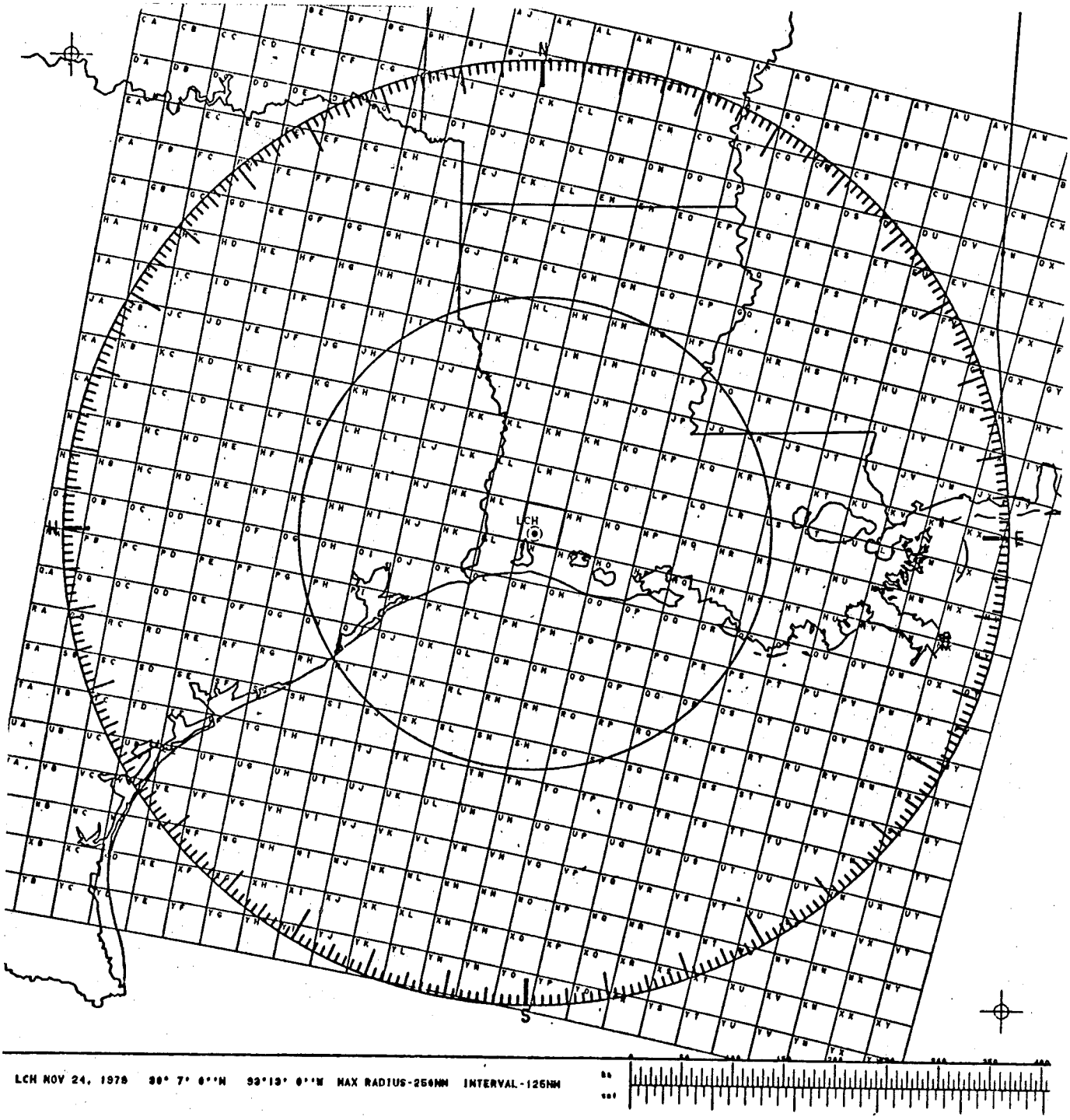

Figure 39.--250 nautical mile radar code grid for Lake Charles, La.

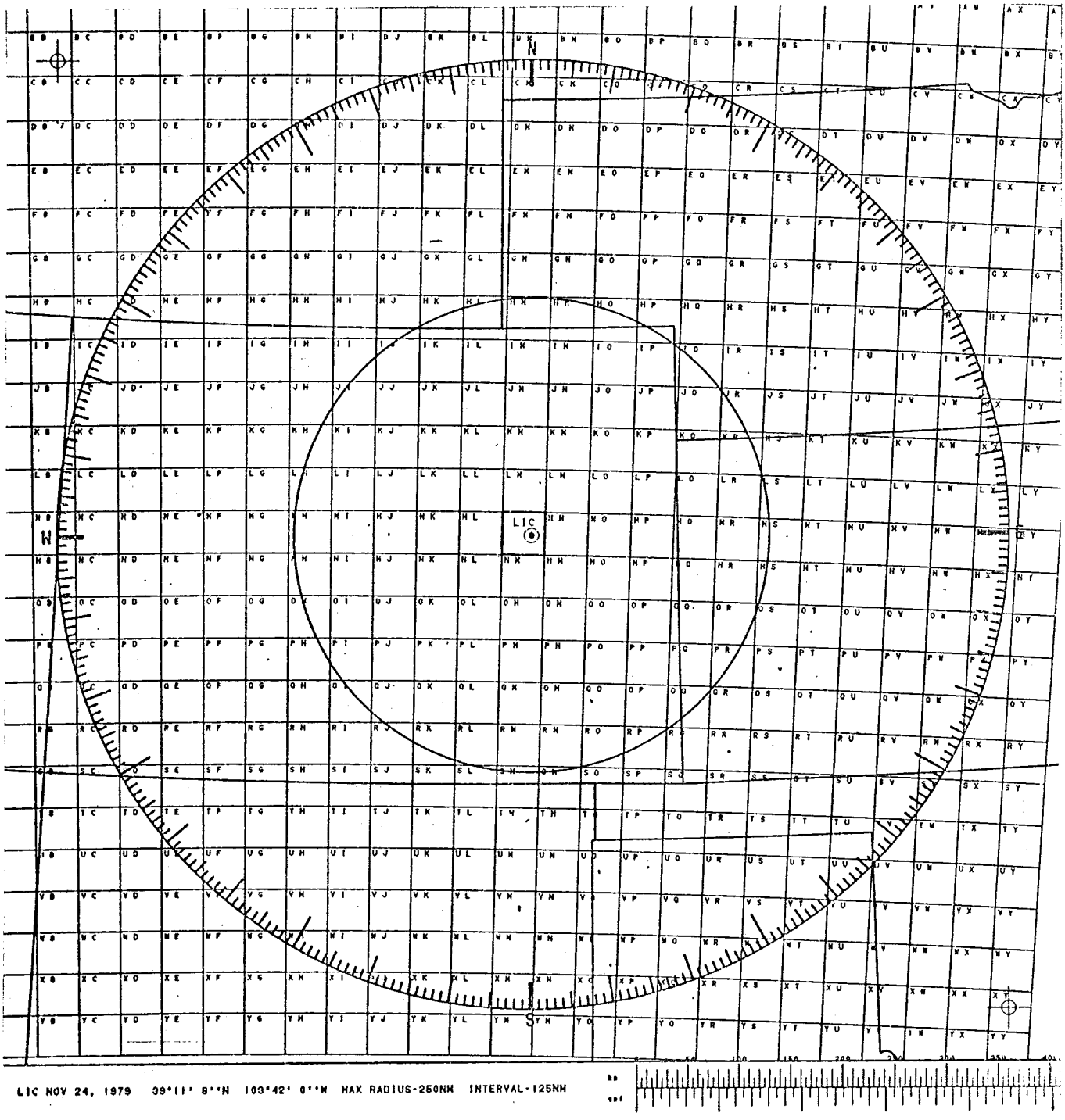

Figure 40.--250 nautical mile radar code grid for Limon, Colorado.

LZK
WSR-88

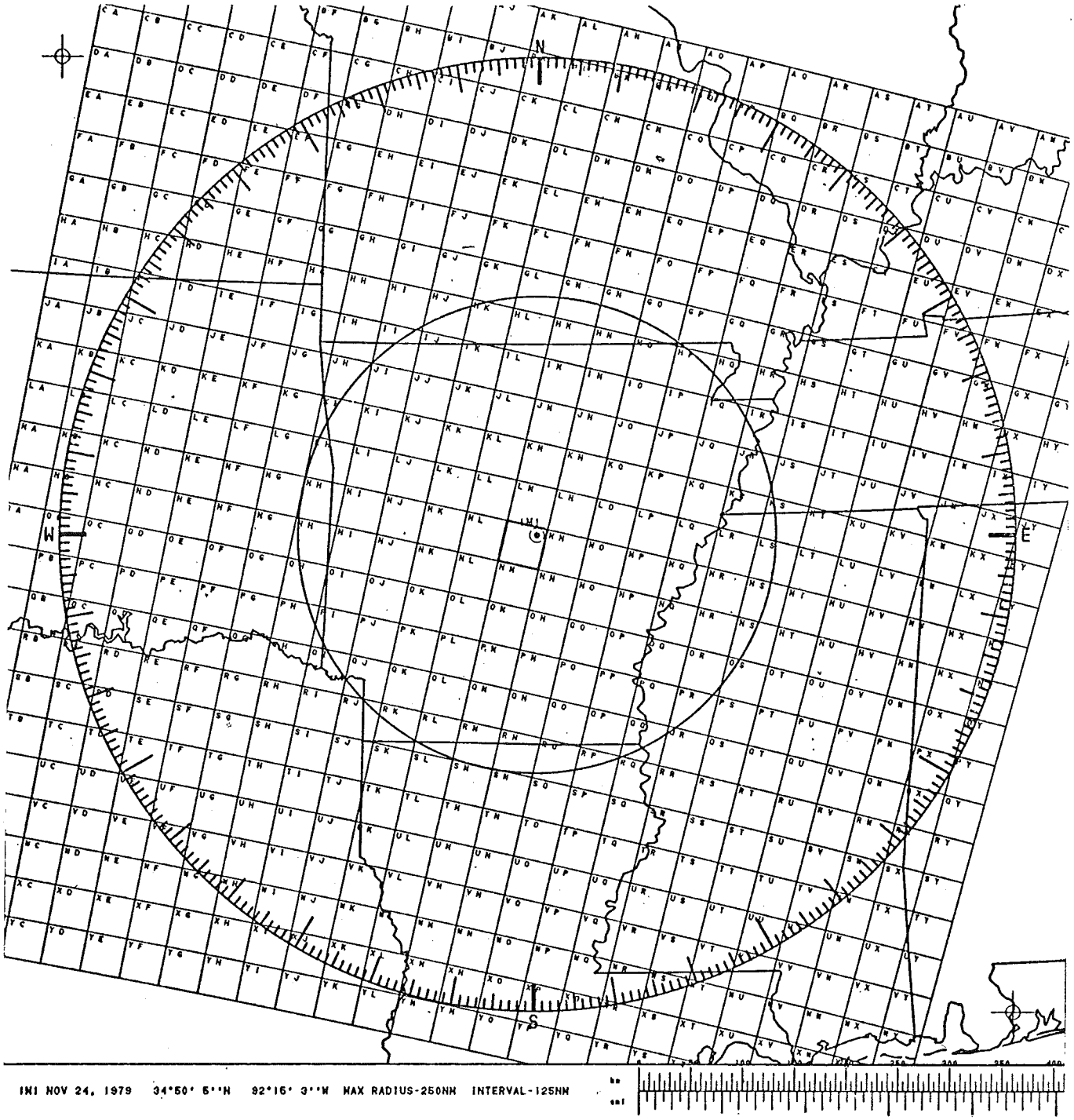

Figure 41.--250 nautical mile radar code grid for Little Rock, Ark.

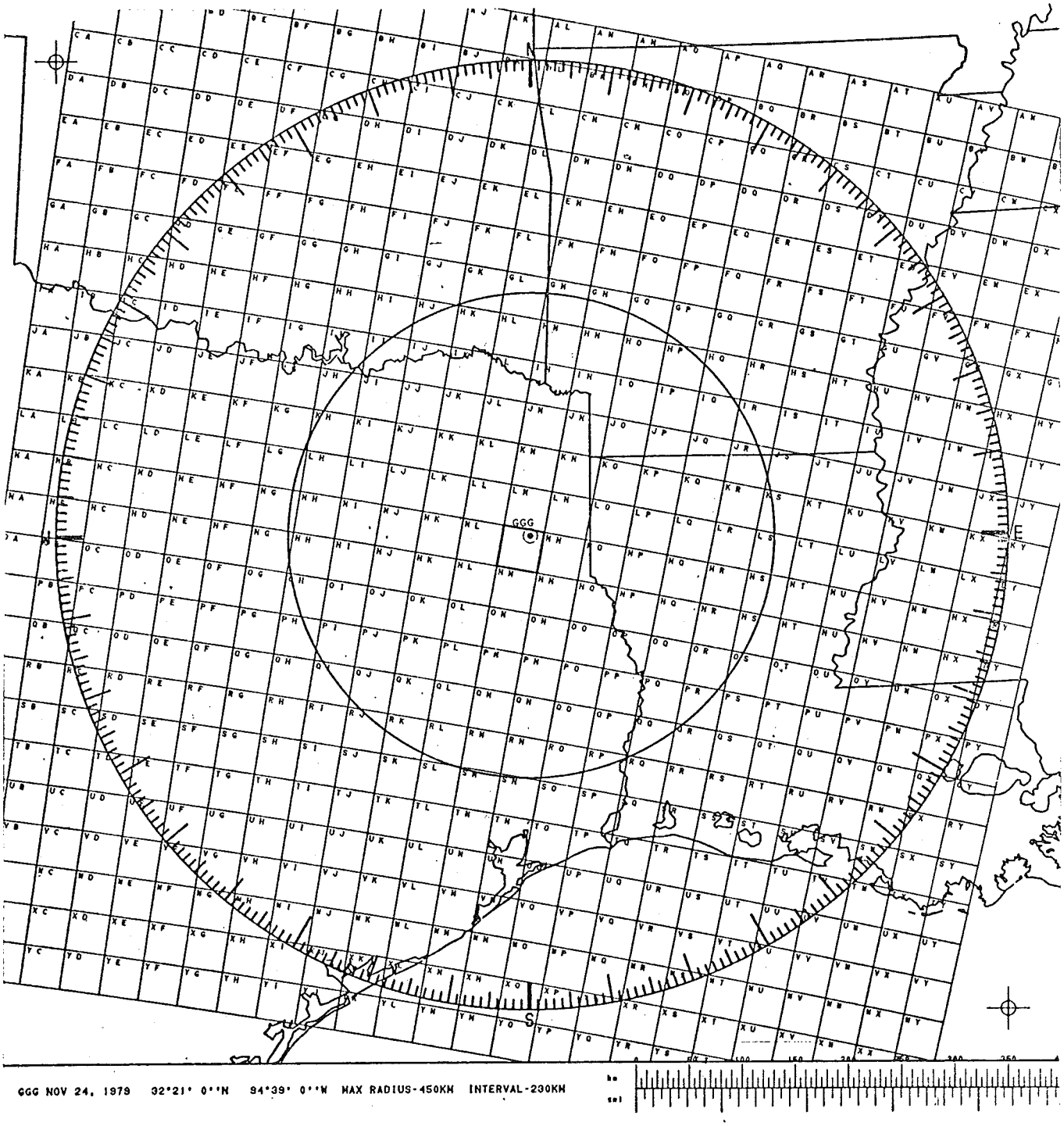

Figure 42.--450 kilometer radar code grid for Longview, Texas.

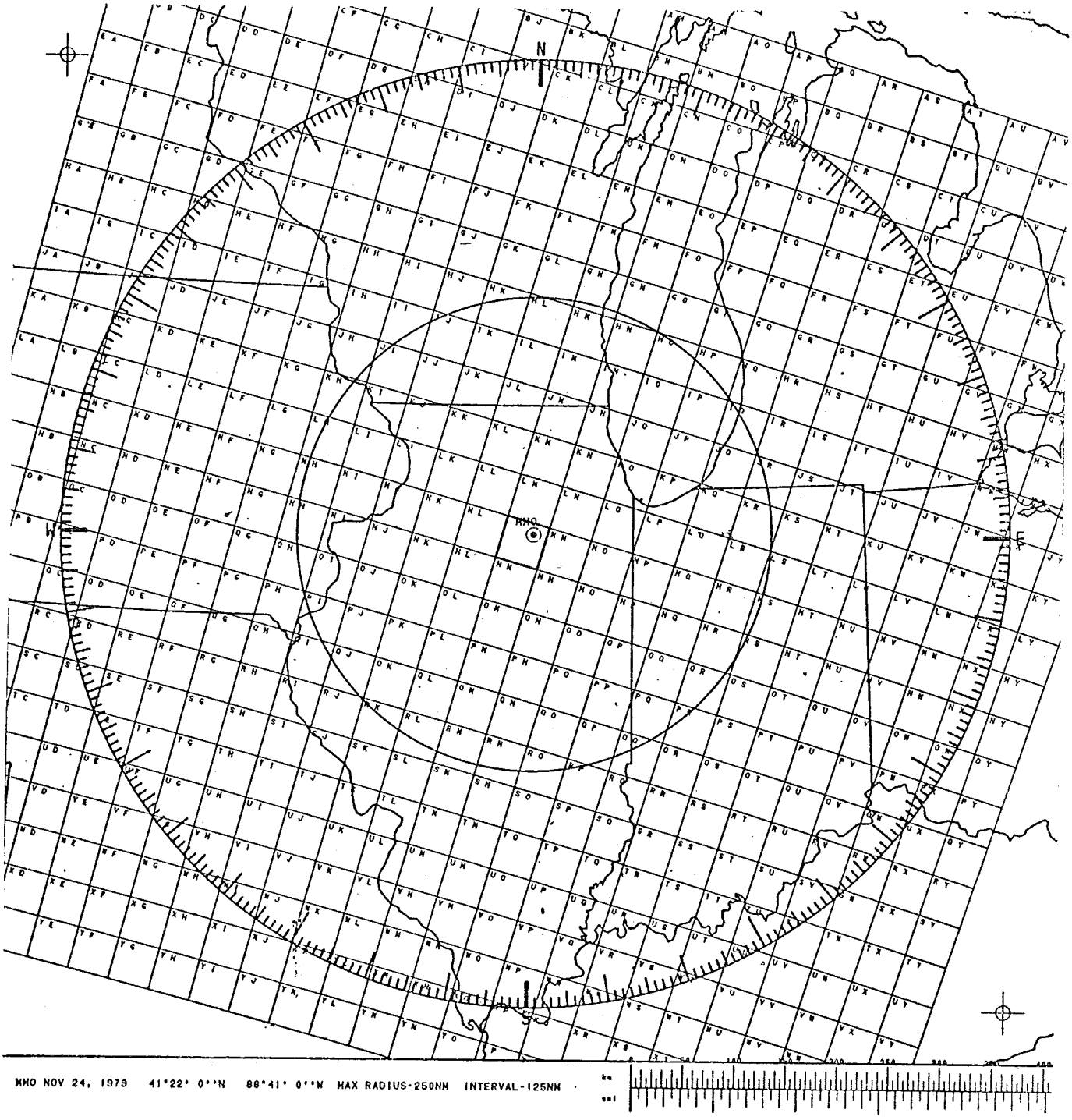

Figure 43.--250 nautical mile radar code grid for Marseilles, Ill.

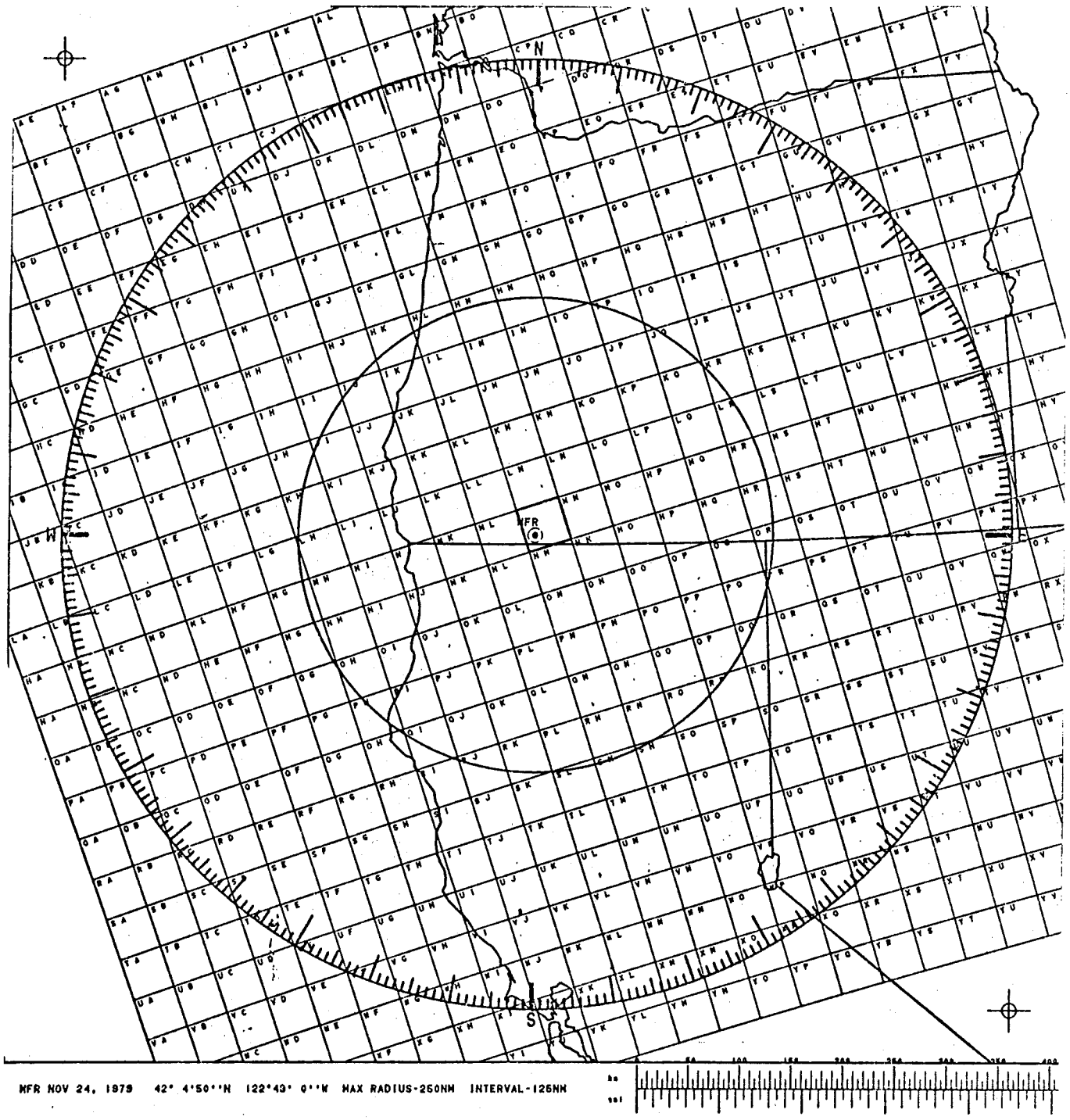

Figure 44.--250 nautical mile radar code grid for Medford, Oregon.

NQA
NOT VALID
STATION

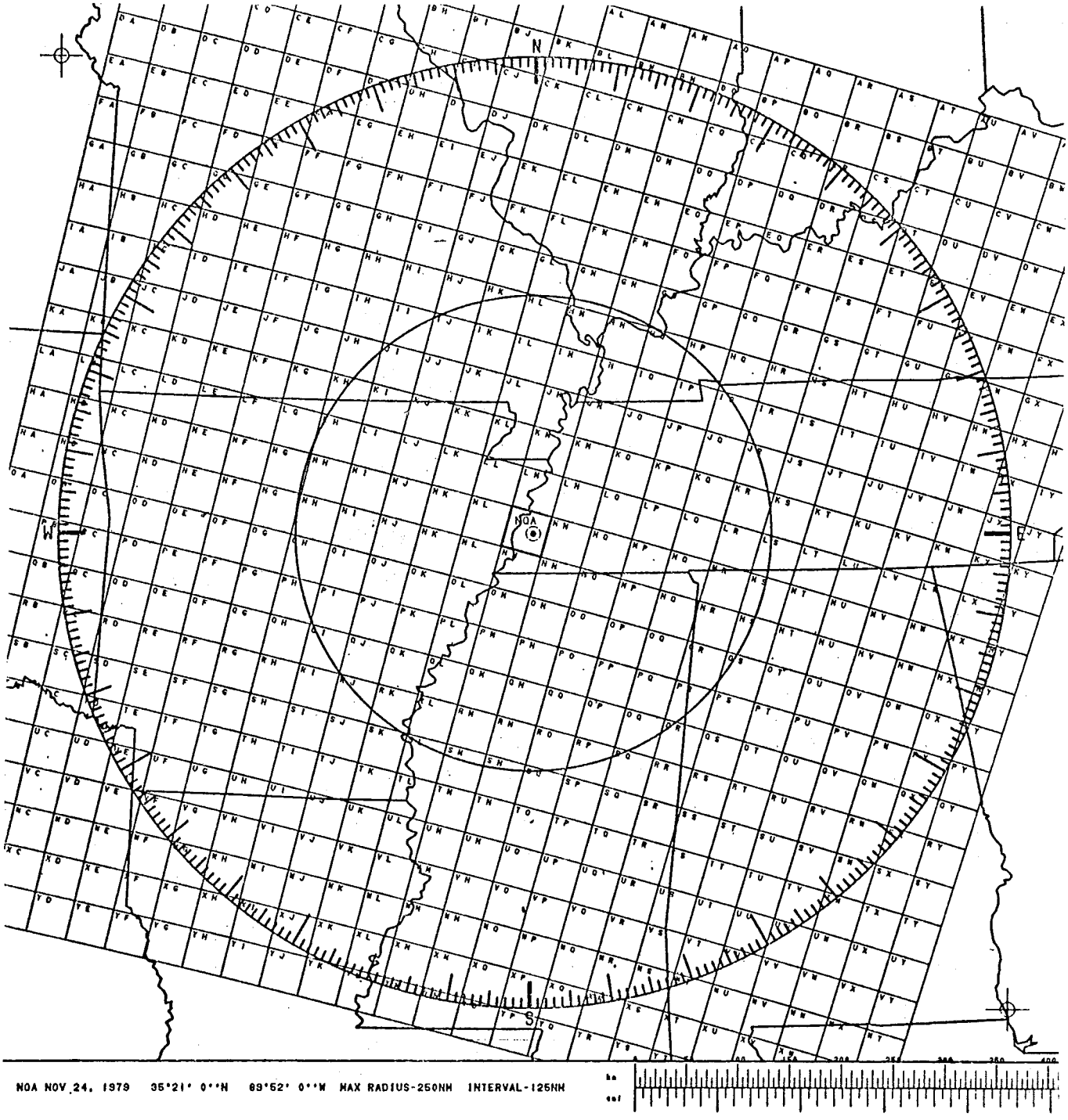

Figure 45.--250 nautical mile radar code grid for Memphis, Tenn.

MIA
WSR-88

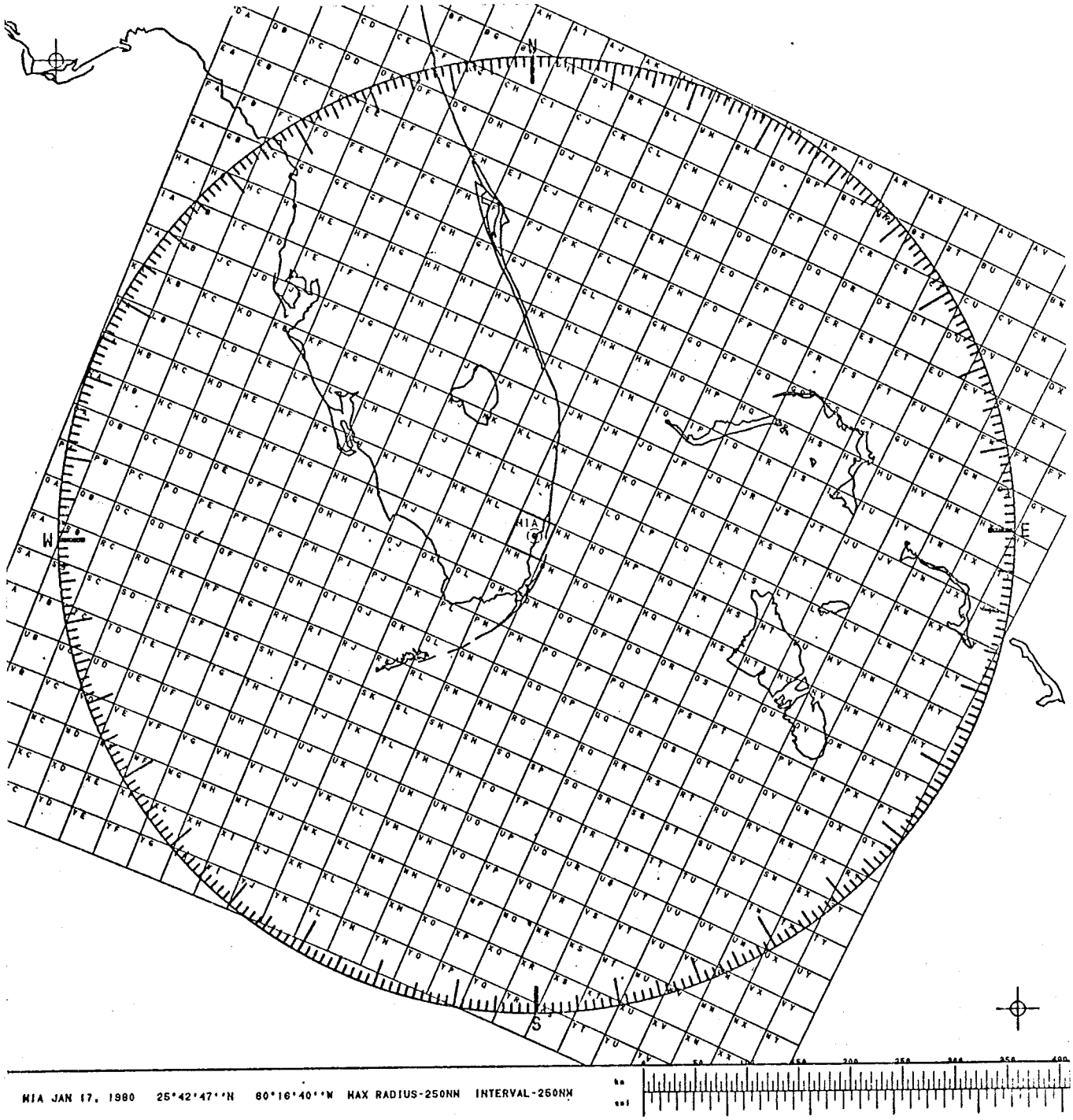

Figure 46.--250 nautical mile radar code grid for Miami, Florida.

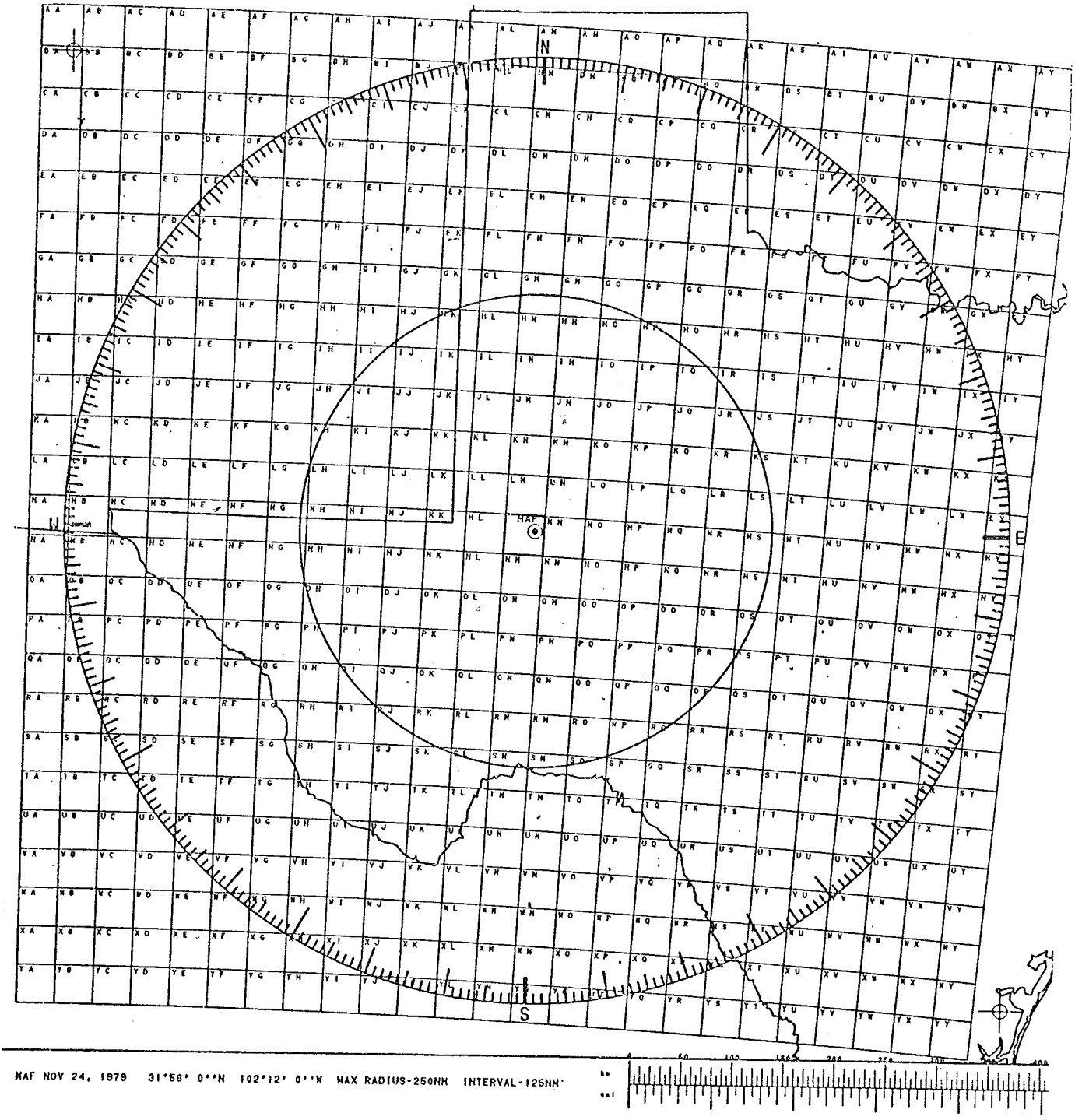

Figure 47.--250 nautical mile radar code grid for Midland, Texas.

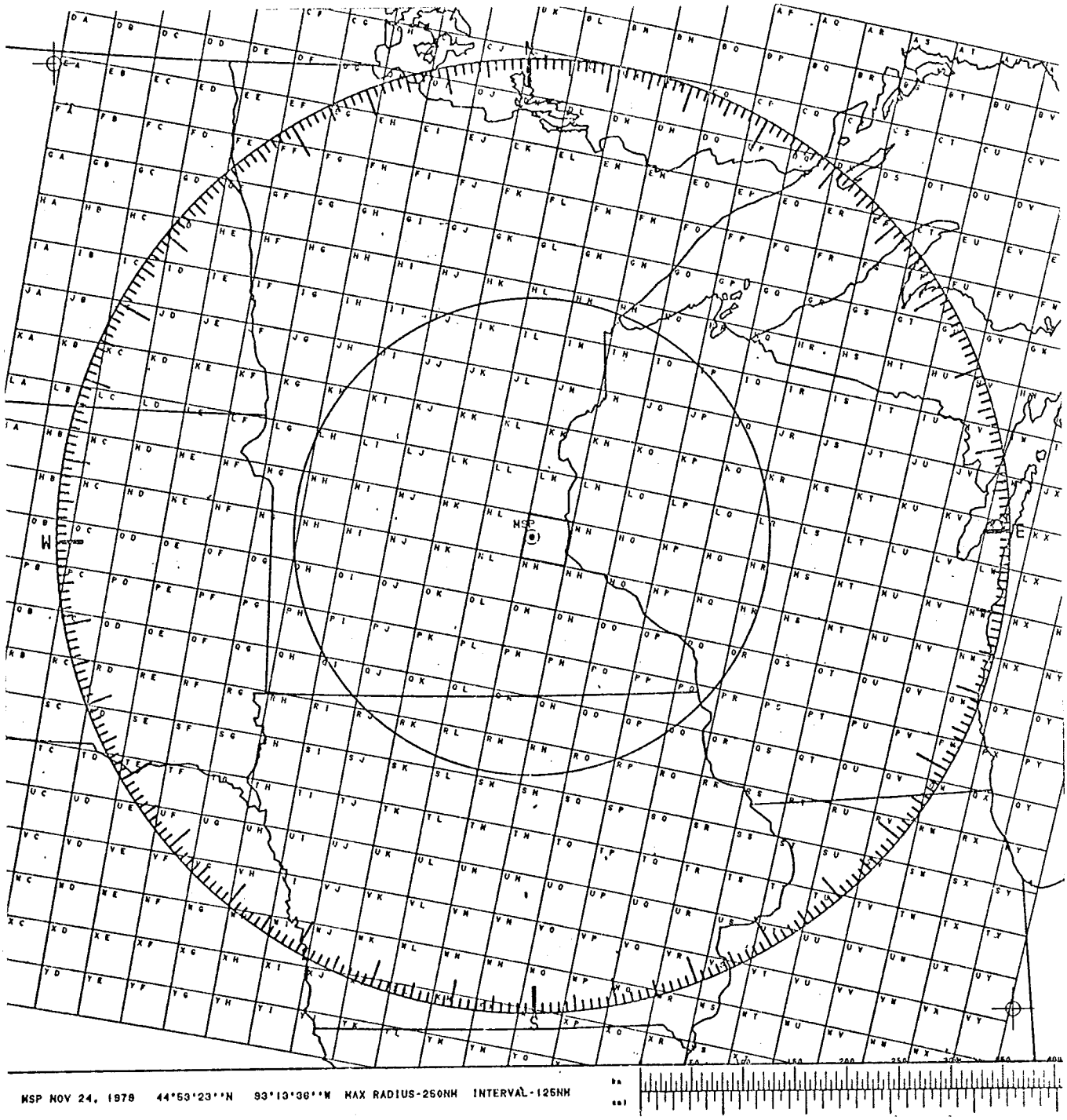

Figure 48.--250 nautical mile radar code grid for Minneapolis, Minn.

MSO

WSR-88

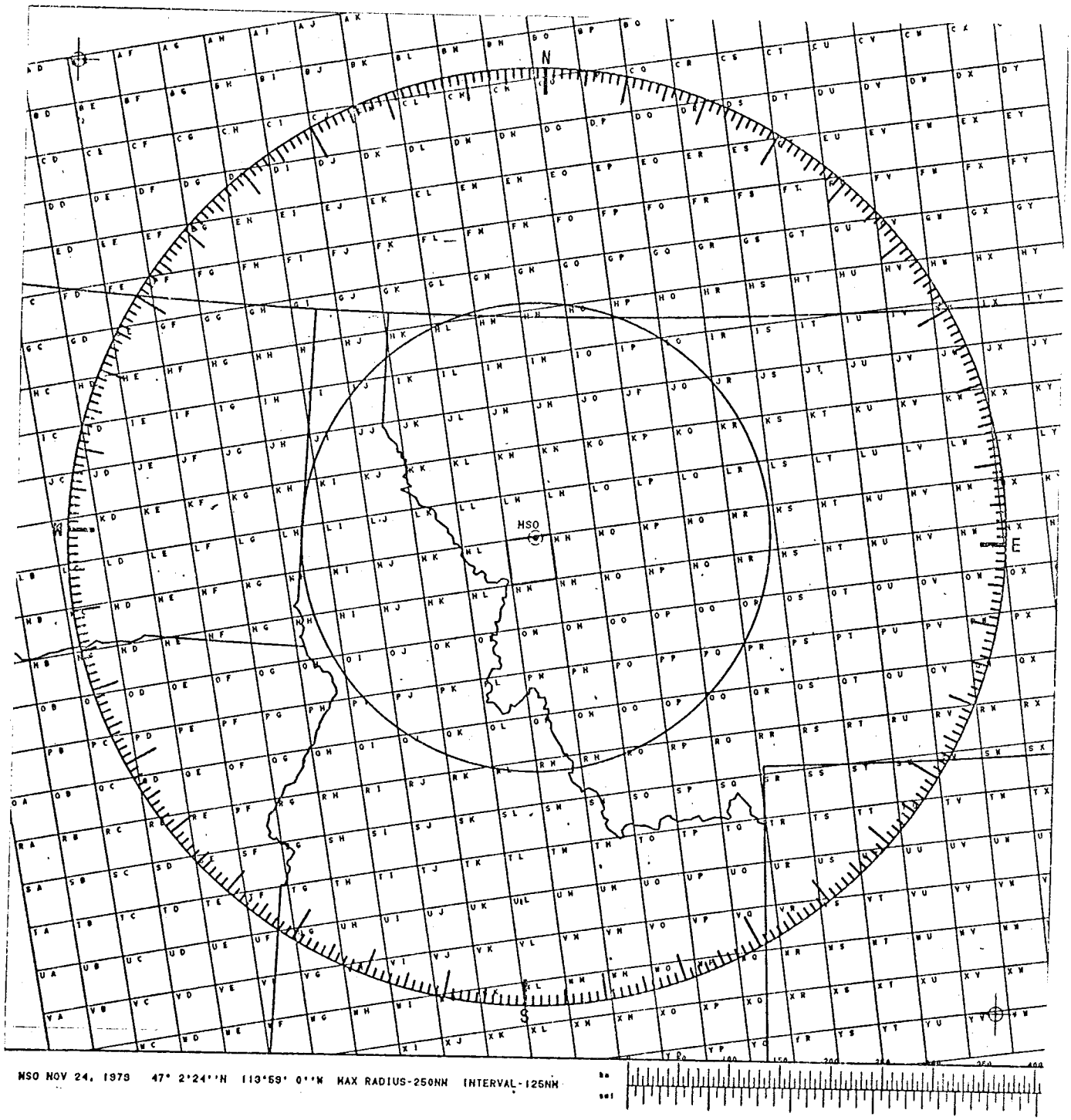

Figure 49.--250 nautical mile radar code grid for Missoula, Mont.

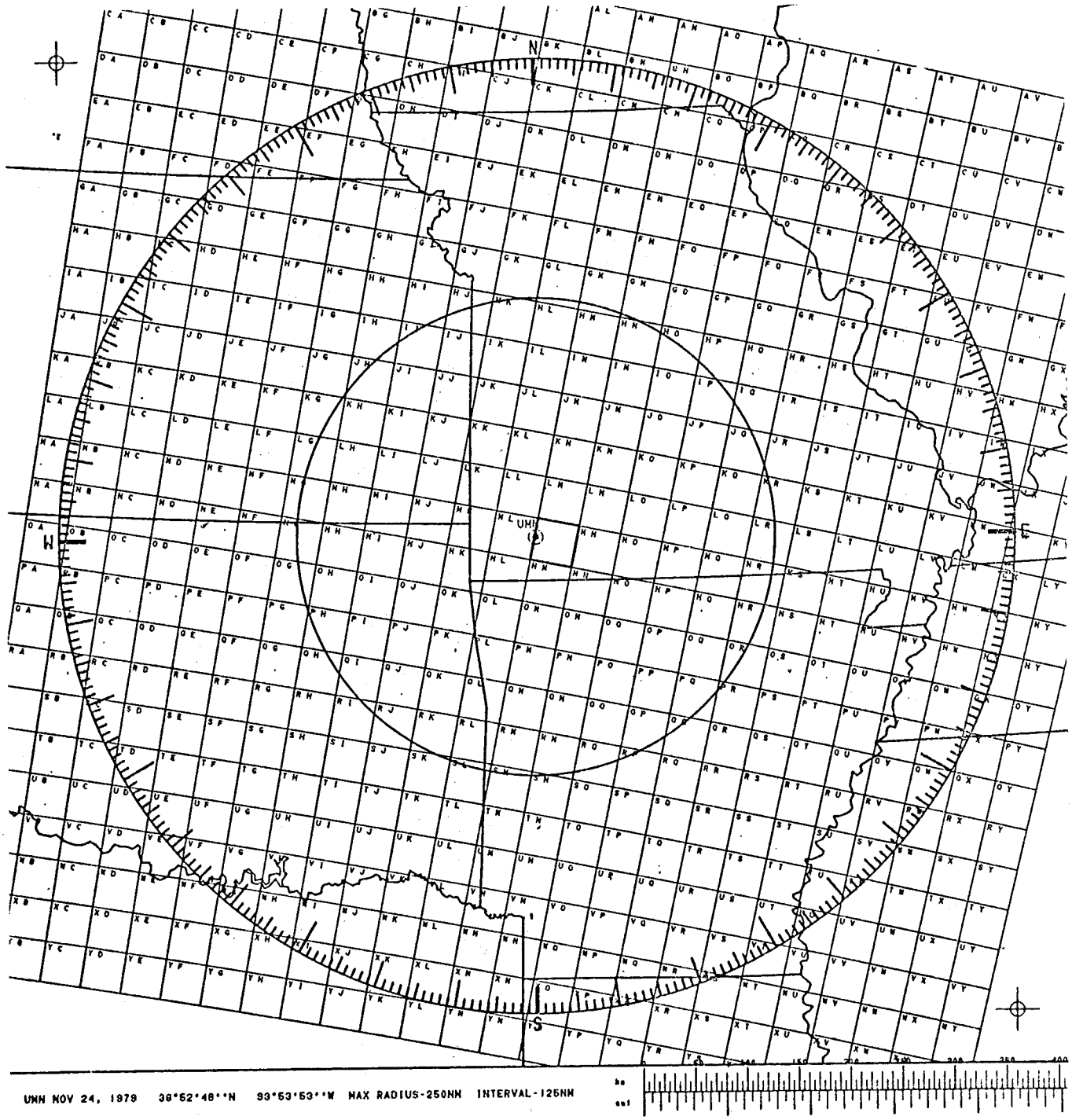

Figure 50.--250 nautical mile radar code grid for Monett, Mo.

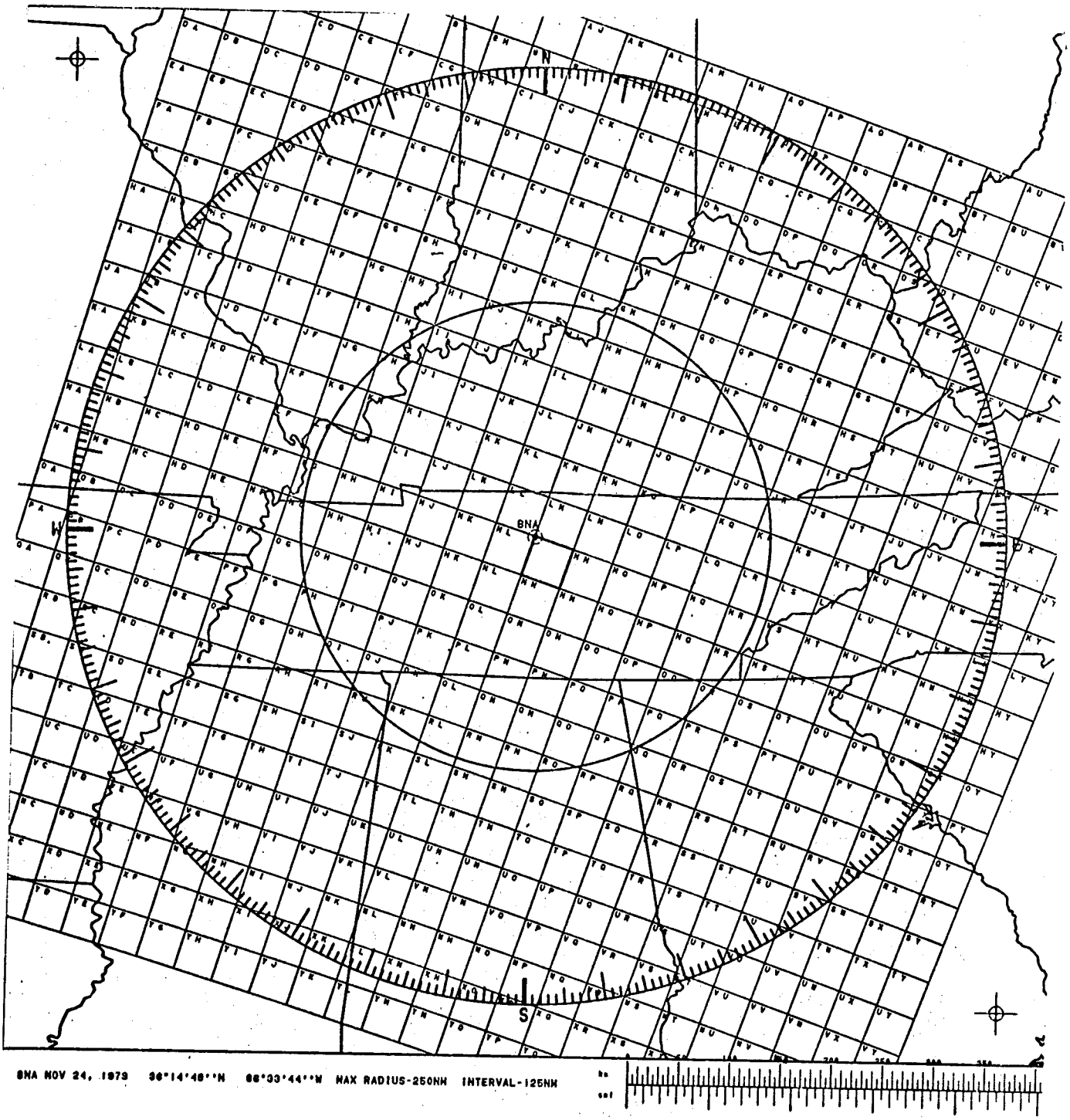

Figure 51.--250 nautical mile radar code grid for Nashville, Tenn.

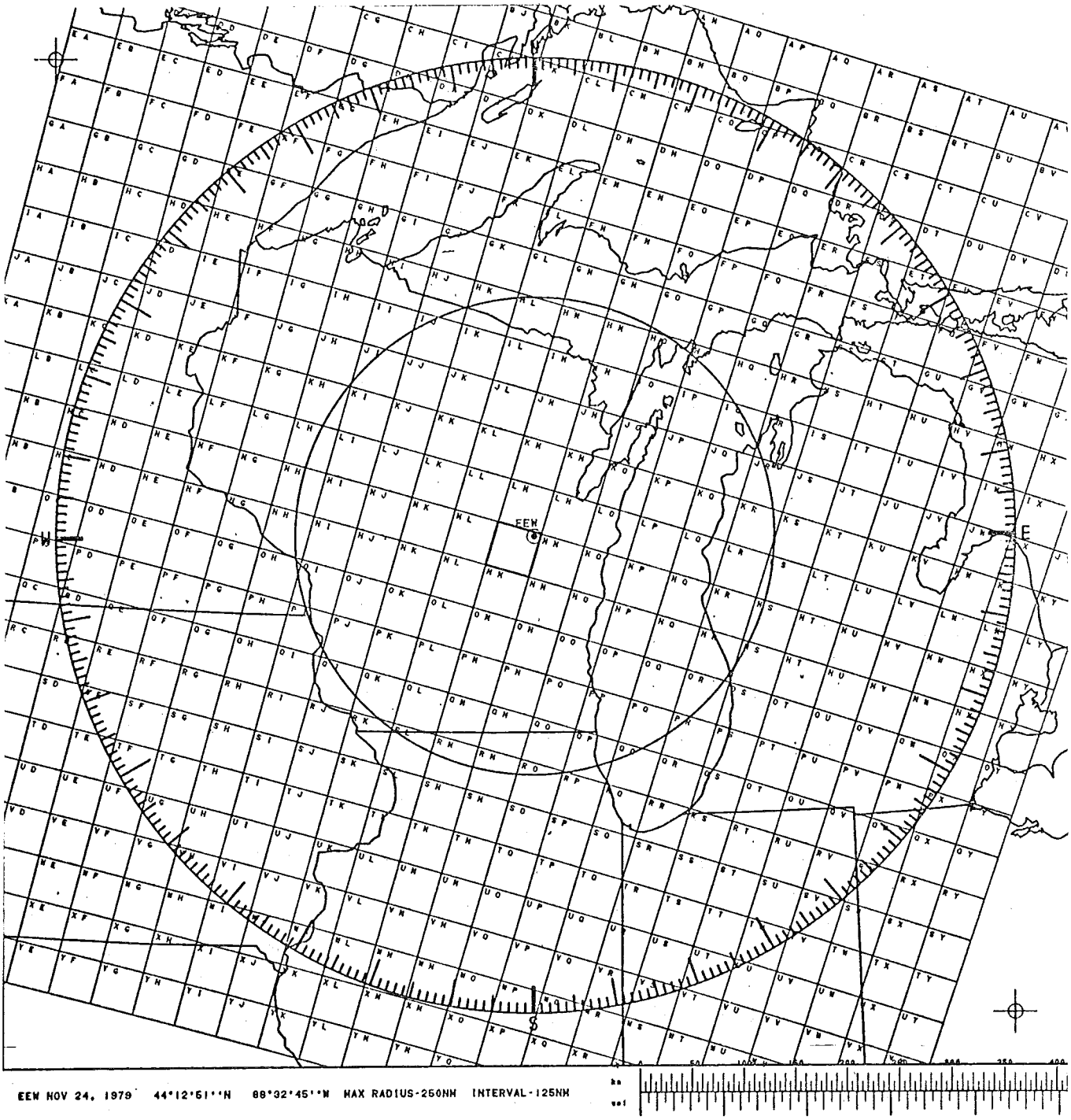

Figure 52.--250 nautical mile radar code grid for Neenah, Wis.

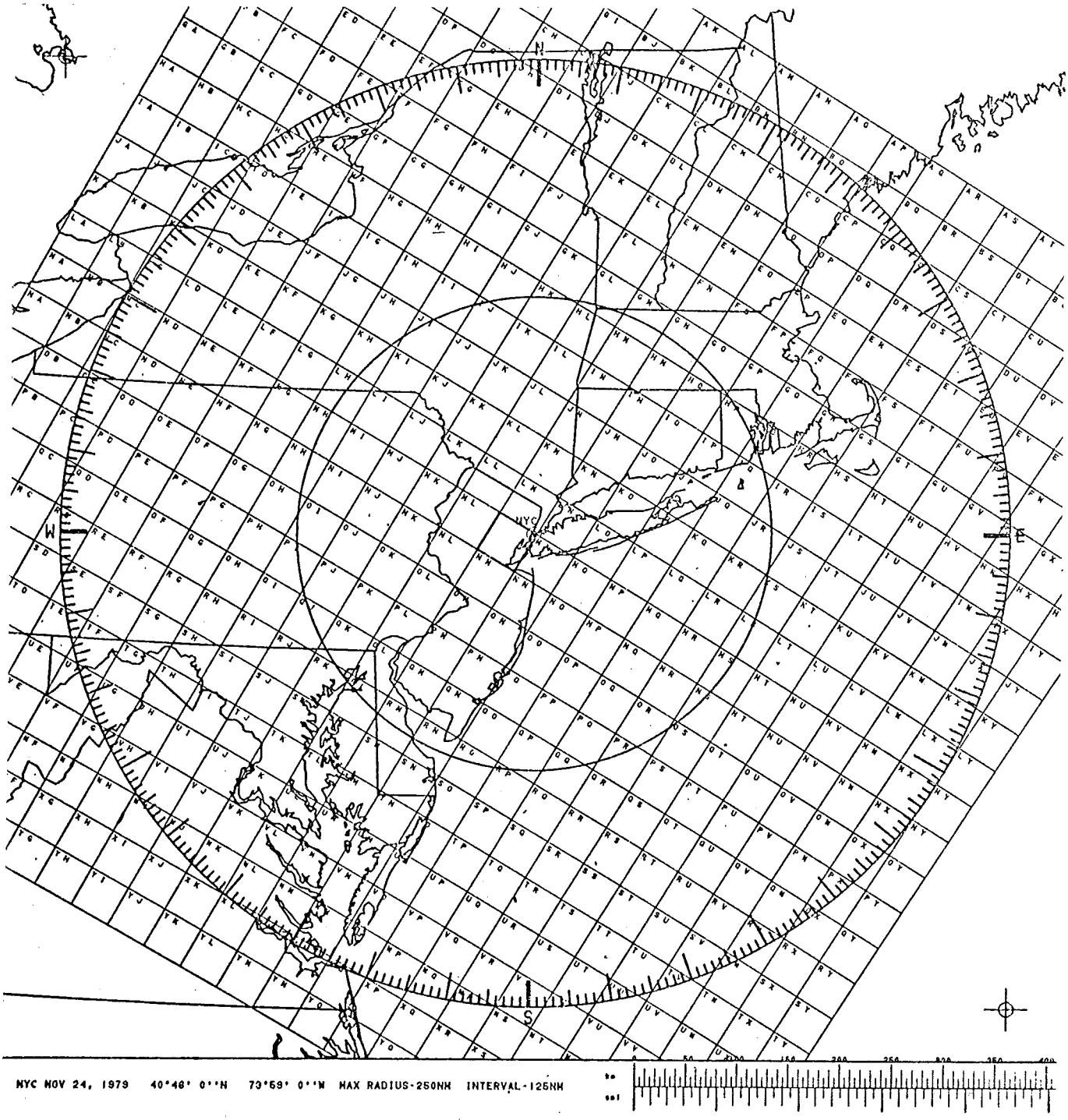

Figure 53.--250 nautical mile radar code grid for New York City, N.Y.

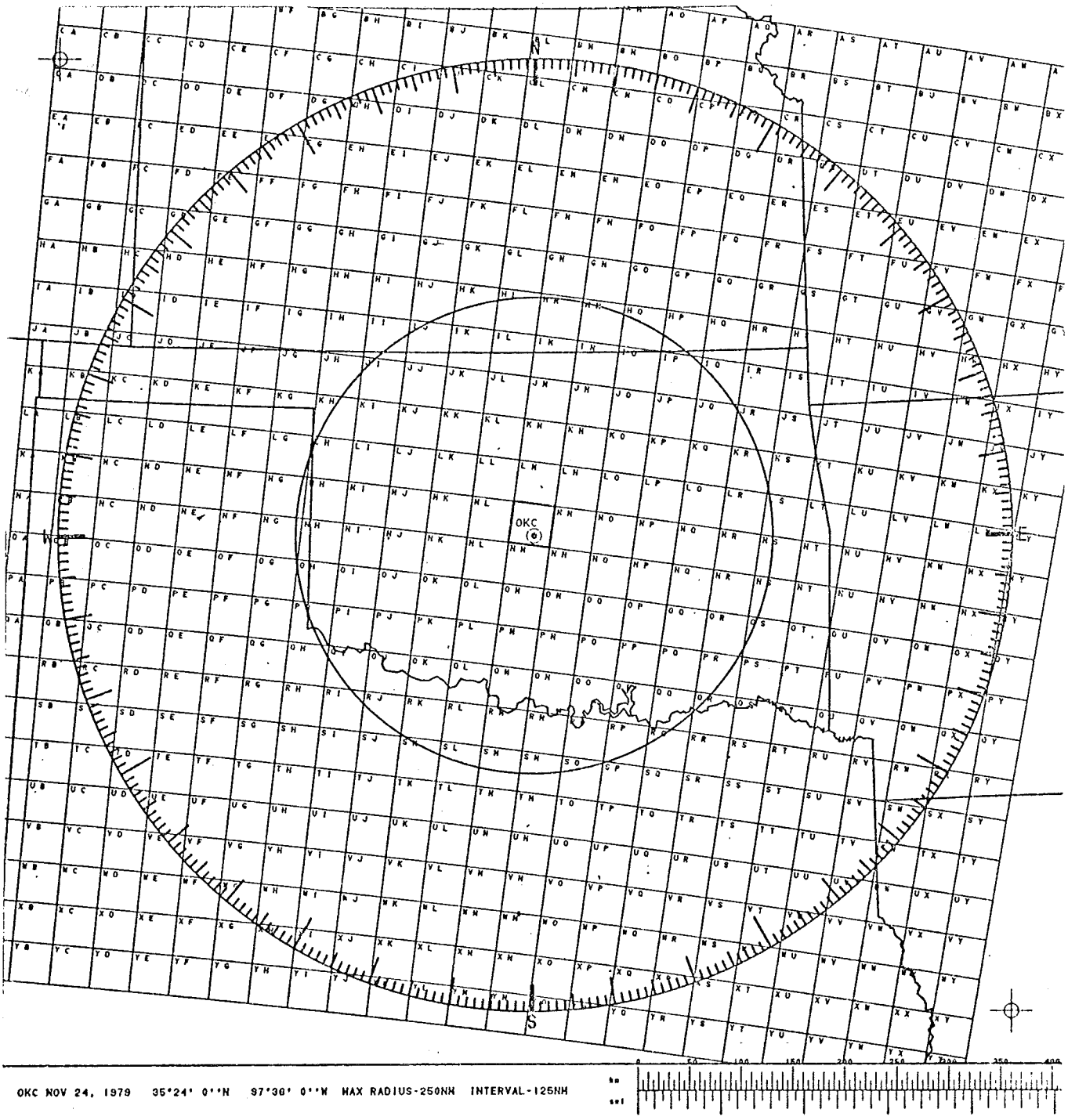

Figure 54.--250 nautical mile radar code grid for Oklahoma City, Okla.

NHK
WSR-74
wrong grid

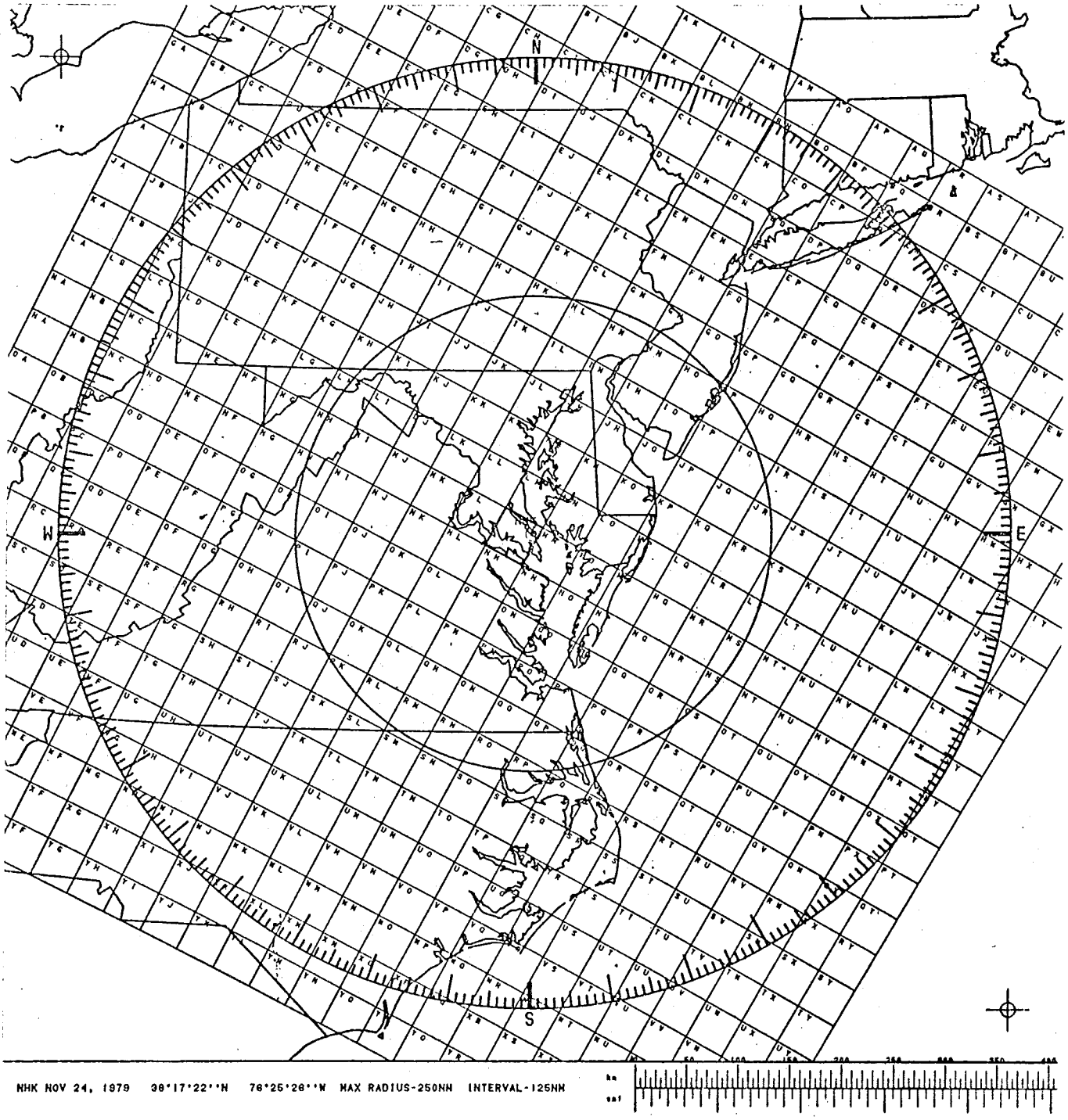

Figure 55.--250 nautical mile radar code grid for Patuxent River, Md.

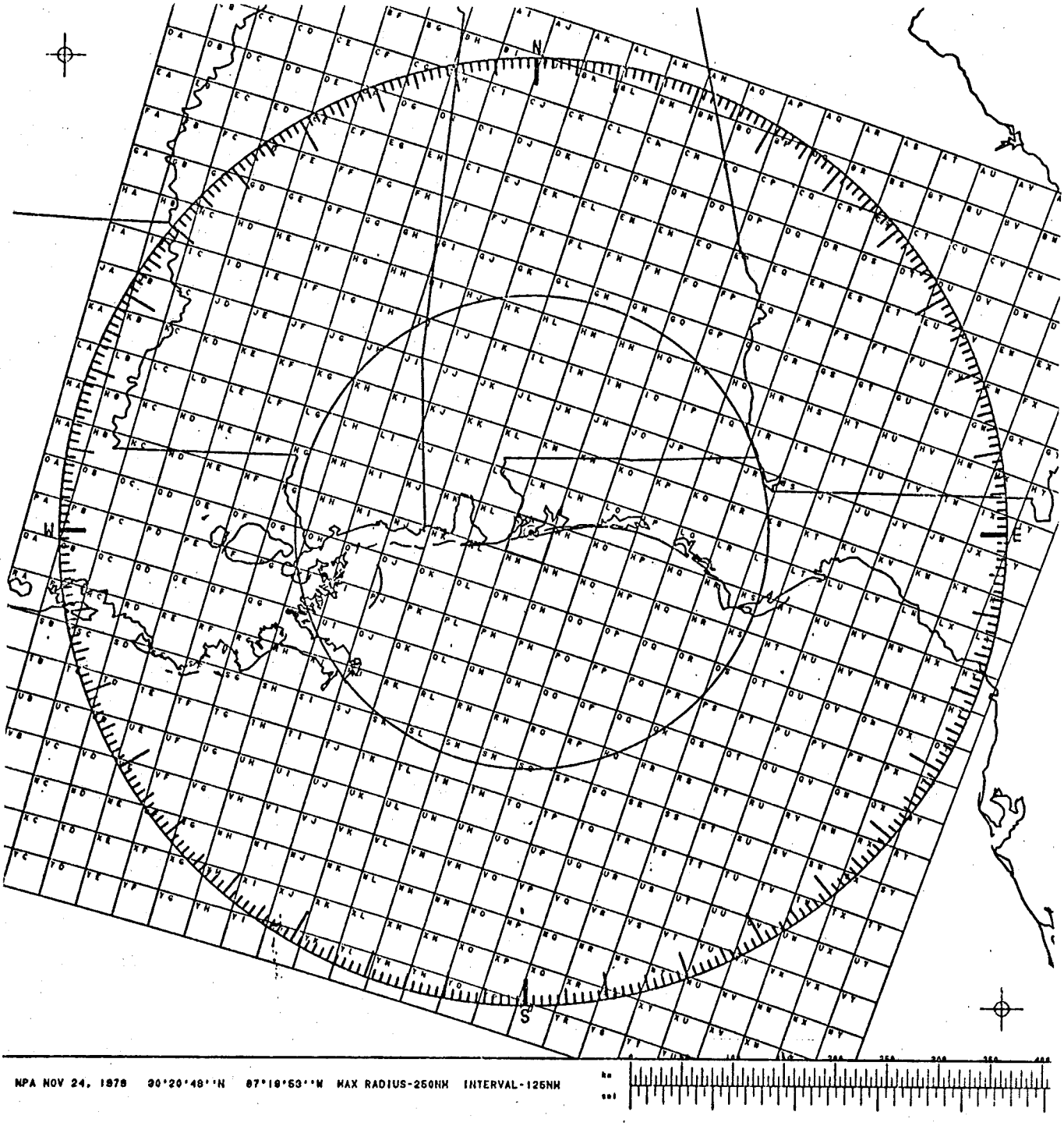

Figure 56.--250 nautical mile radar code grid for Pensacola, Fla.

PIT
WSR-88

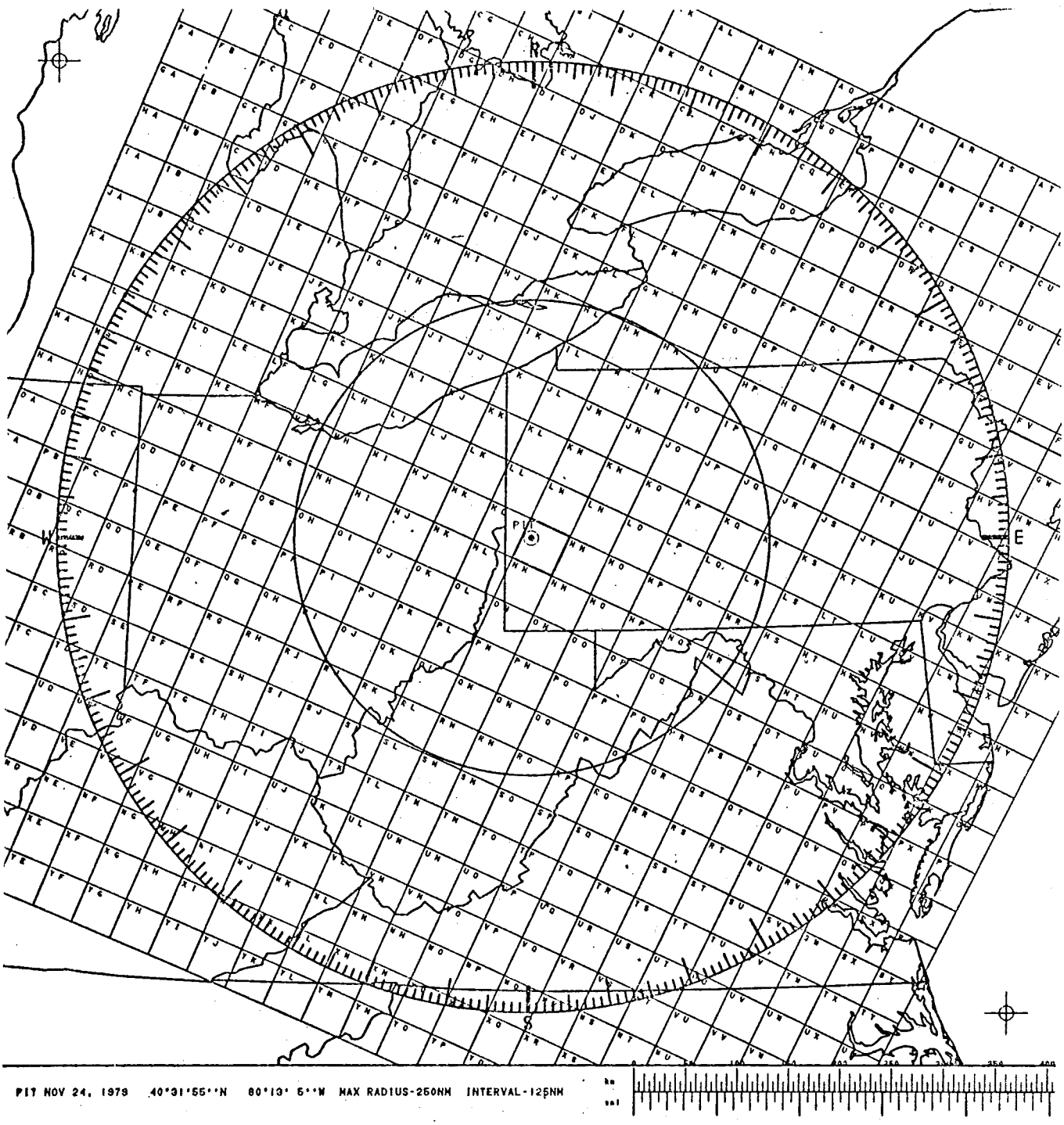

Figure 57.--250 nautical mile radar code grid for Pittsburgh, Pa.

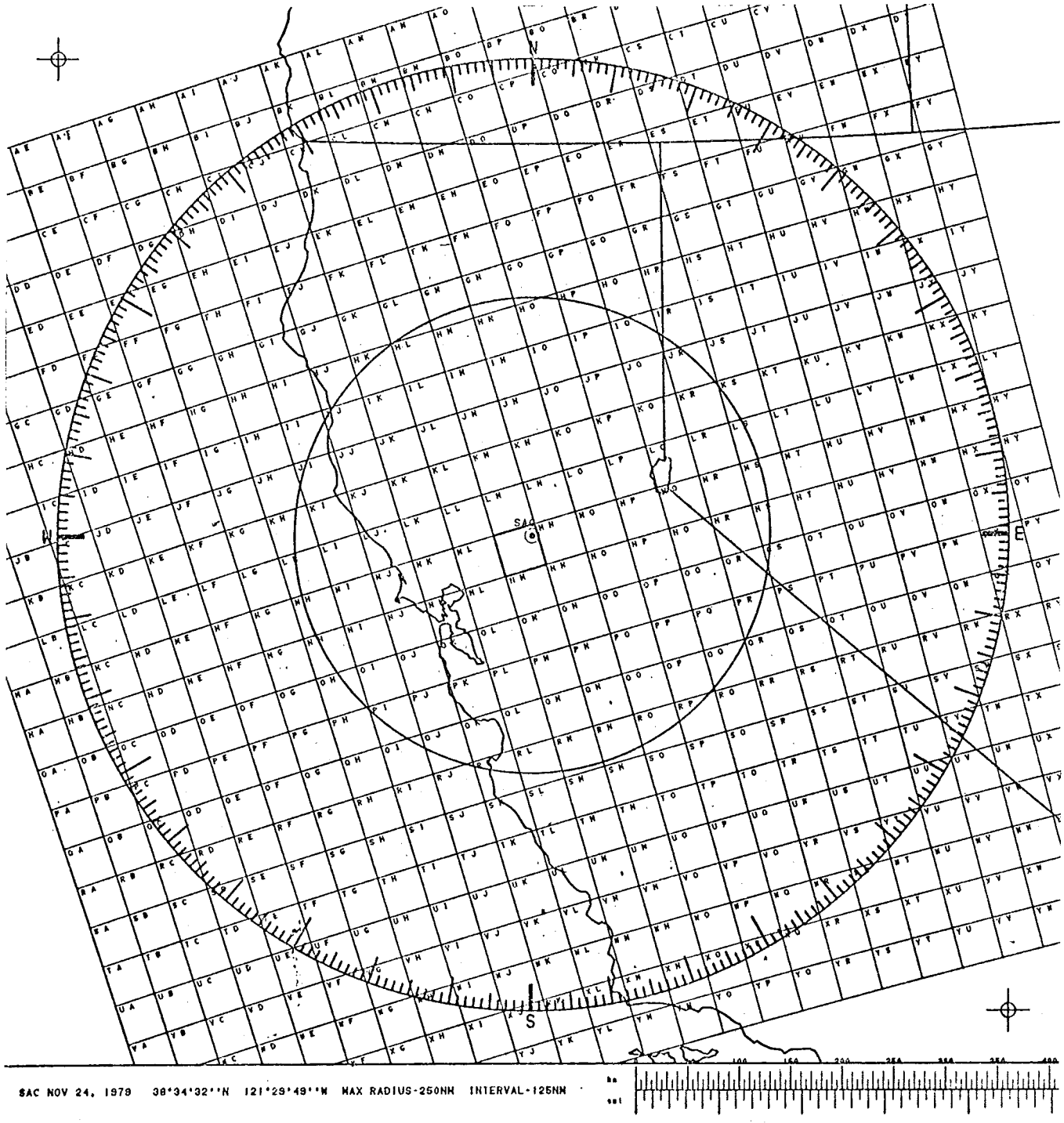

Figure 58.--250 nautical mile radar code grid for Sacramento, Calif.

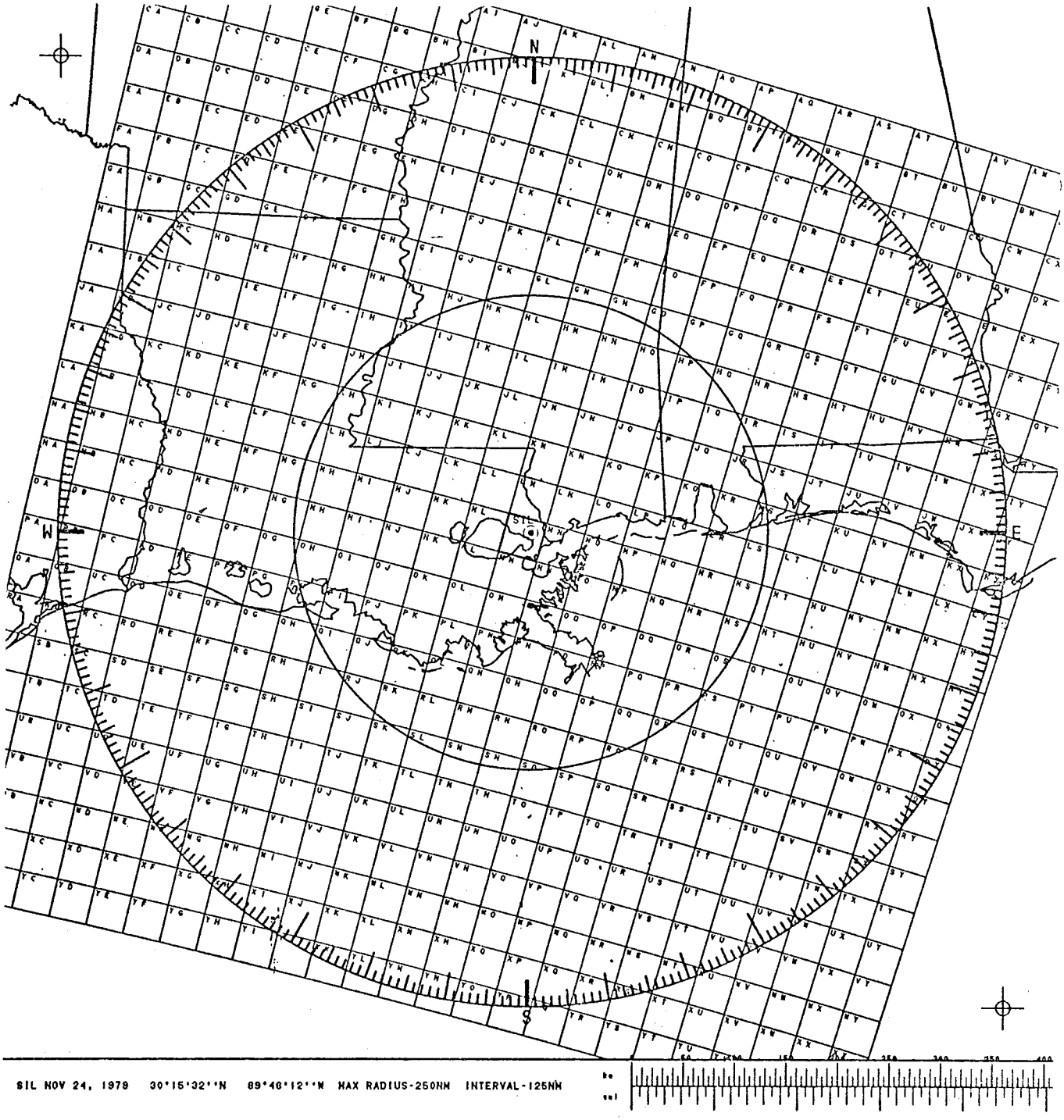

Figure 59.--250 nautical mile radar code grid for Slidell, La.

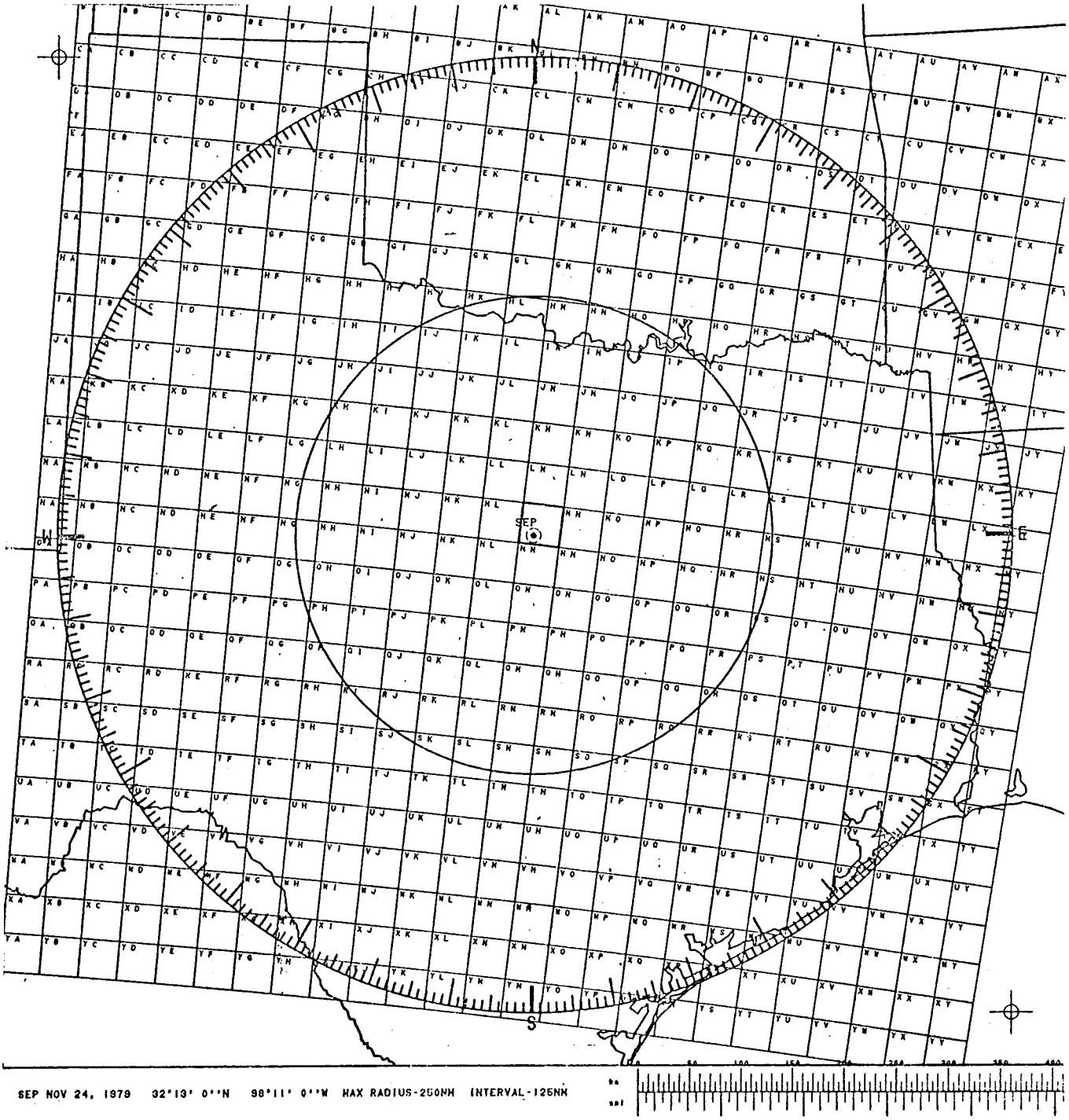

Figure 60.--250 nautical mile radar code grid for Stephenville, Tex.

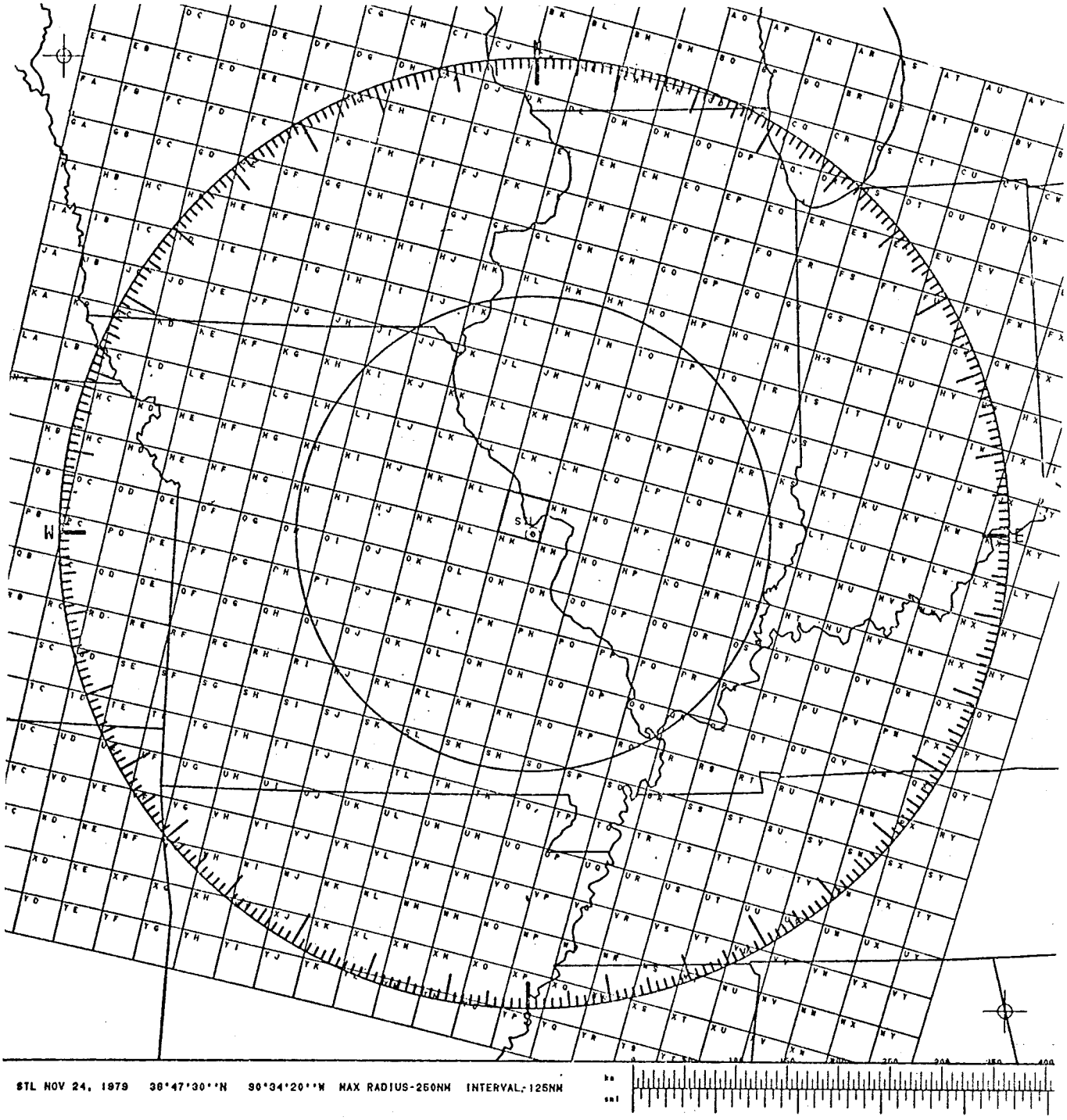

Figure 61..--250 nautical mile radar code grid for St. Louis, Mo.

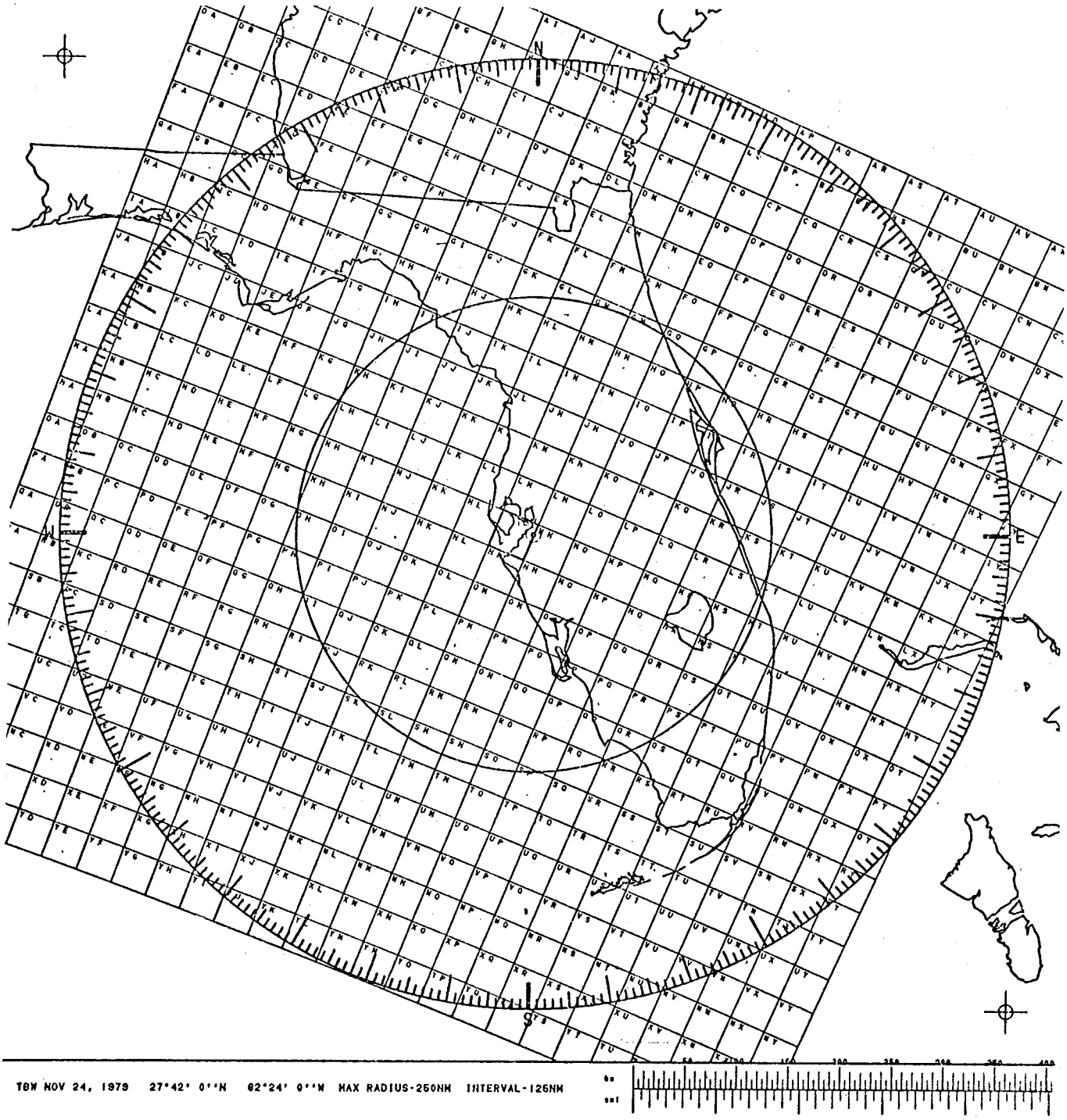

Figure 62.--250 nautical mile radar code grid for Tampa, Florida.

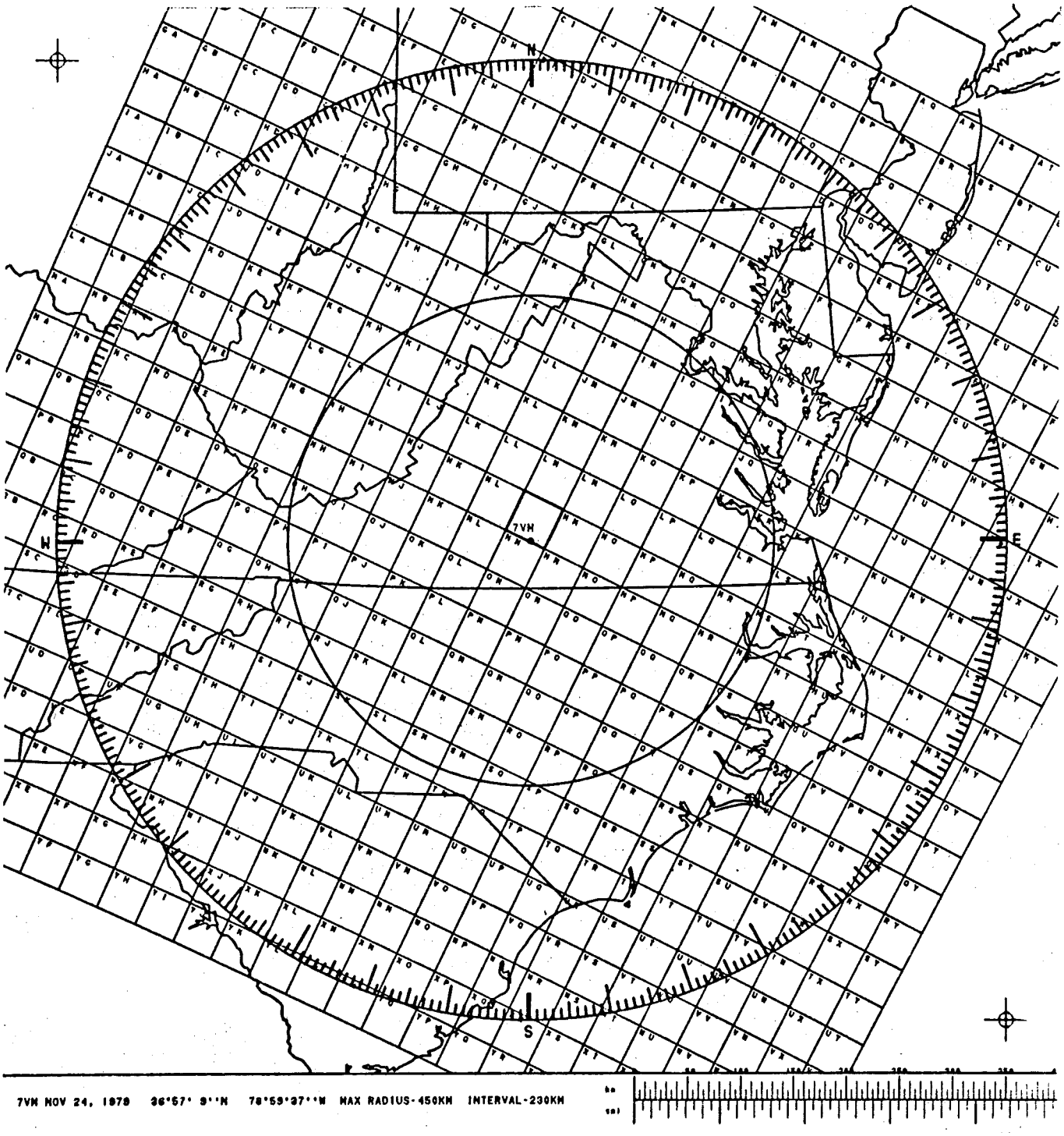

Figure 63.--450 kilometer radar code grid for Volens, Virginia.

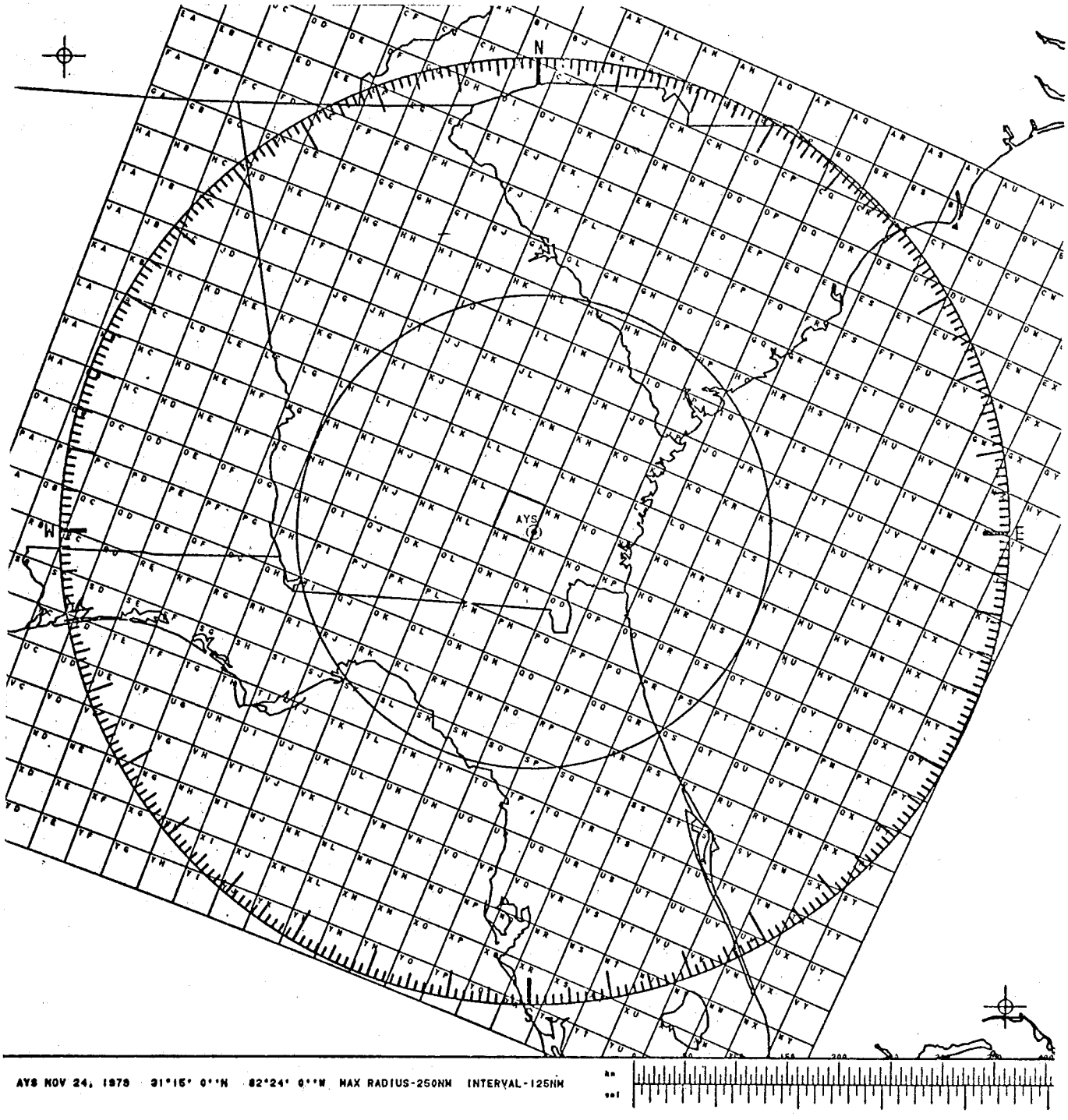

Figure 64.--250 nautical mile radar code grid for Waycross, Ga.

ICT
WSR-88

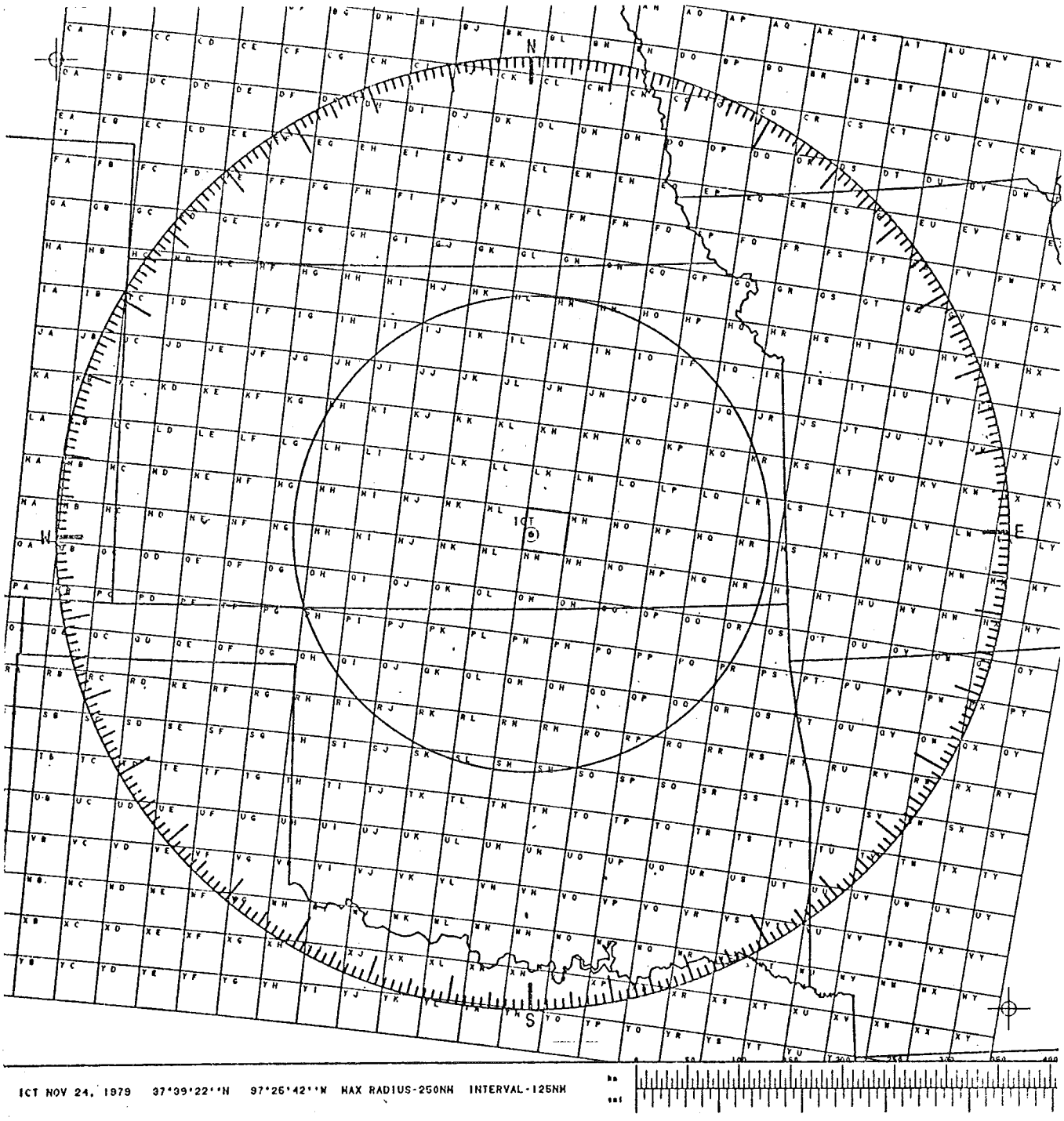

Figure 65.--250 nautical mile radar code grid for Wichita, Kansas.

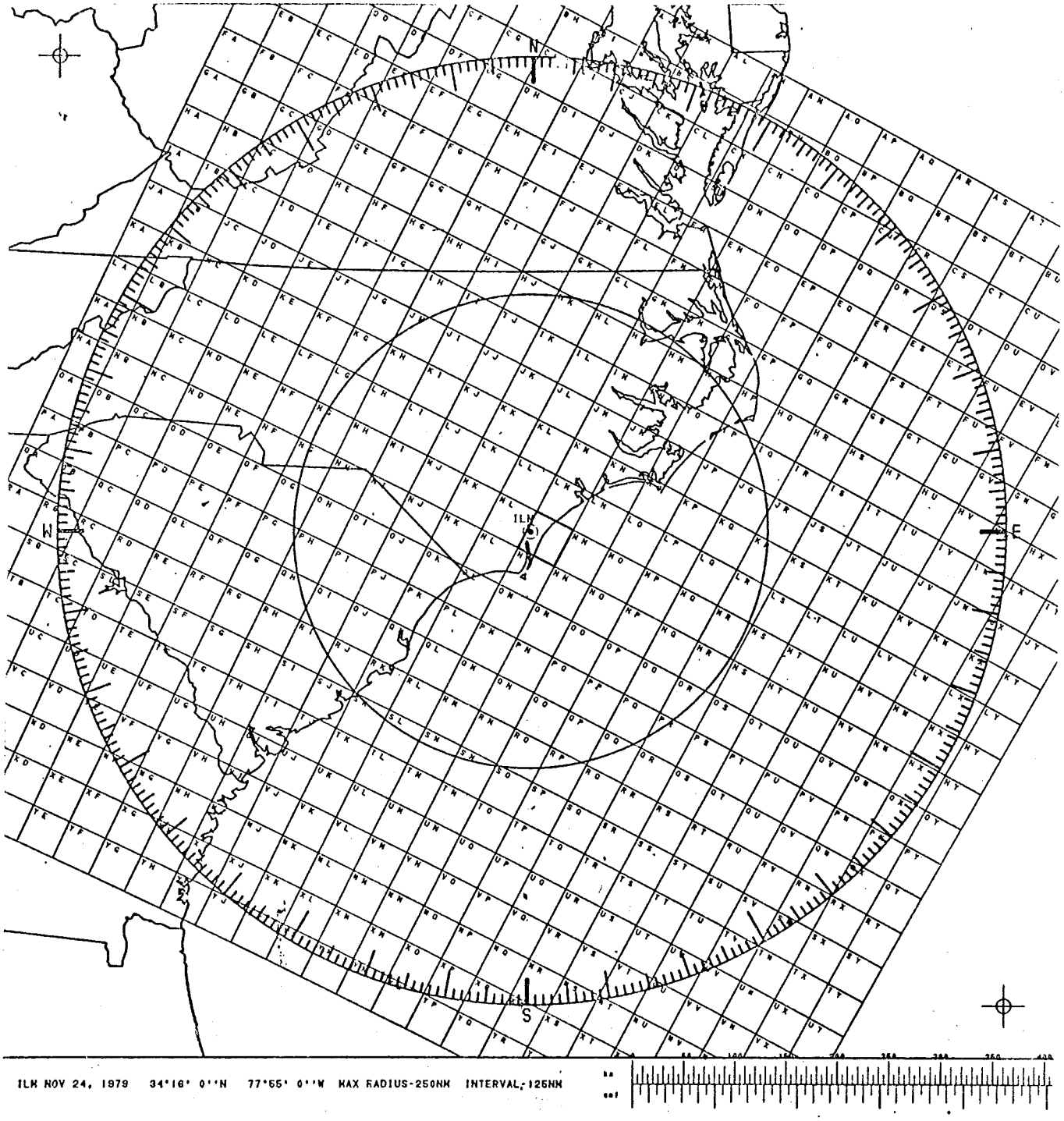

Figure 66.--250 nautical mile radar code grid for Wilmington, N.C.

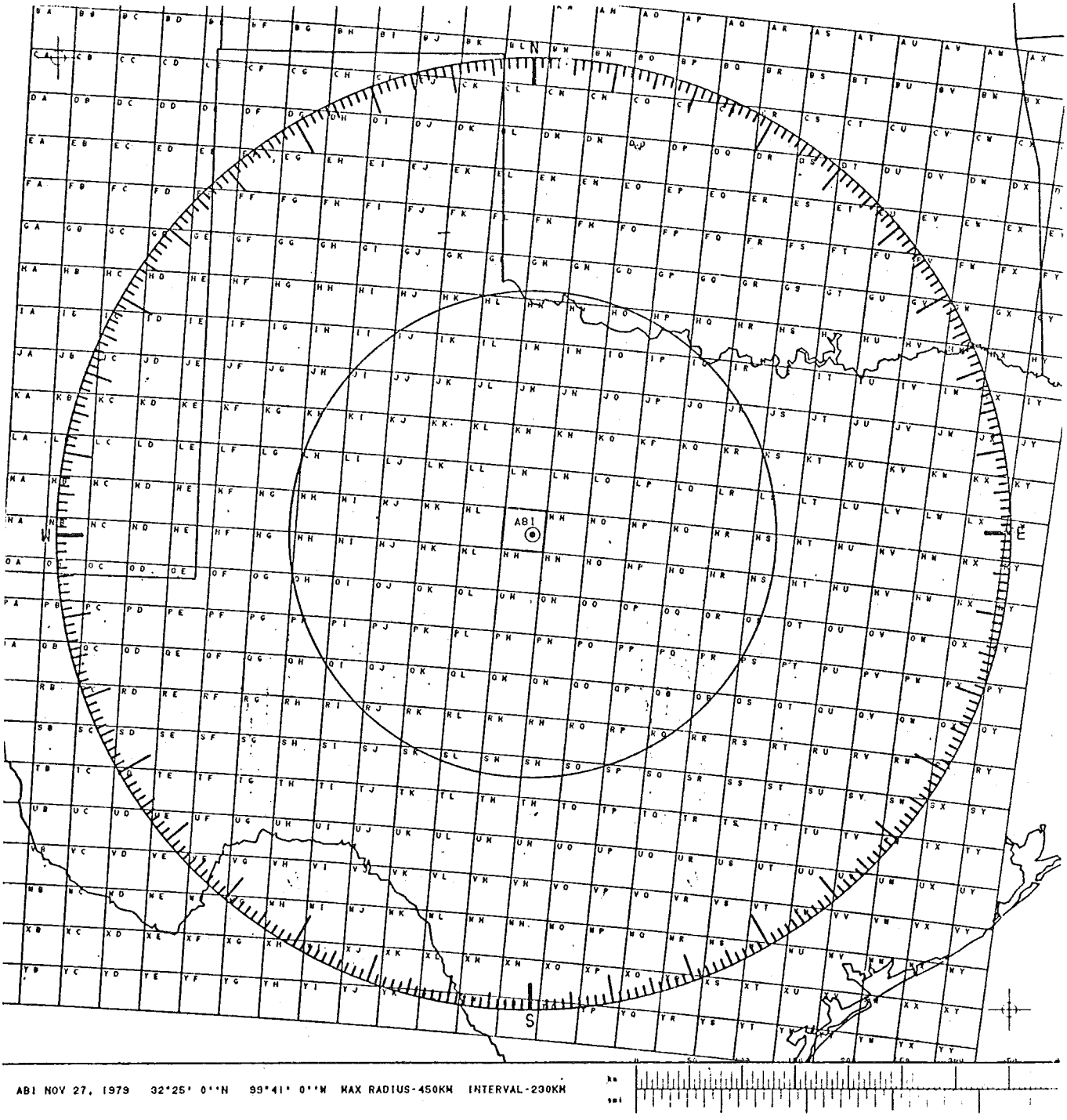

Figure 67.--450 kilometer radar code grid for Abilene, Texas.

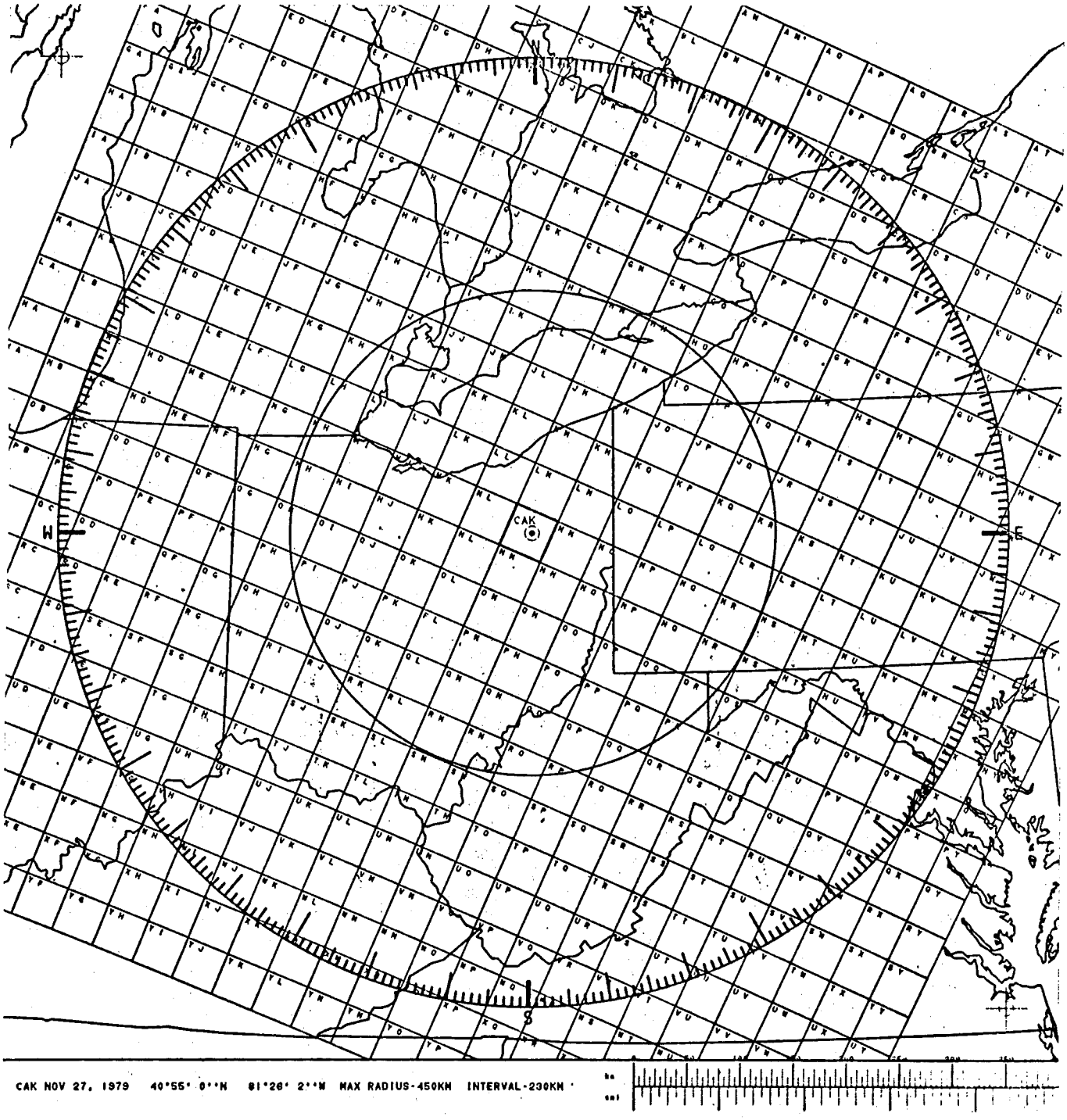

Figure 68.--450 kilometer radar code grid for Akron, Ohio.

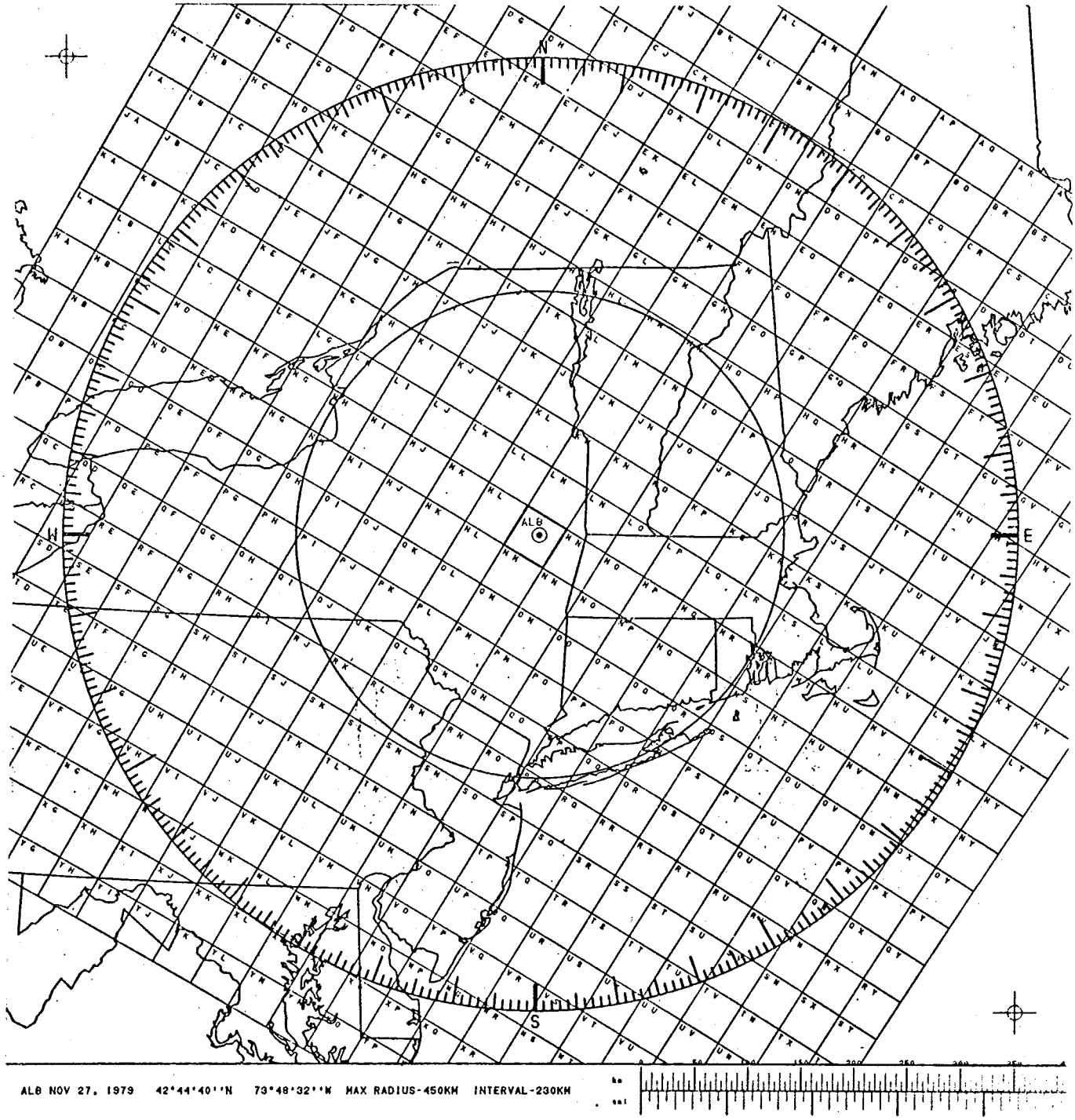

Figure 69.--450 kilometer radar code grid for Albany, New York.

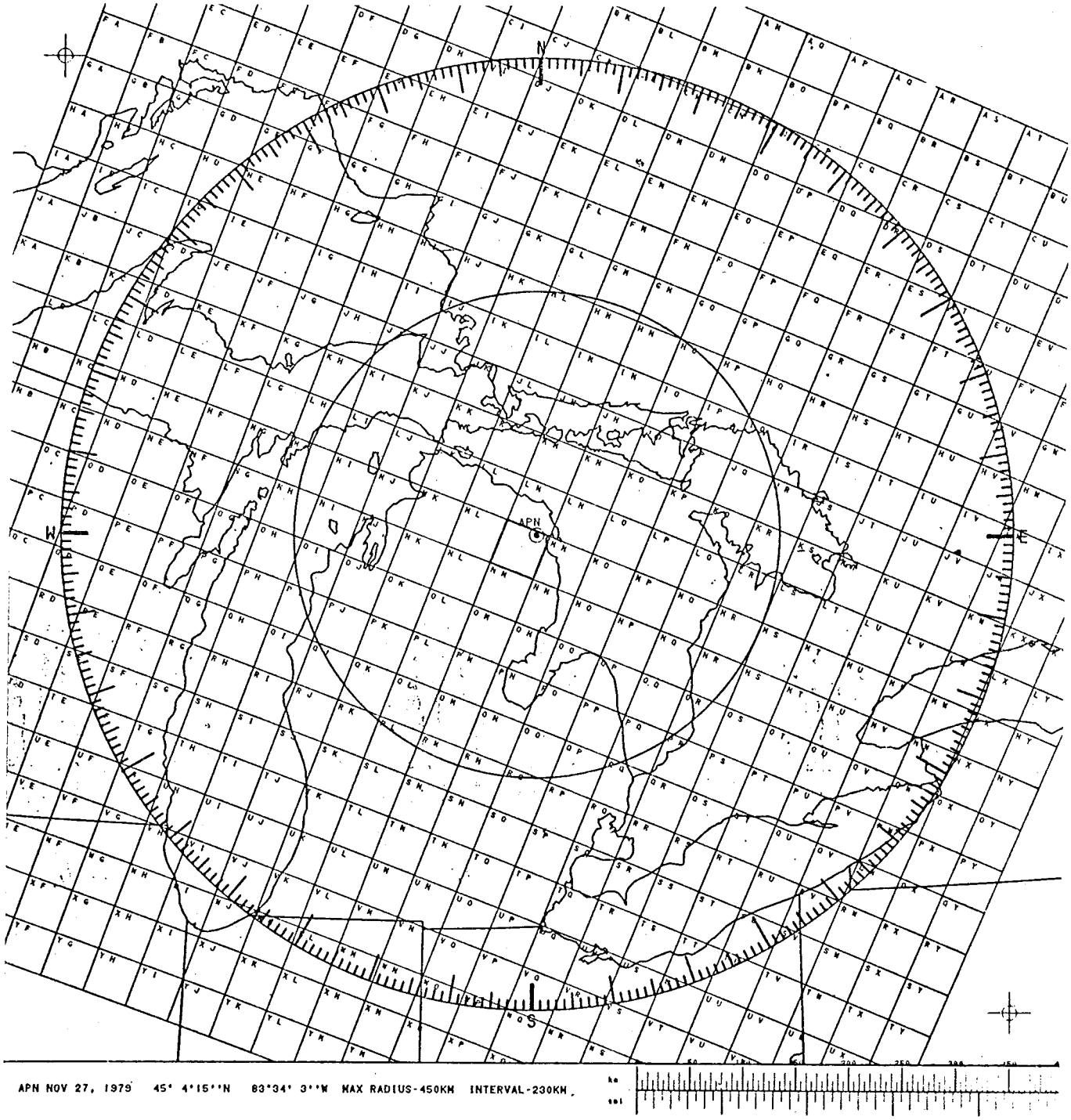

Figure 70.--450 kilometer radar code grid for Alpena, Michigan.

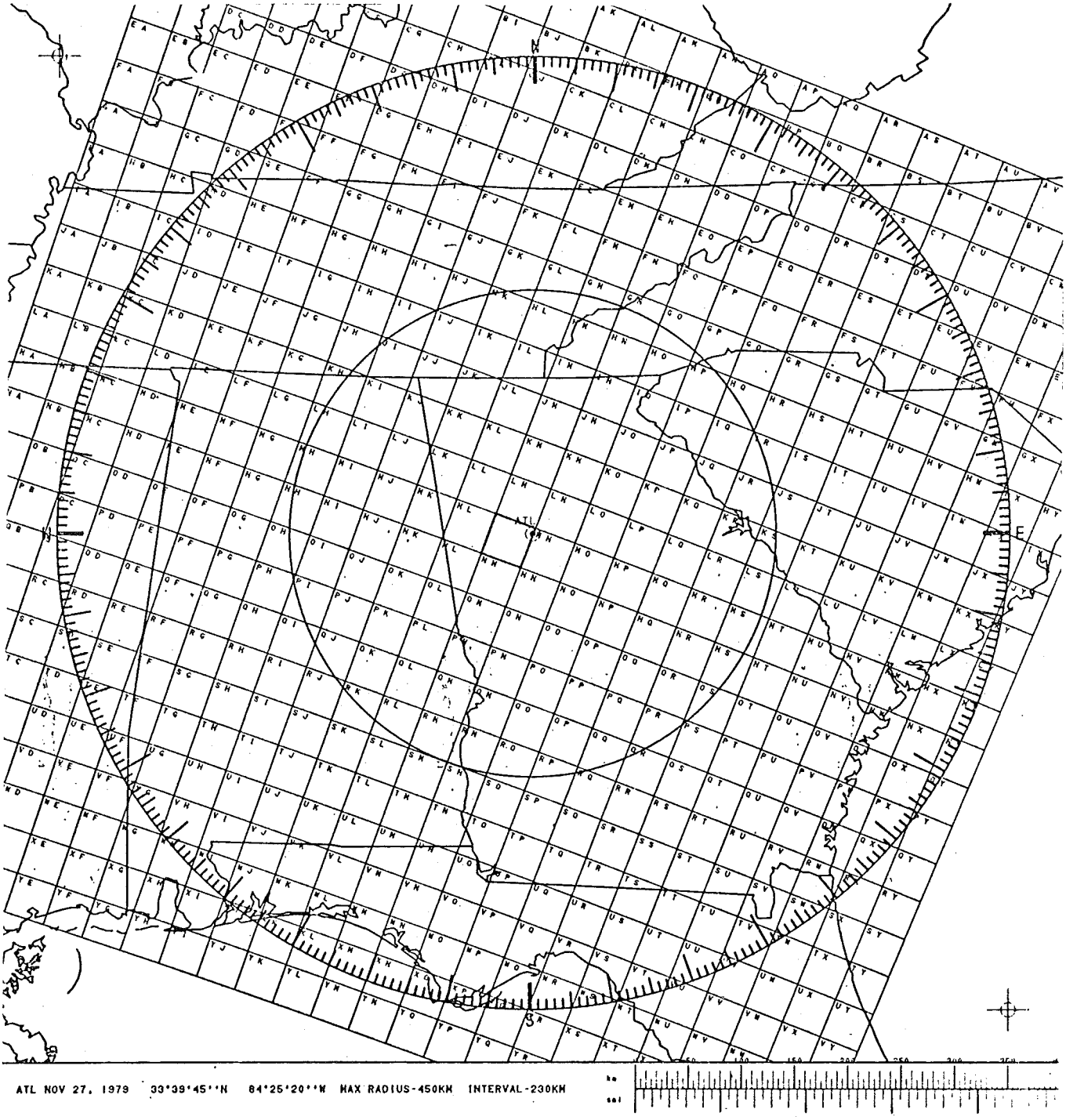

Figure 71.--450 kilometer radar code grid for Atlanta, Georgia.

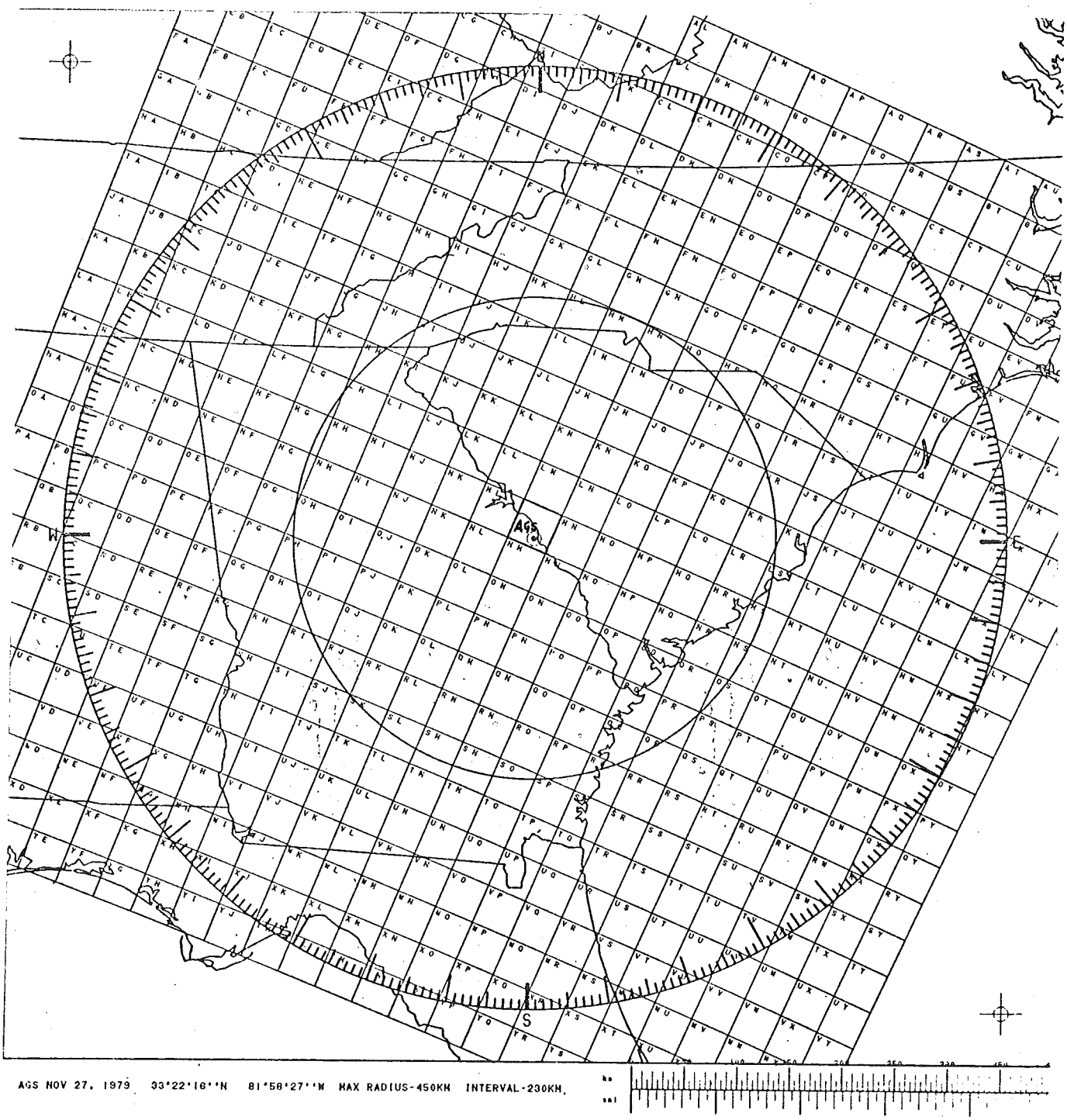

Figure 72.--450 kilometer radar code grid for Augusta, Georgia.

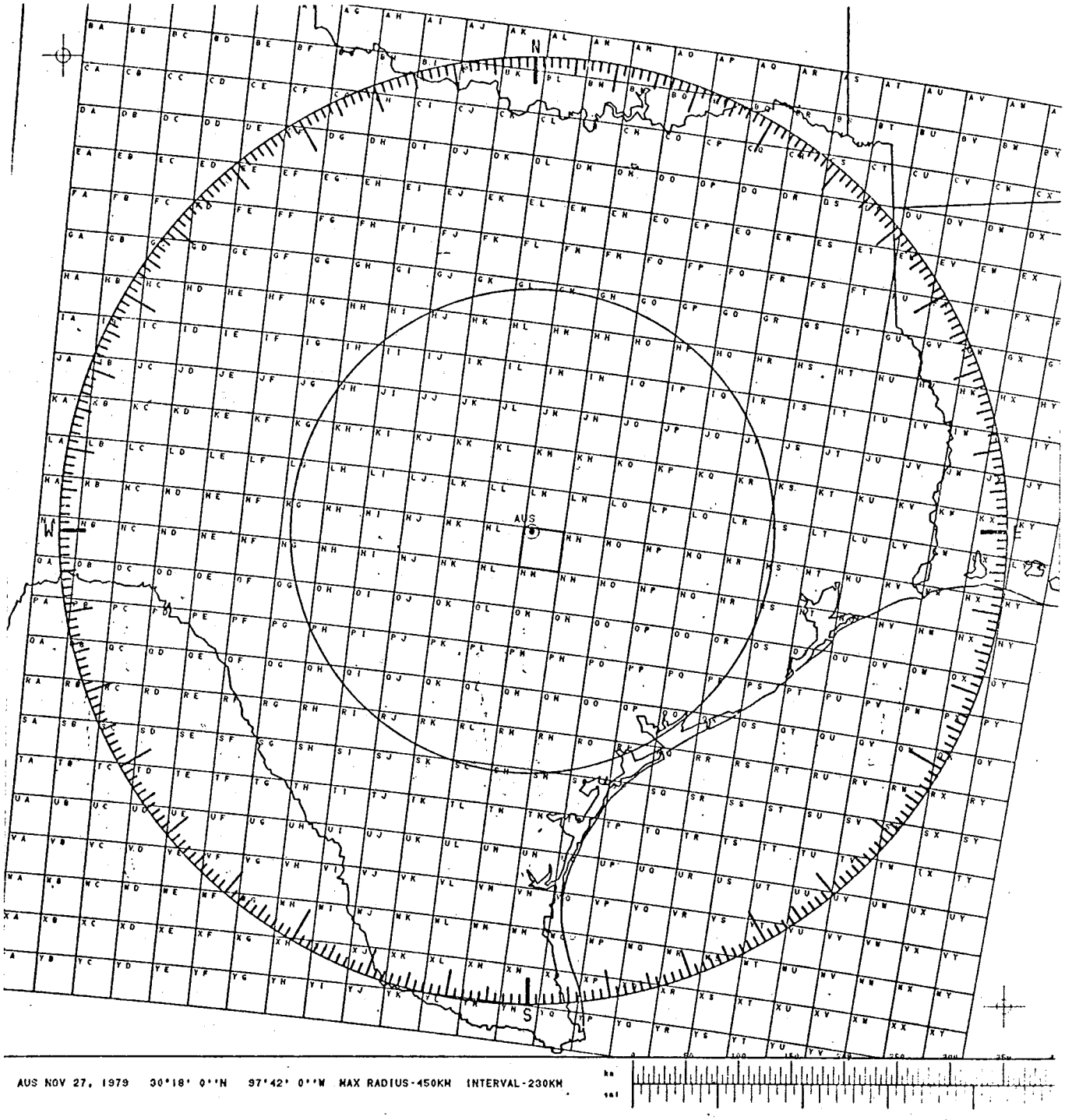

Figure 73.--450 kilometer radar code grid for Austin, Texas.

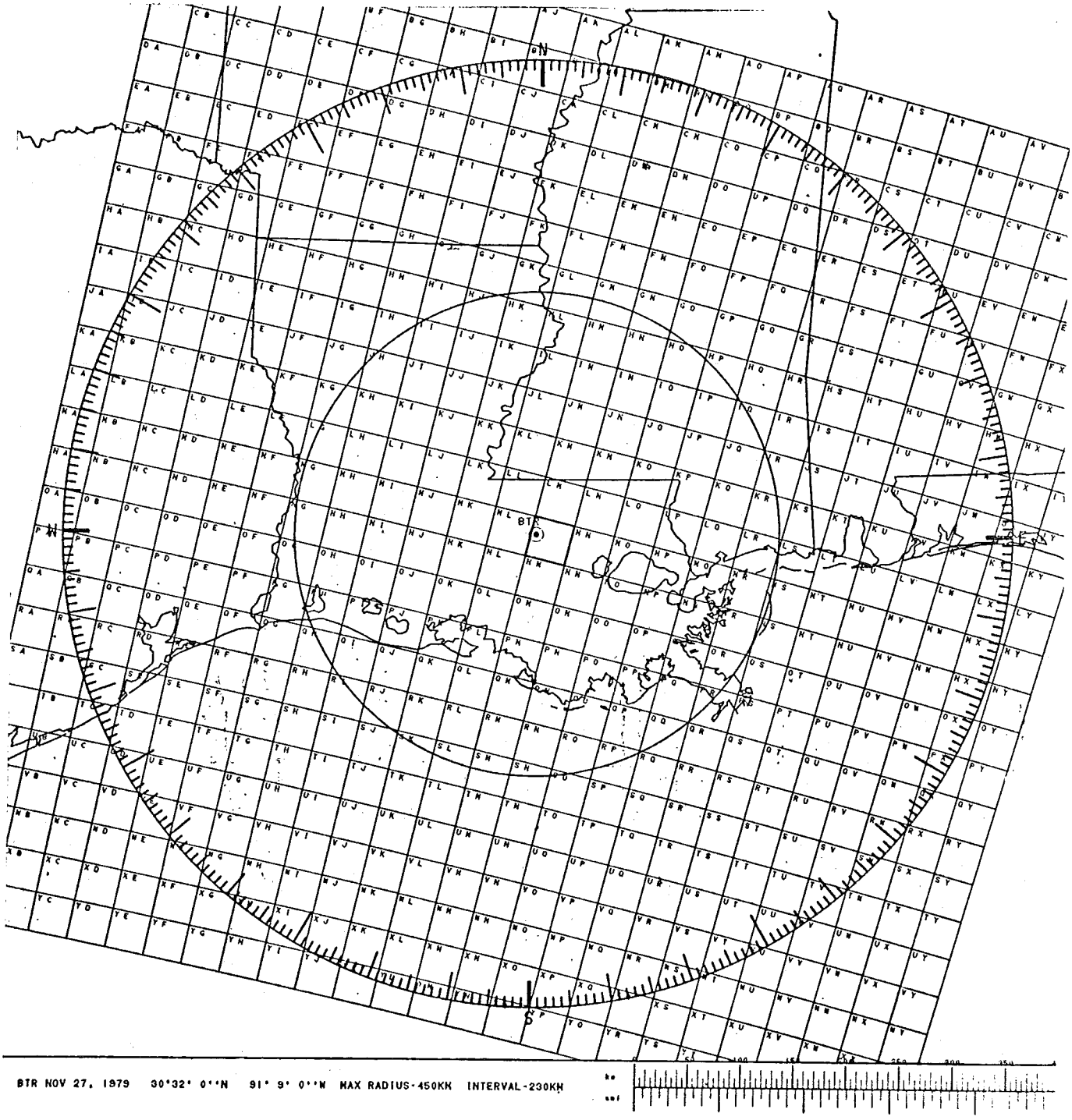

Figure 74.--450 kilometer radar code grid for Baton Rouge, La.

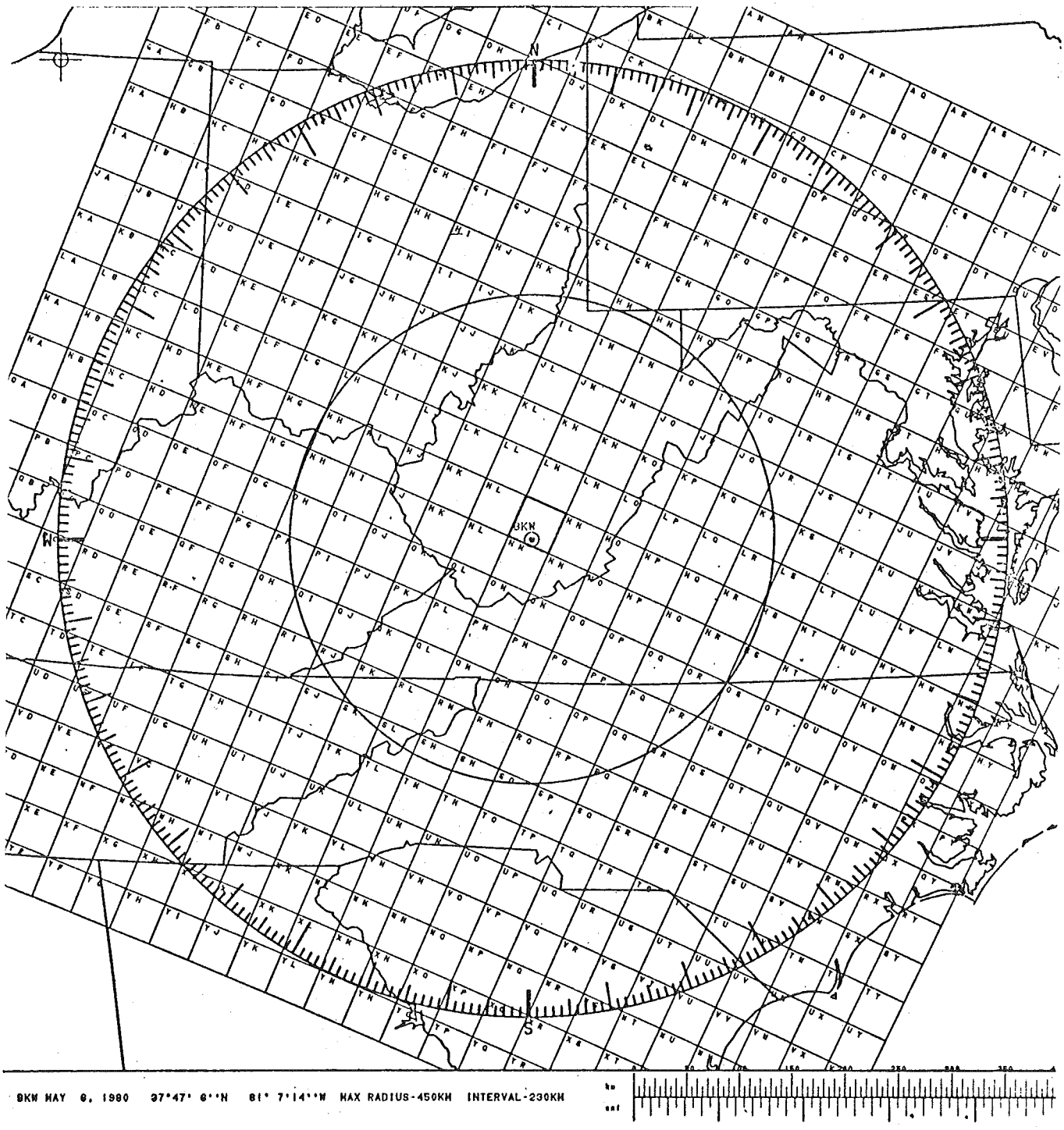

Figure 75.--450 kilometer radar code grid for Beckley, W. Va.

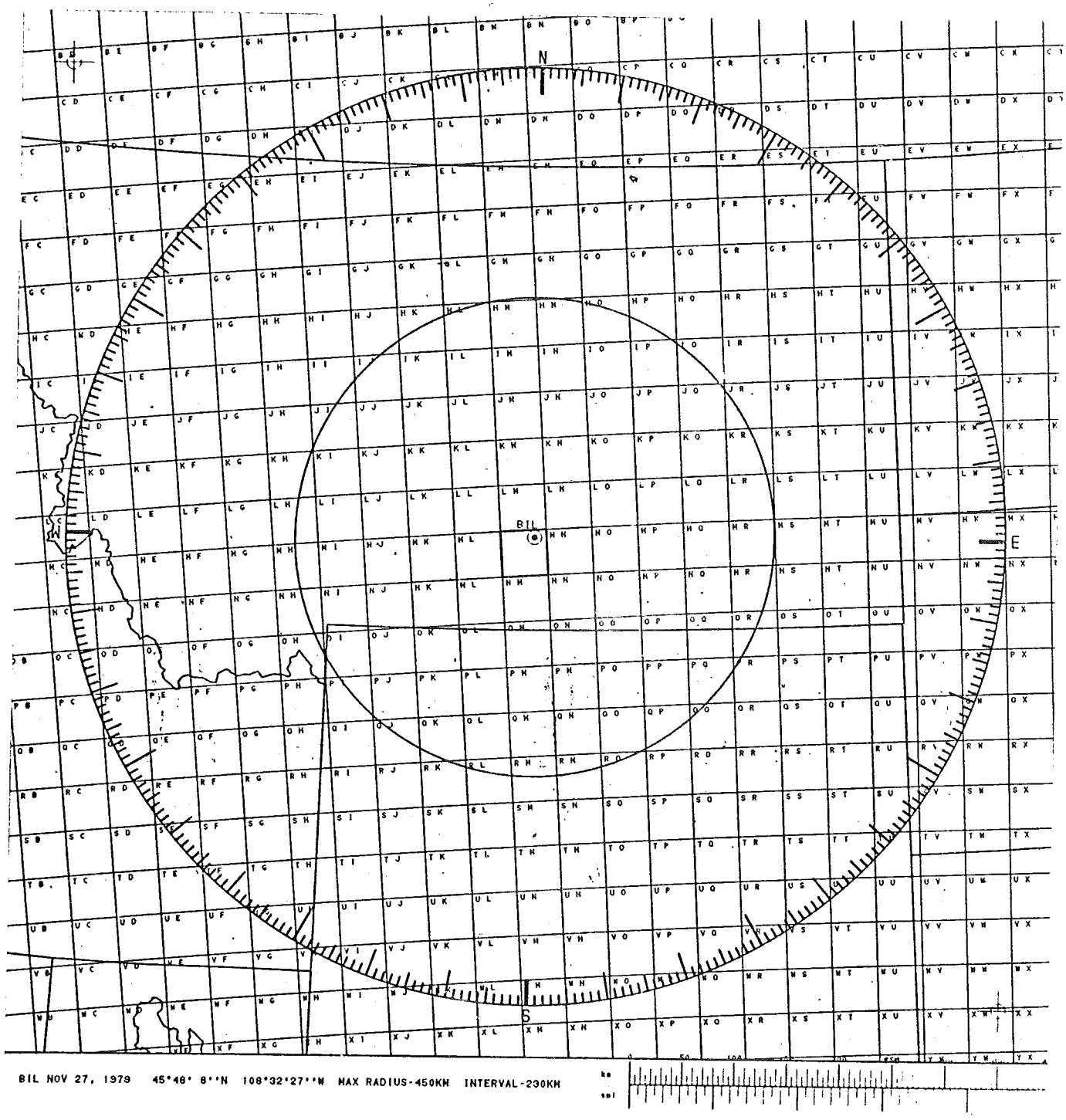

Figure 76.--450 kilometer radar code grid for Billings, Montana.

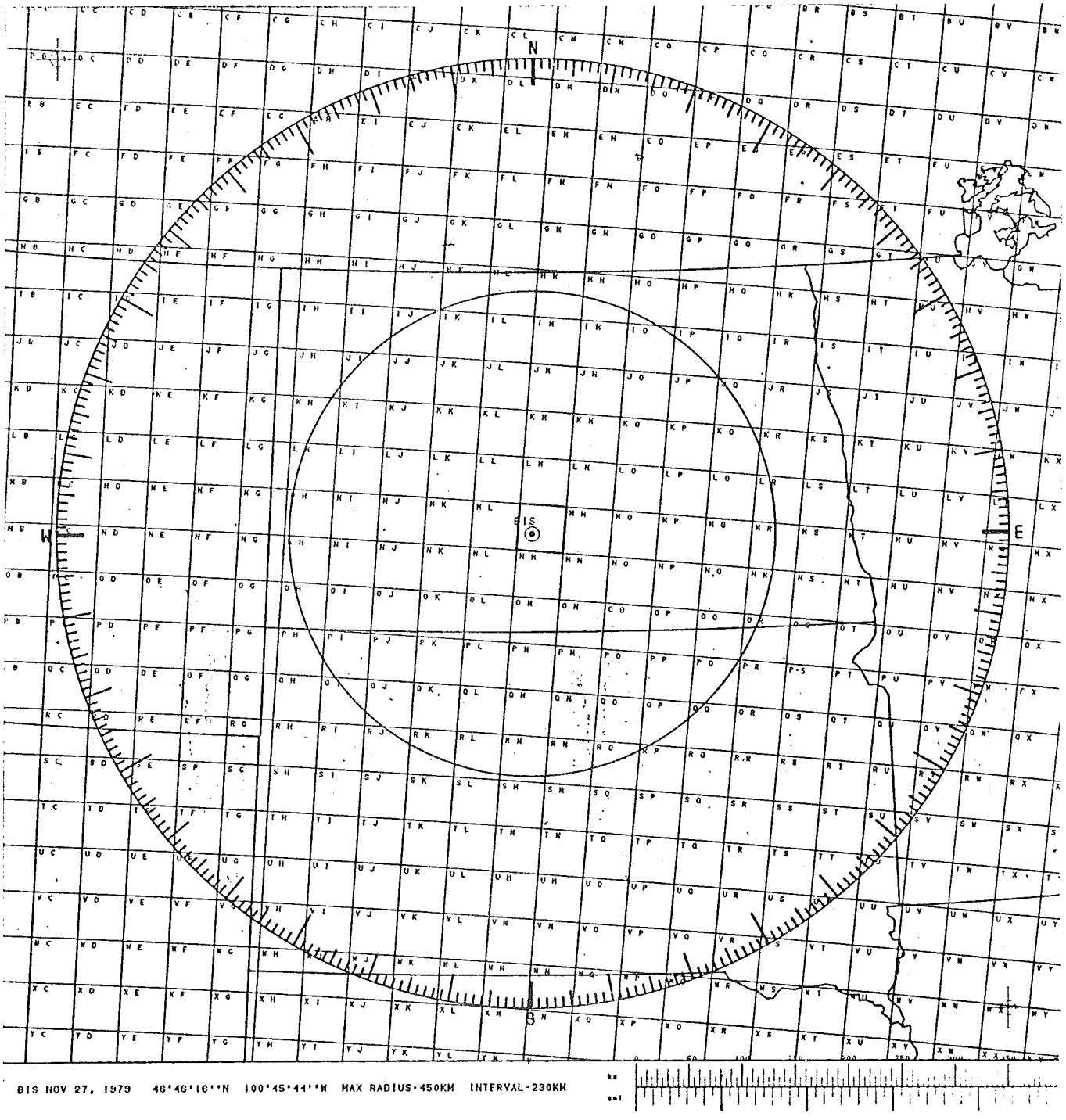

Figure 77.--450 kilometer radar code grid for Bismarck, N. Dak.

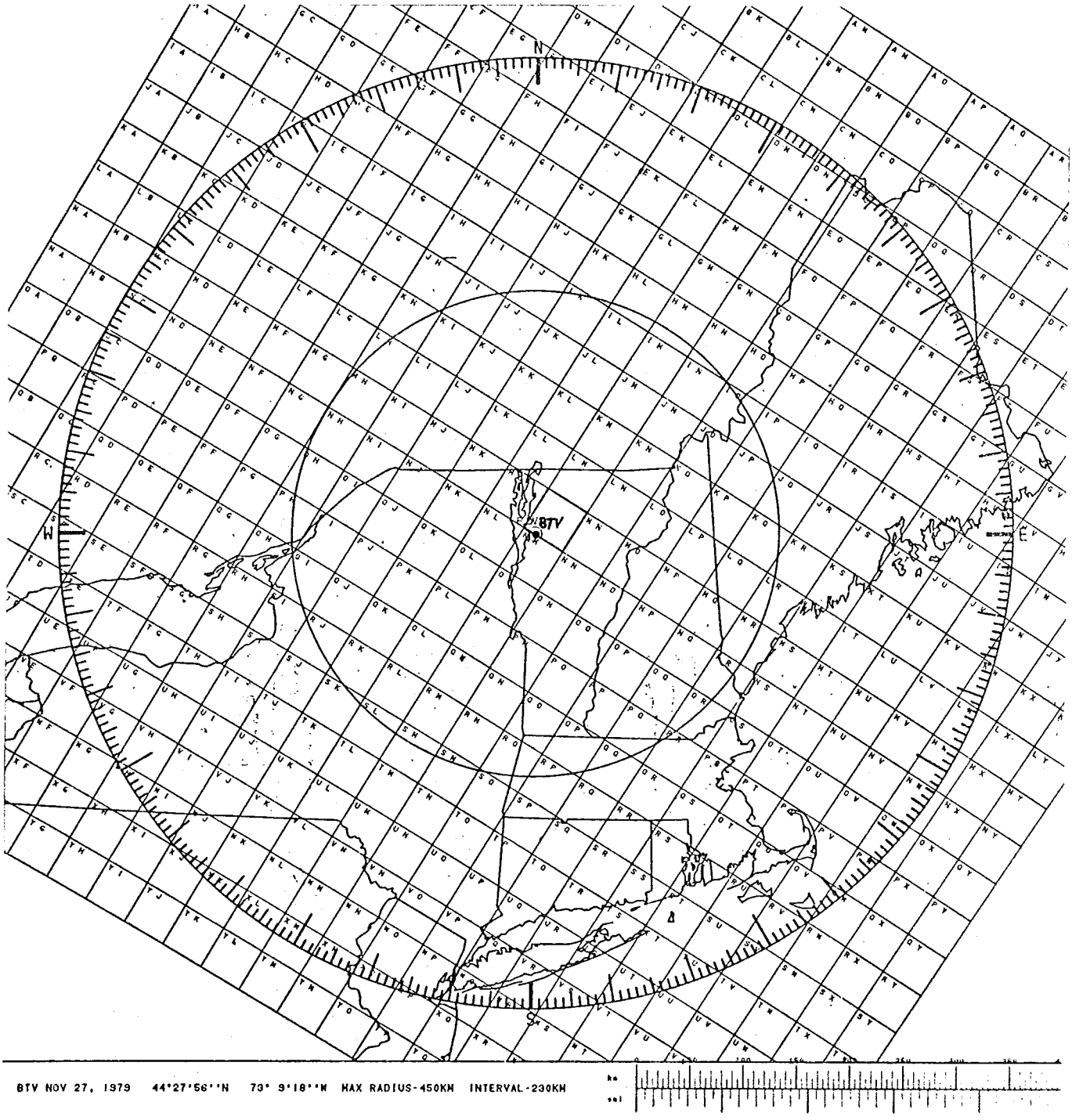

Figure 78.--450 kilometer radar code grid for Burlington, Vermont.

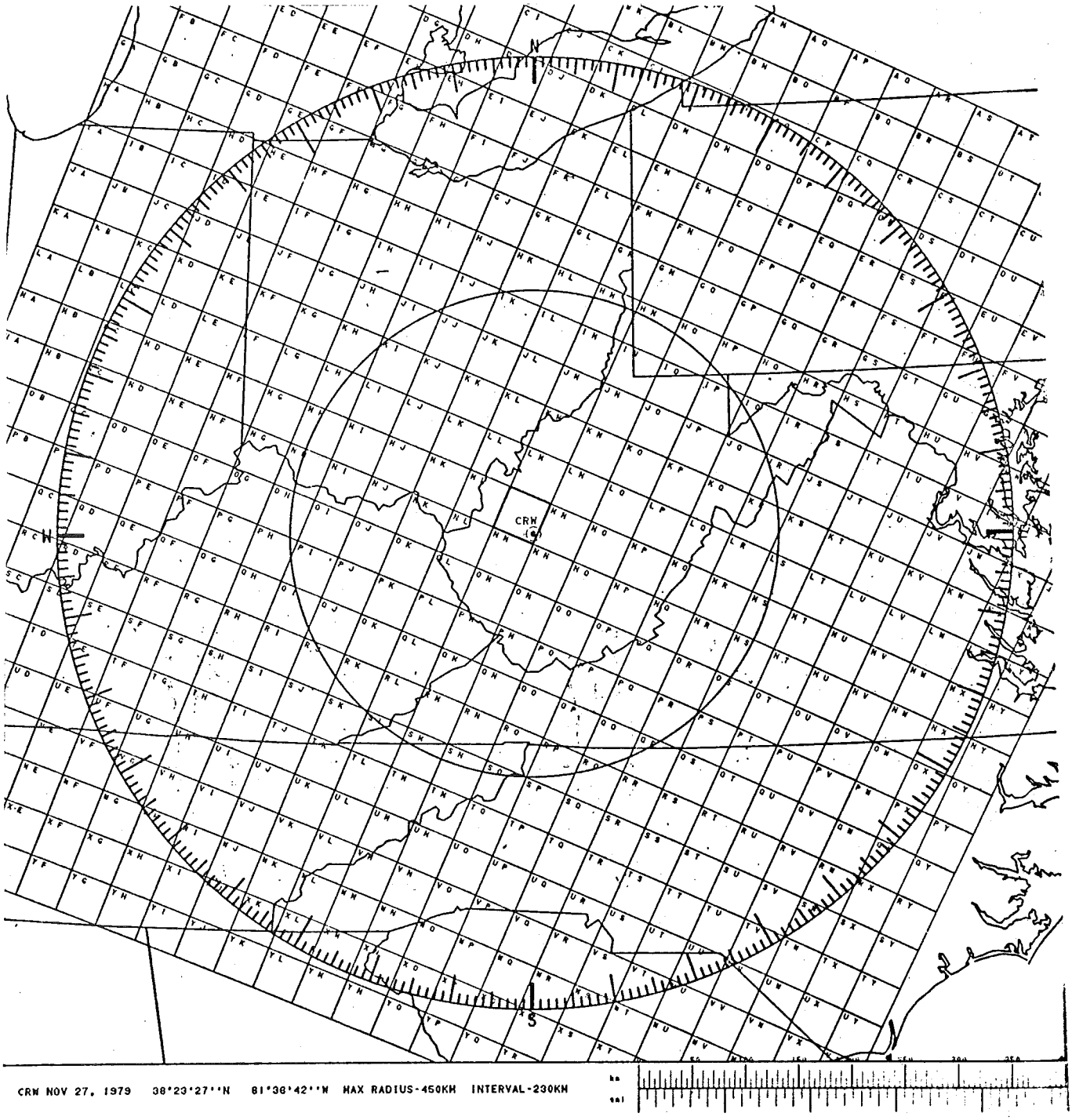

Figure 79.--450 kilometer radar code grid for Charleston, W. Va.

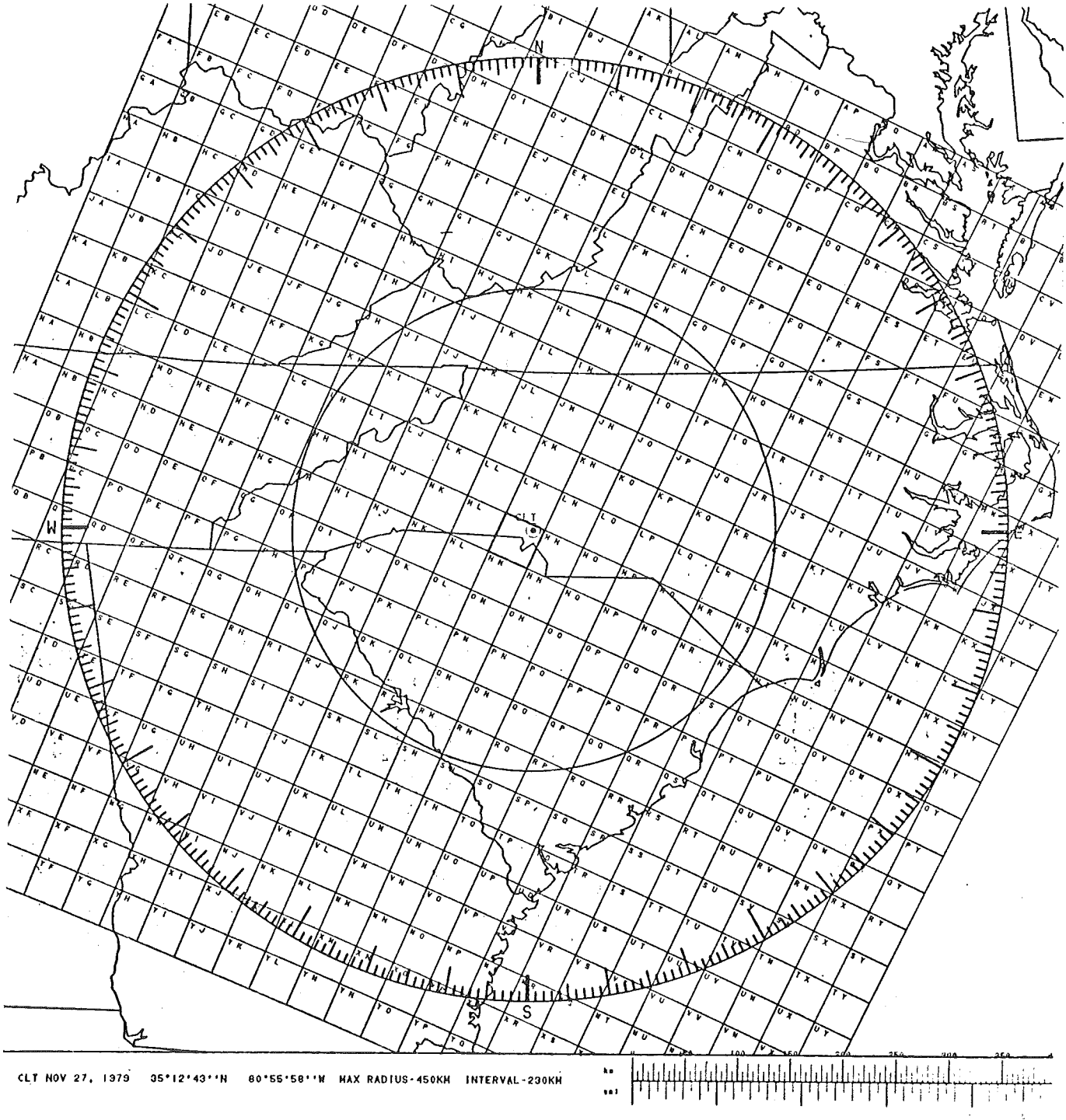

Figure 80.--450 kilometer radar code grid for Charlotte, N.C.

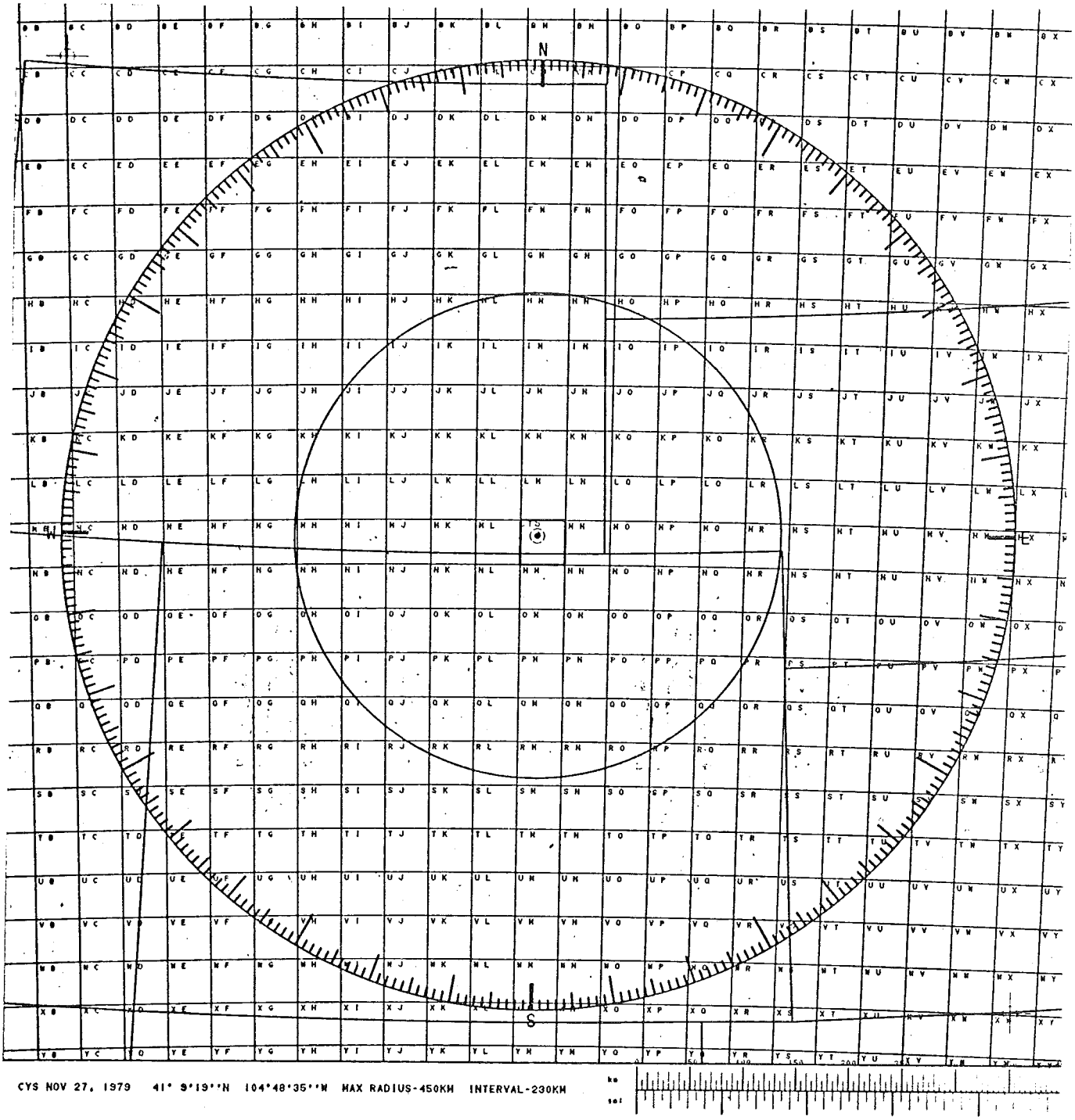

Figure 81.--450 kilometer radar code grid for Cheyenne, Wyoming.

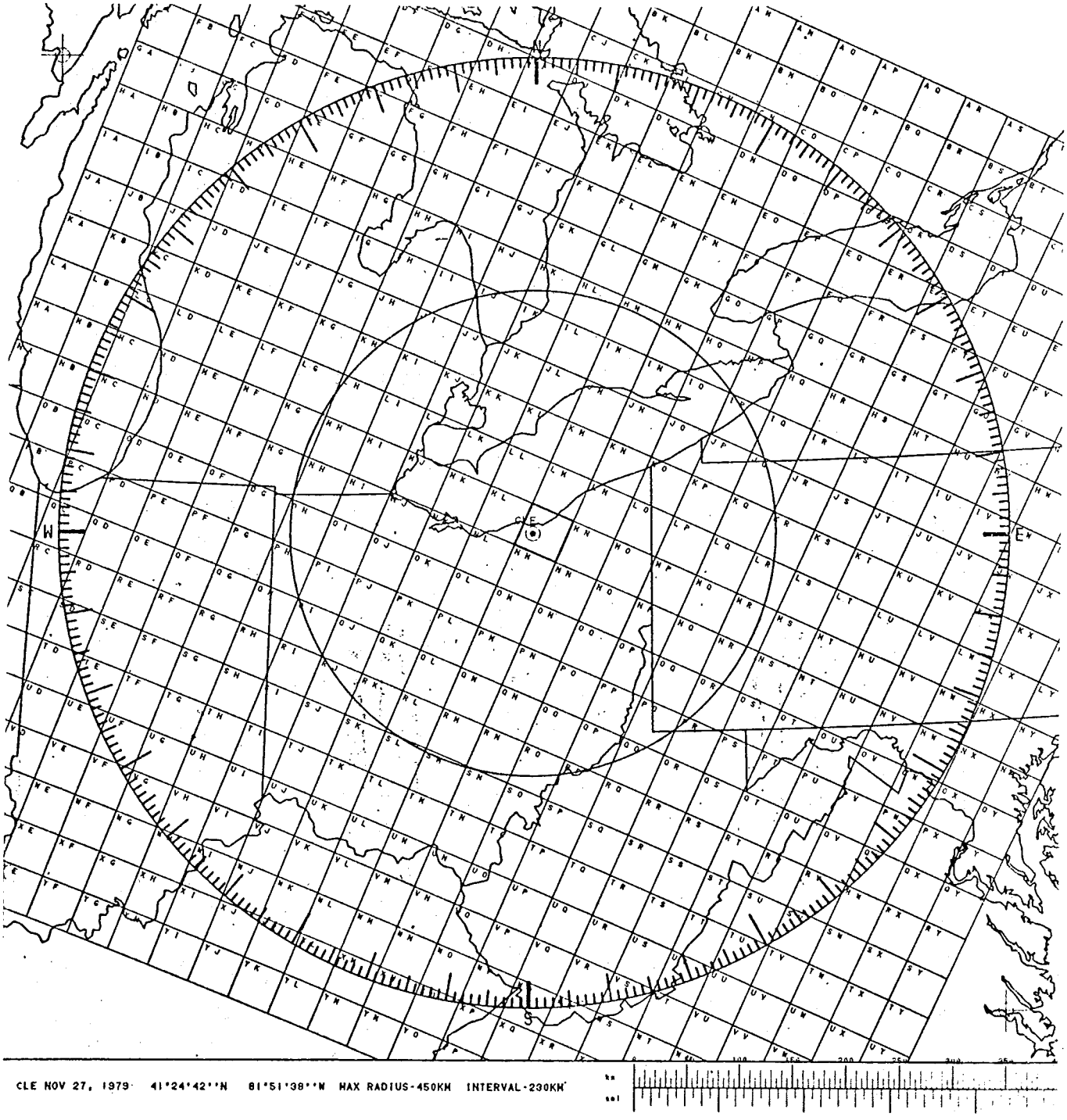

Figure 82.--450 kilometer radar code grid for Cleveland, Ohio.

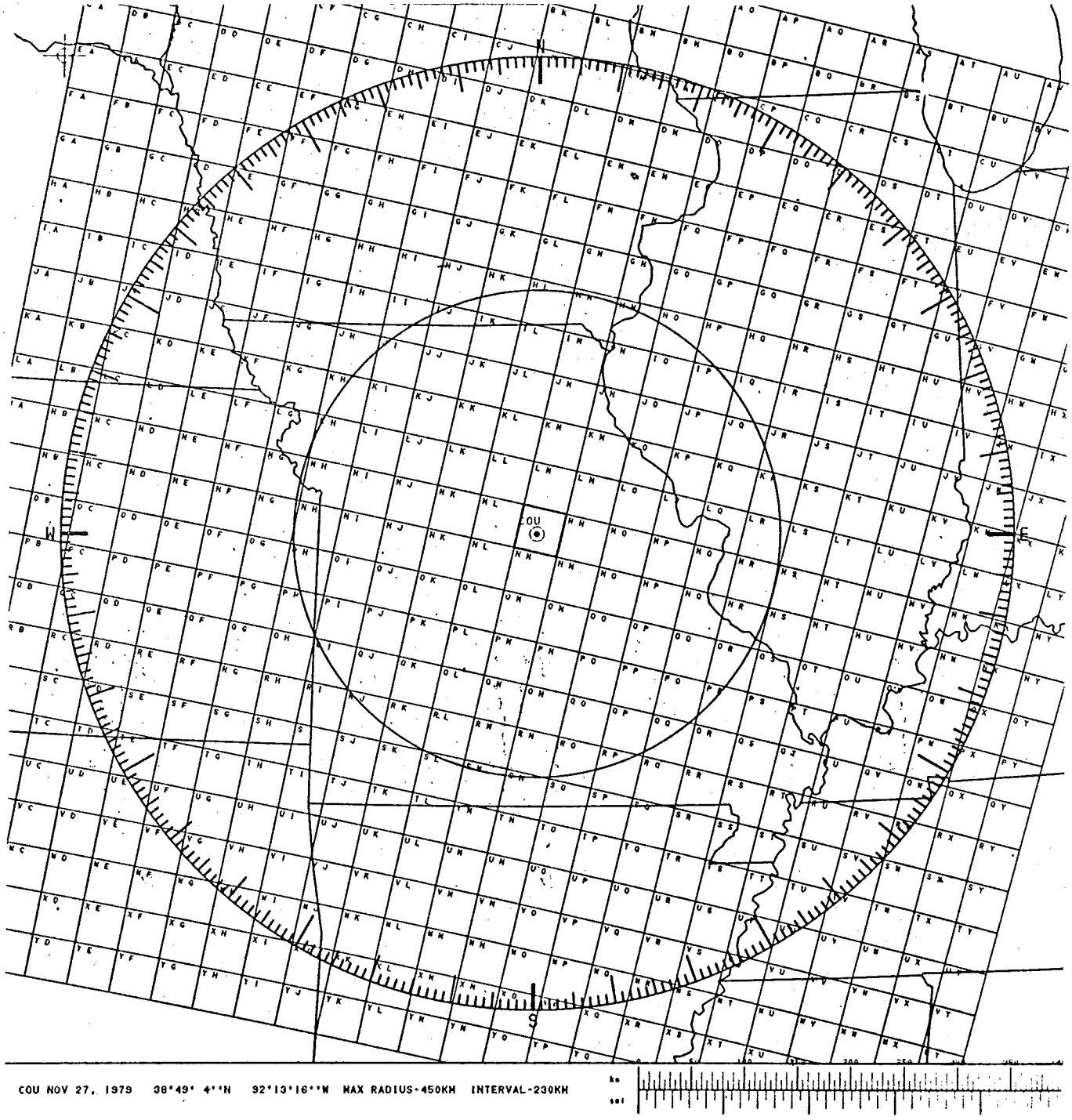

Figure 83.--450 kilometer radar code grid for Columbia, Missouri.

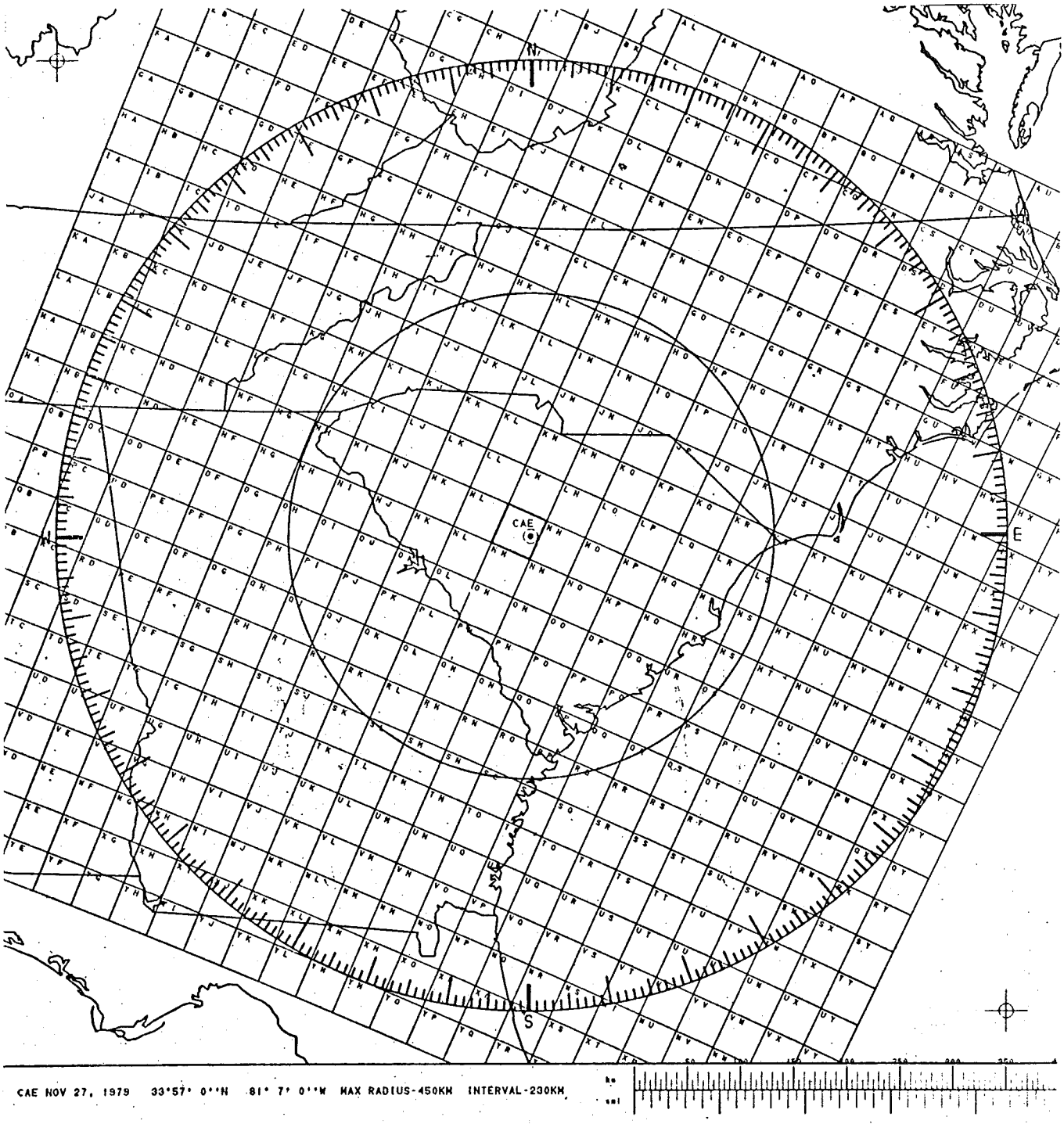

Figure 84.--450 kilometer radar code grid for Columbia, S.C.

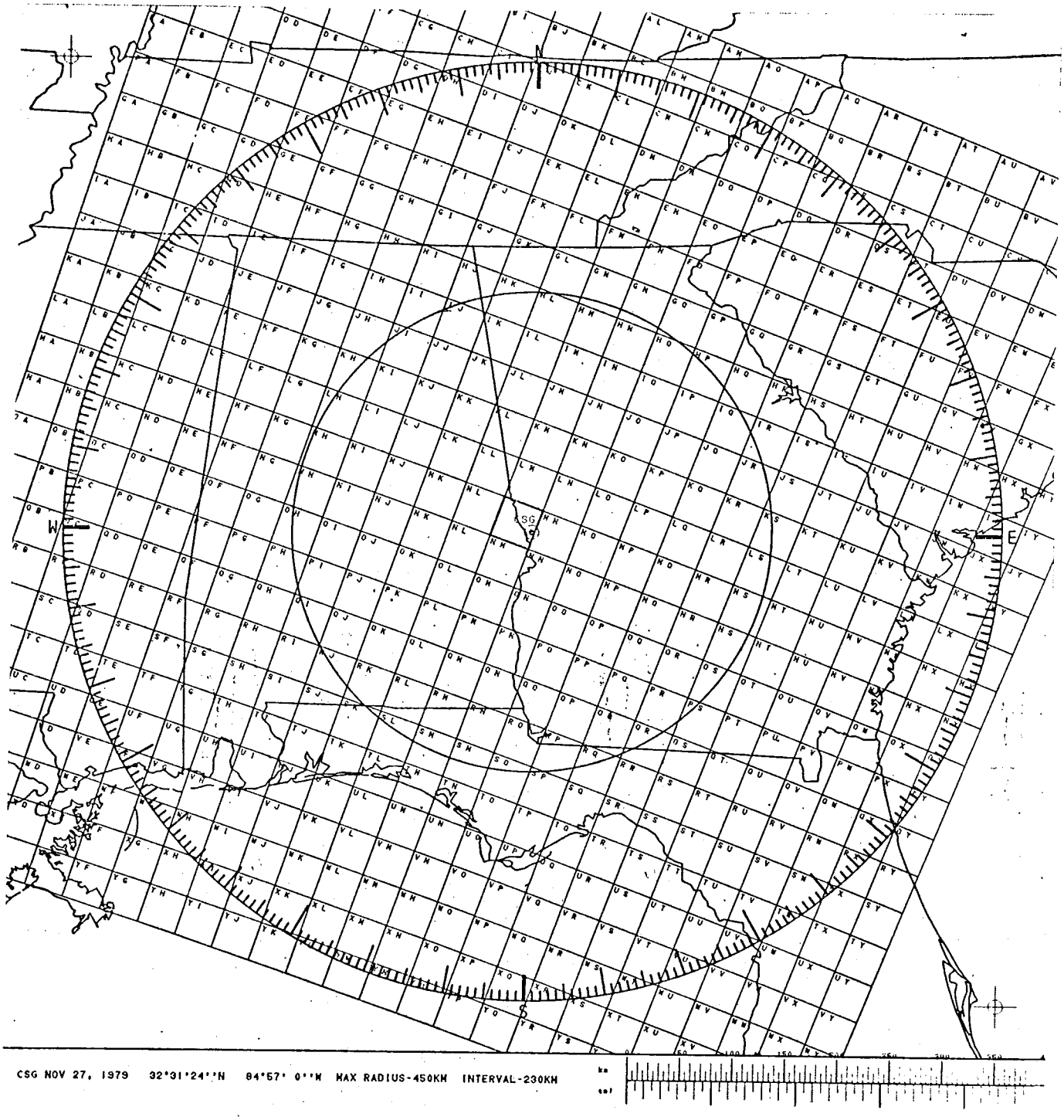

Figure 85.--450 kilometer radar code grid for Columbus, Georgia.

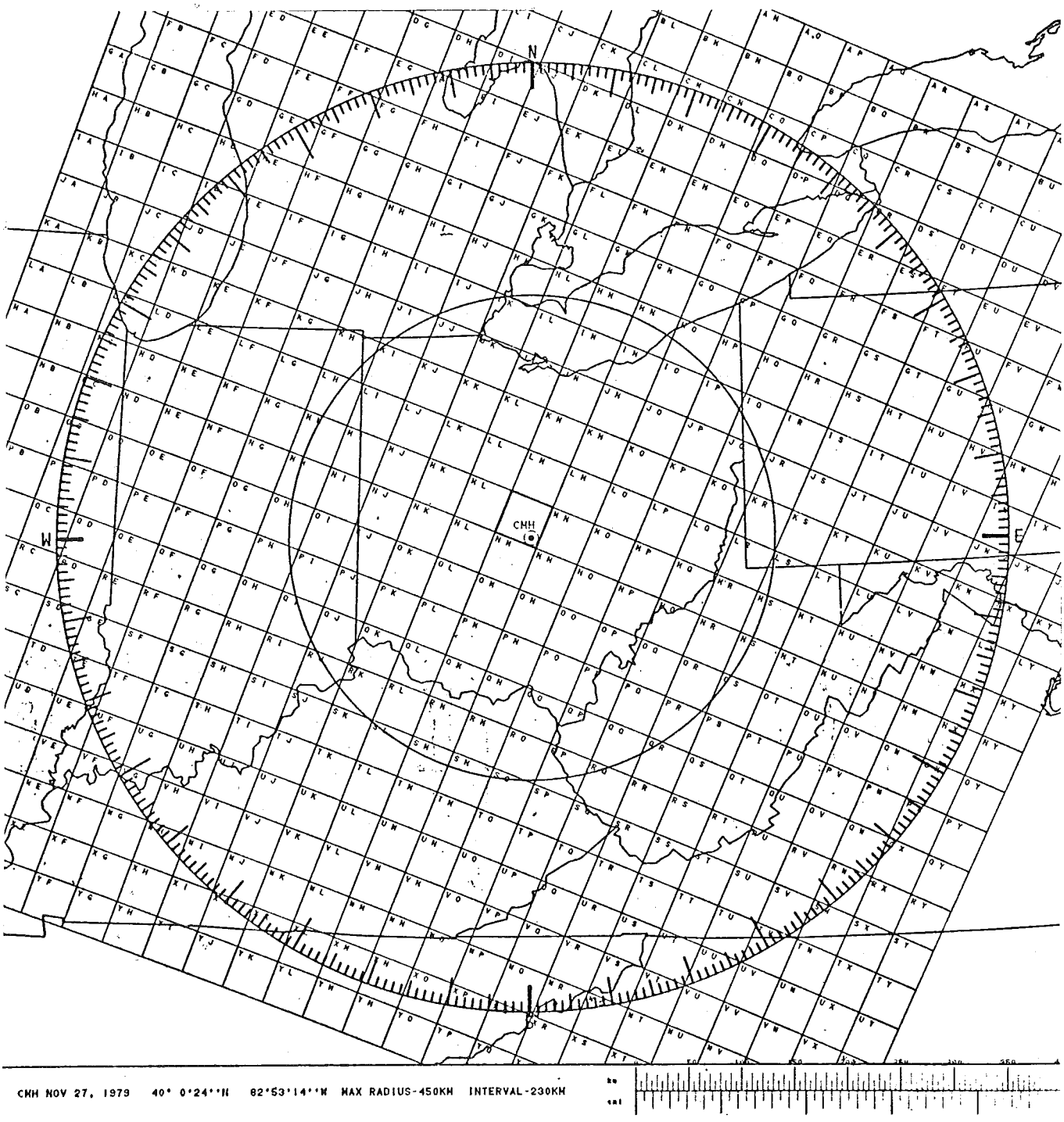

Figure 86.--450 kilometer radar code grid for Columbus, Ohio.

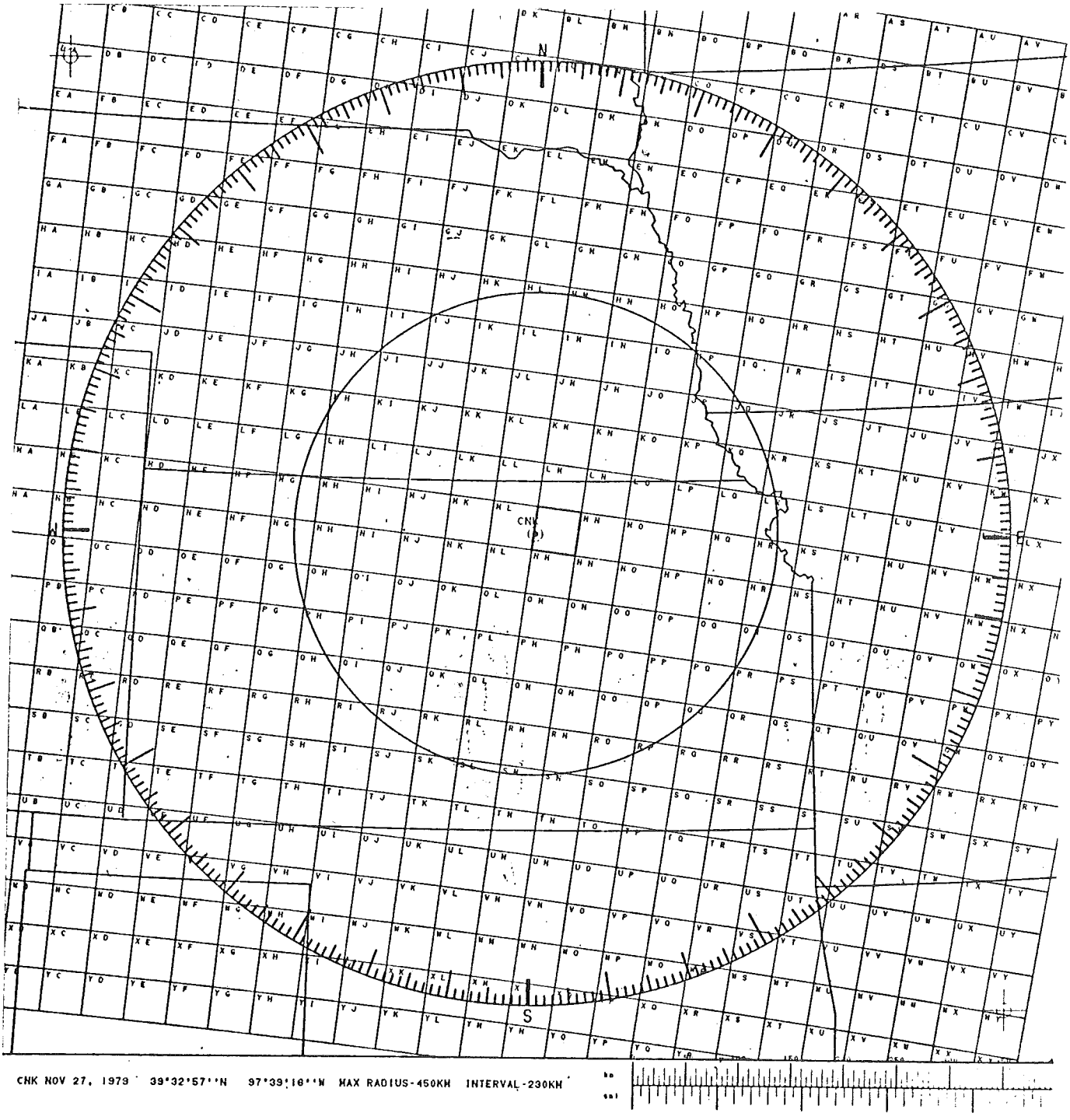

Figure 87.--450 kilometer radar code grid for Concordia, Kansas.

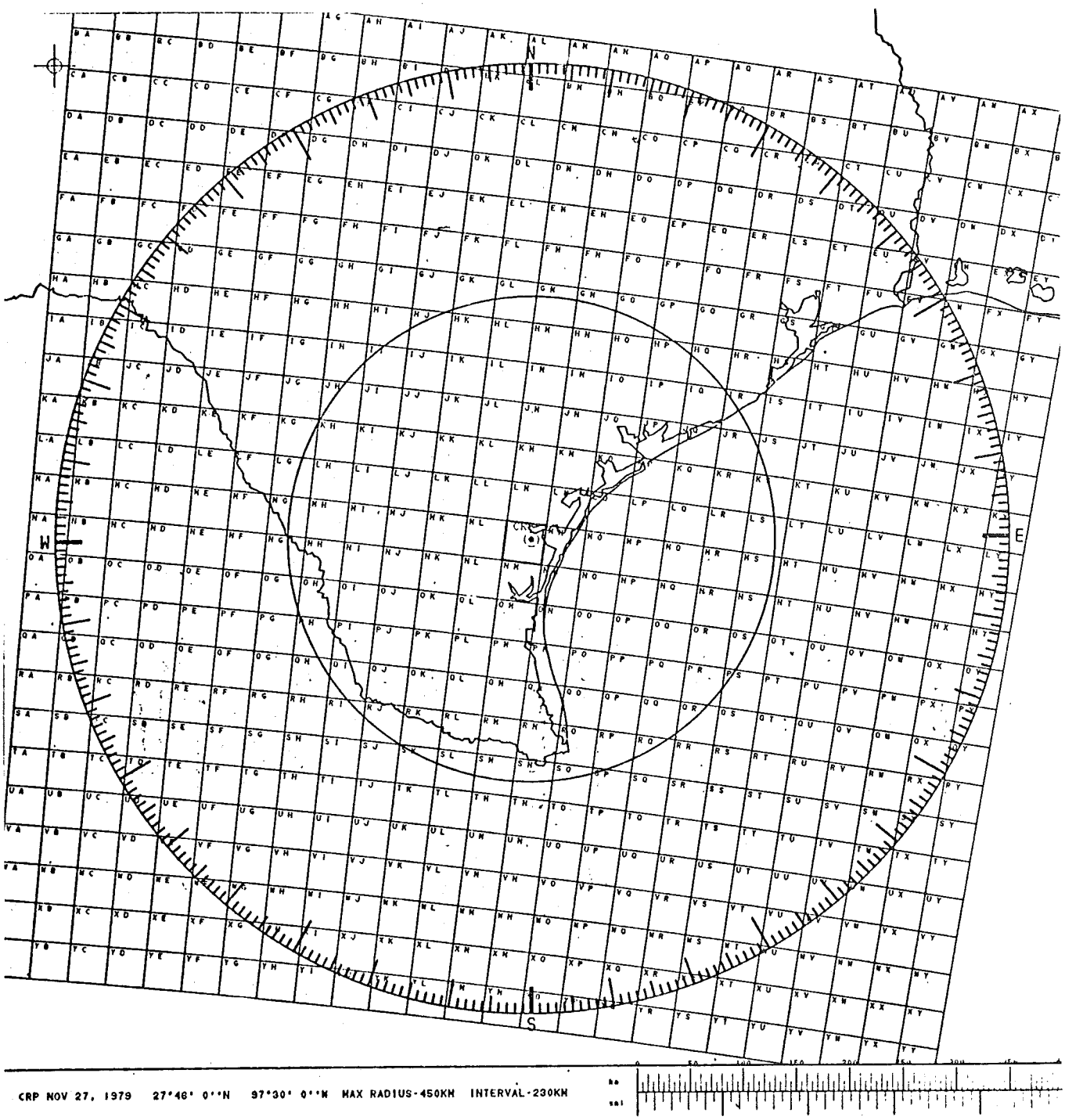

Figure 88.--450 kilometer radar code grid for Corpus Christi, Tex.

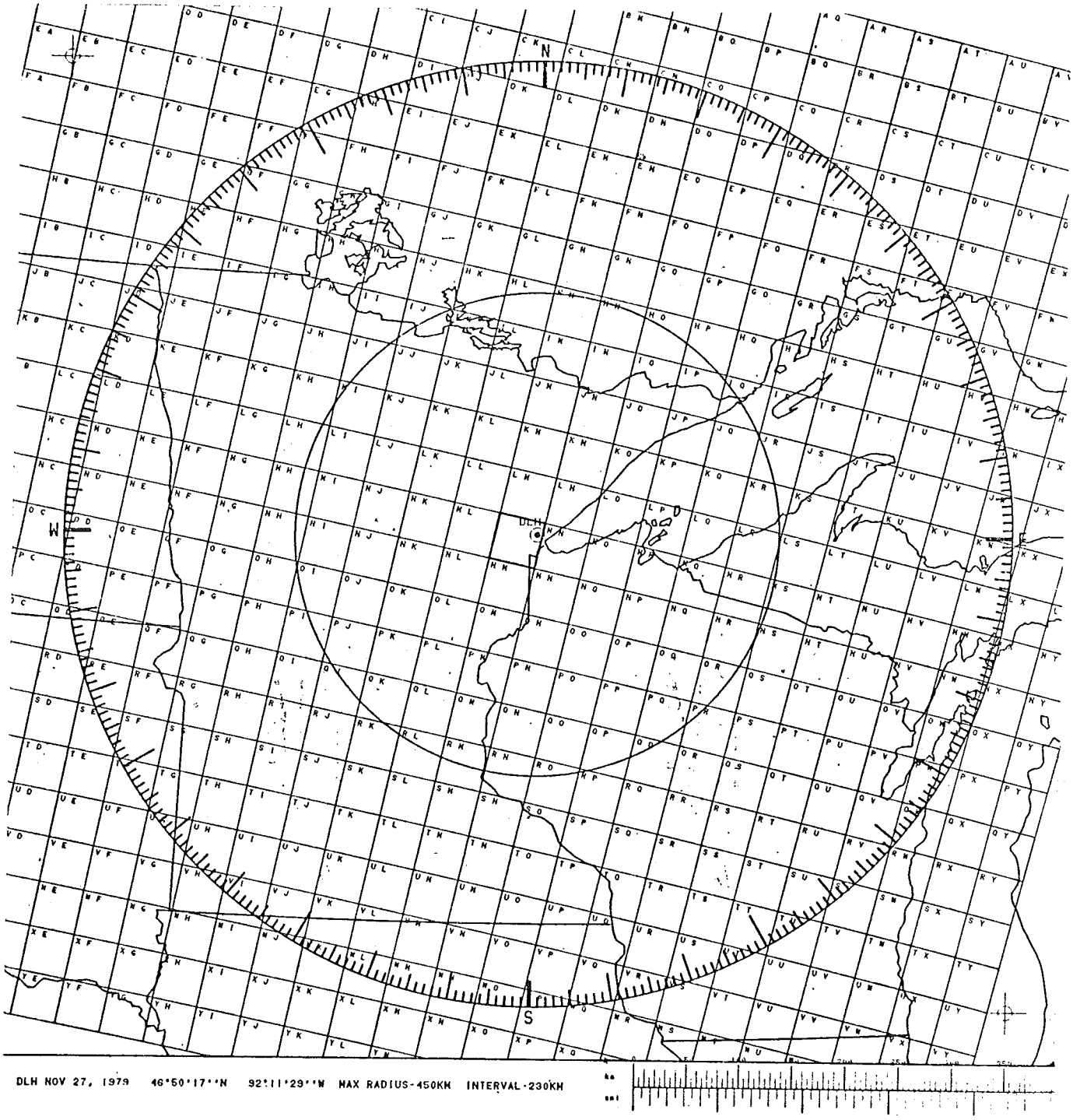

Figure 89.--450 kilometer radar code grid for Duluth, Minnesota.

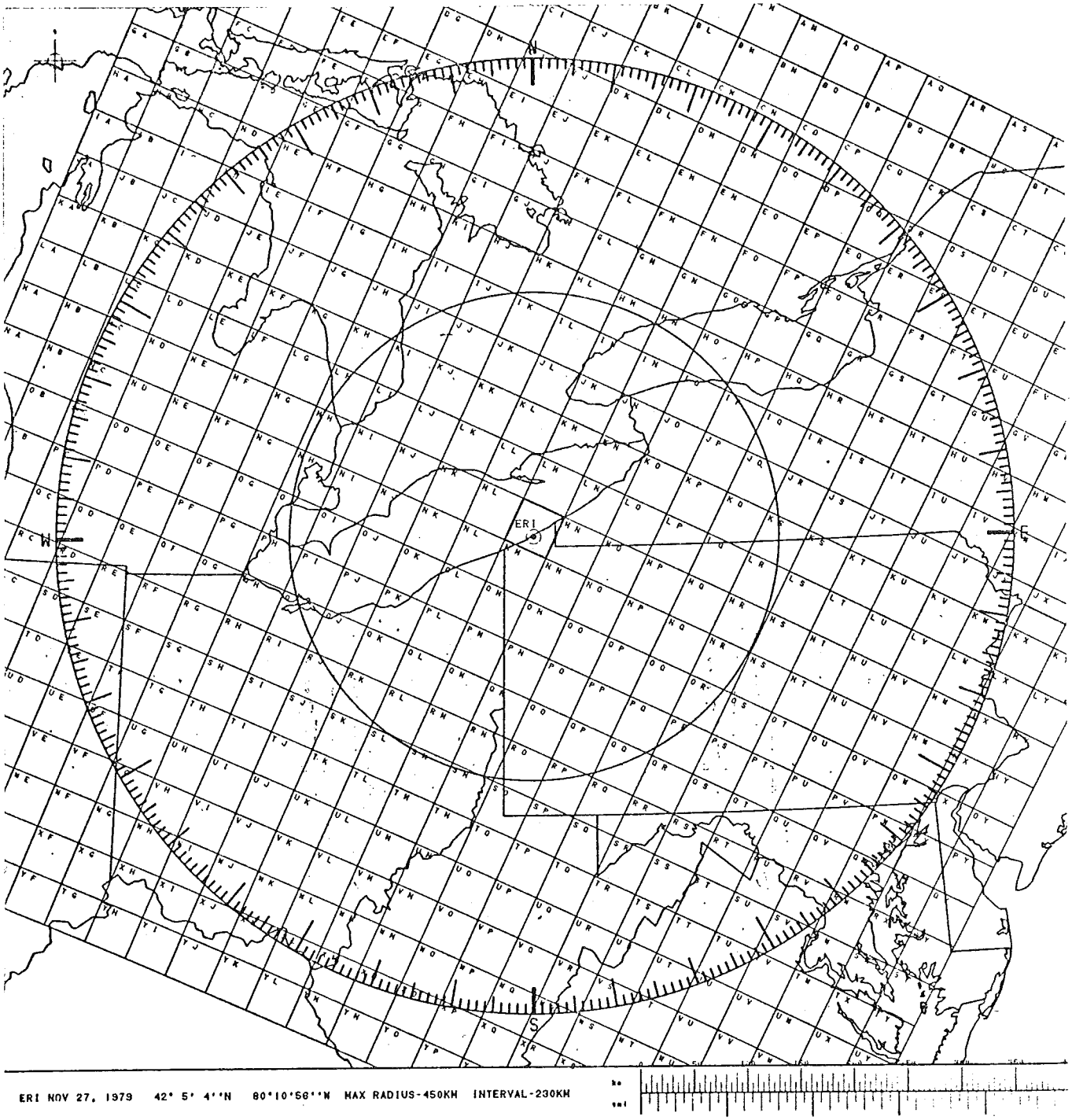

Figure 90.--450 kilometer radar code grid for Erie, Pennsylvania.

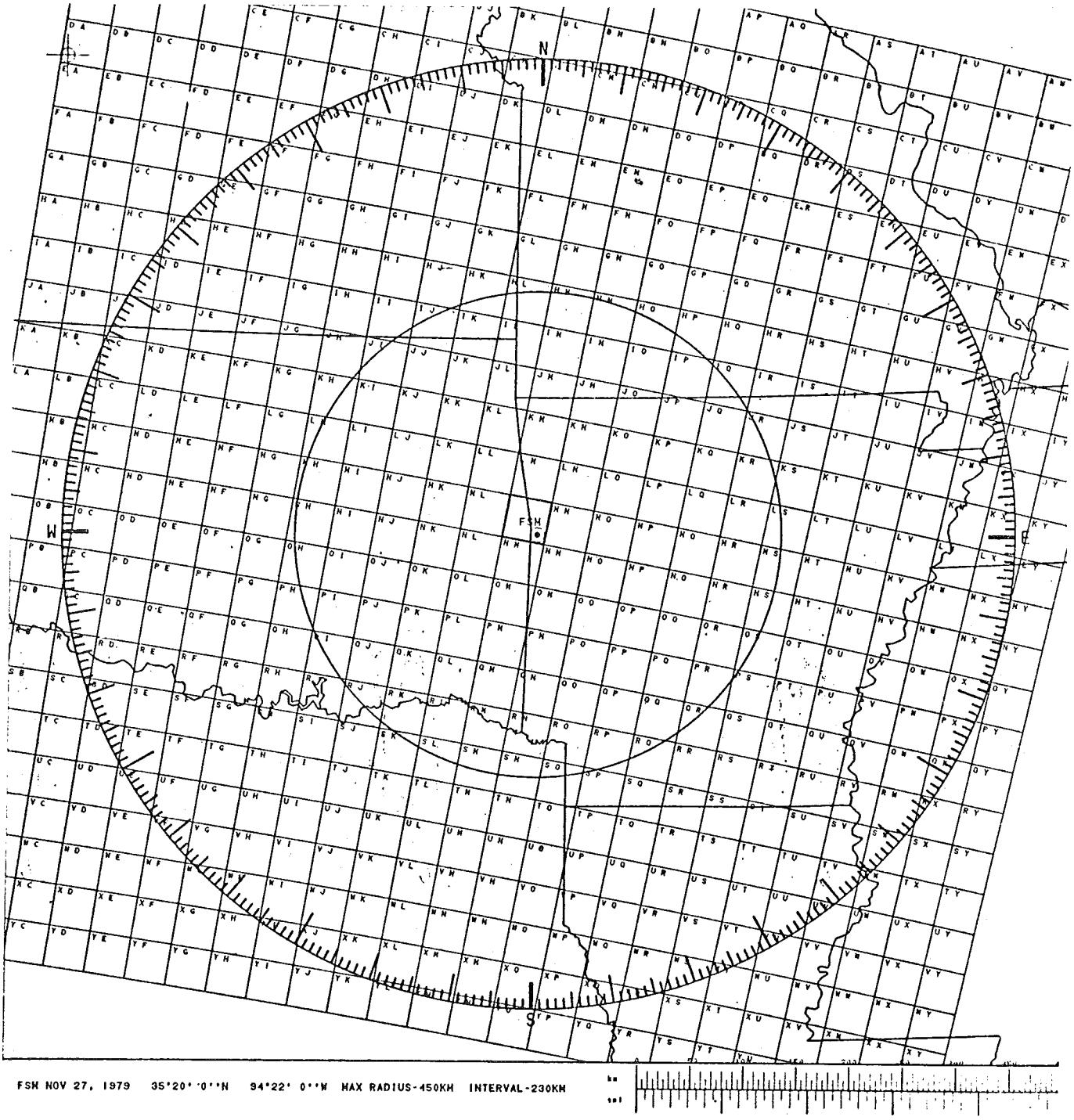

Figure 91.--450 kilometer radar code grid for Fort Smith, Ark.

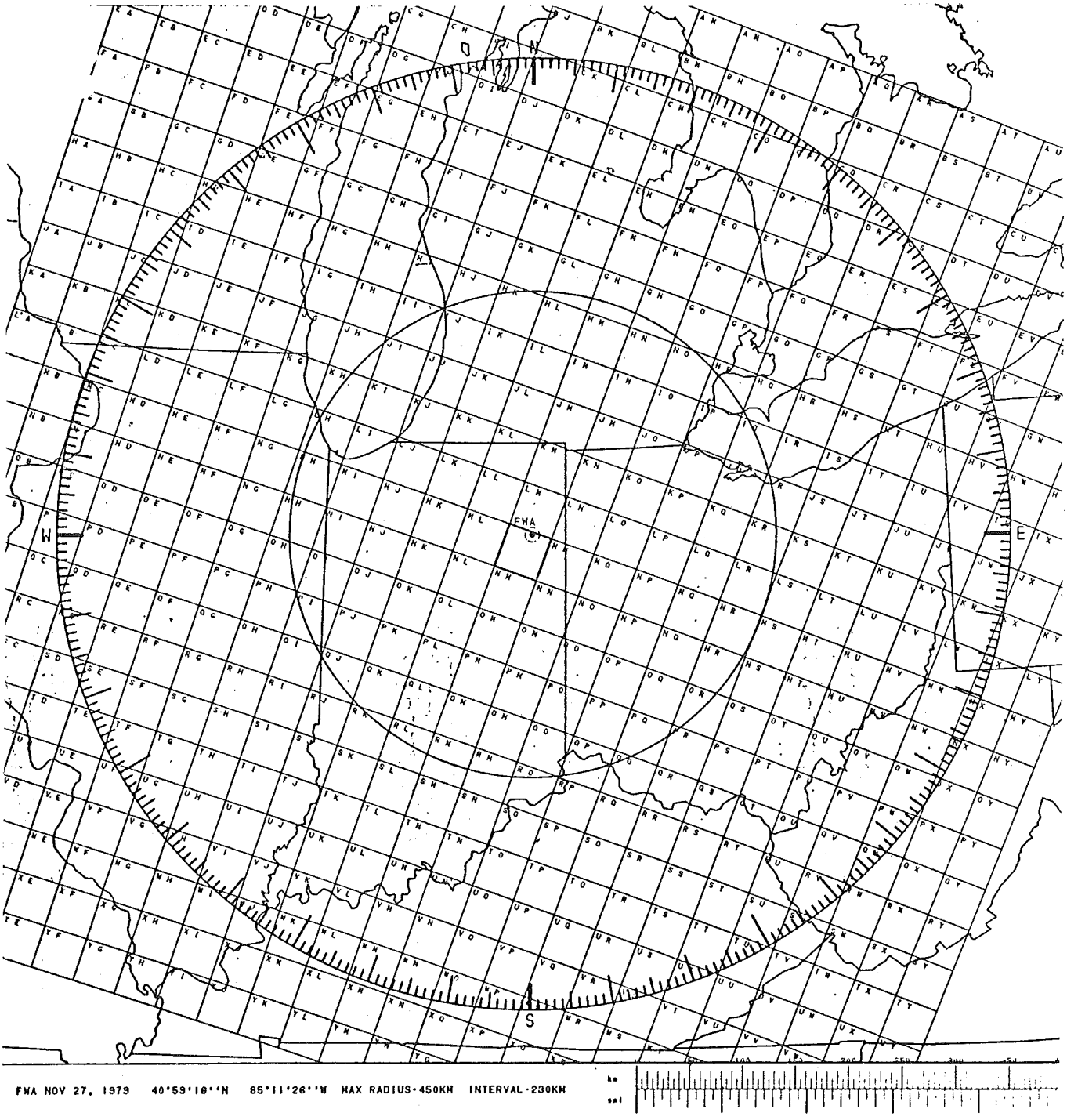

Figure 92.--450 kilometer radar code grid for Fort Wayne, Indiana.

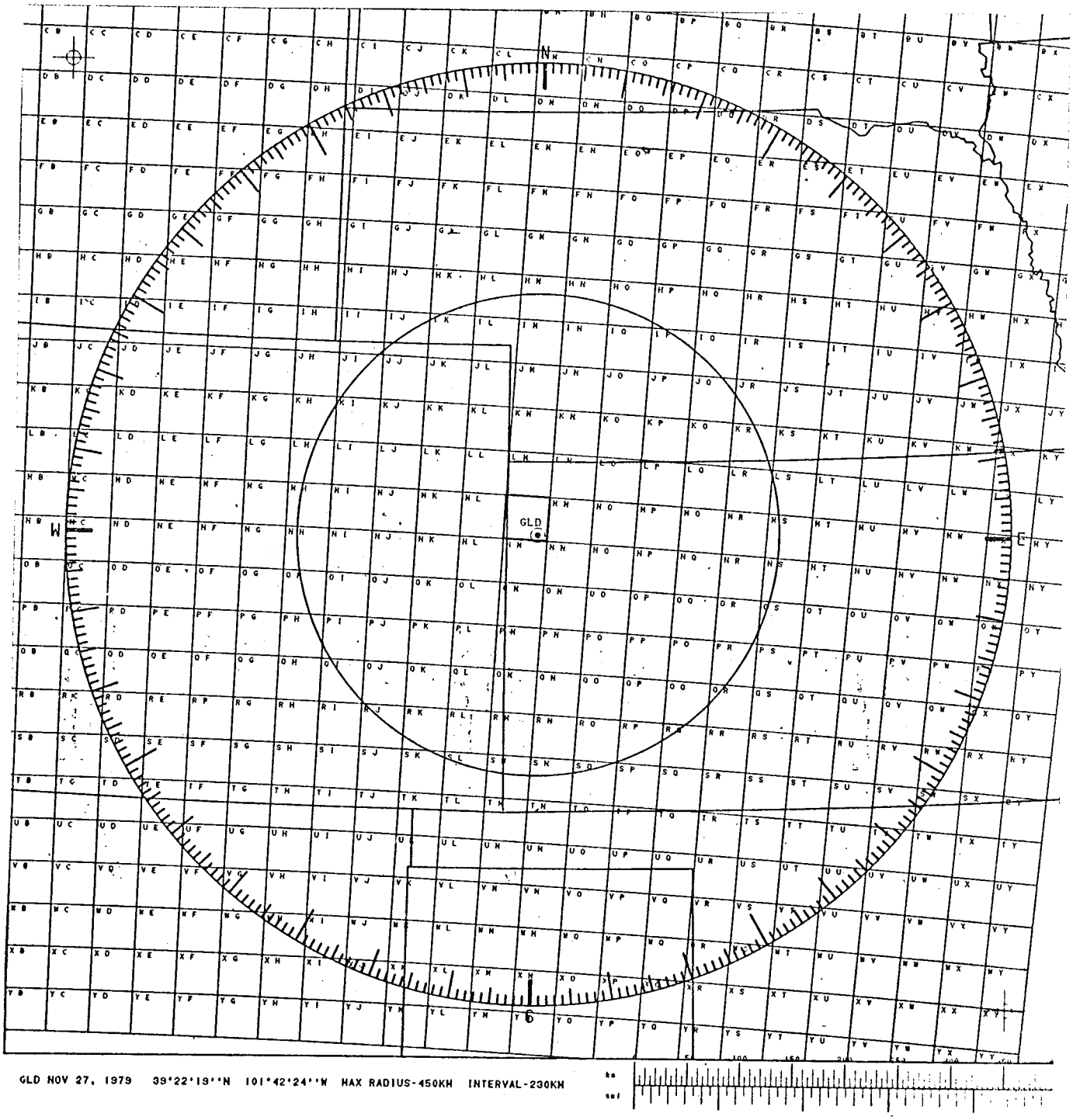

Figure 93.--450 kilometer radar code grid for Goodland, Kansas.

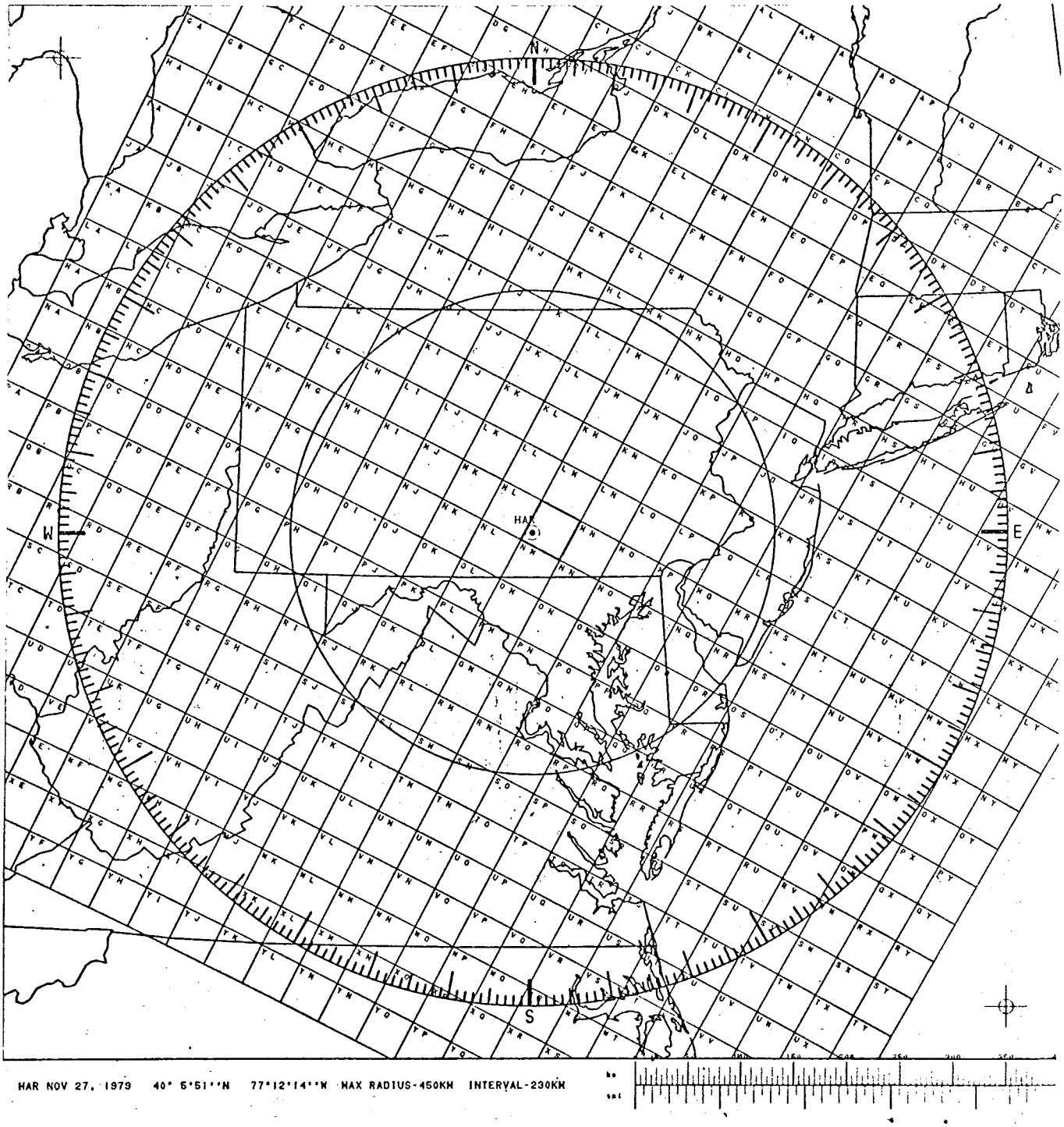

Figure 94.--450 kilometer radar code grid for Harrisburg, Pa.

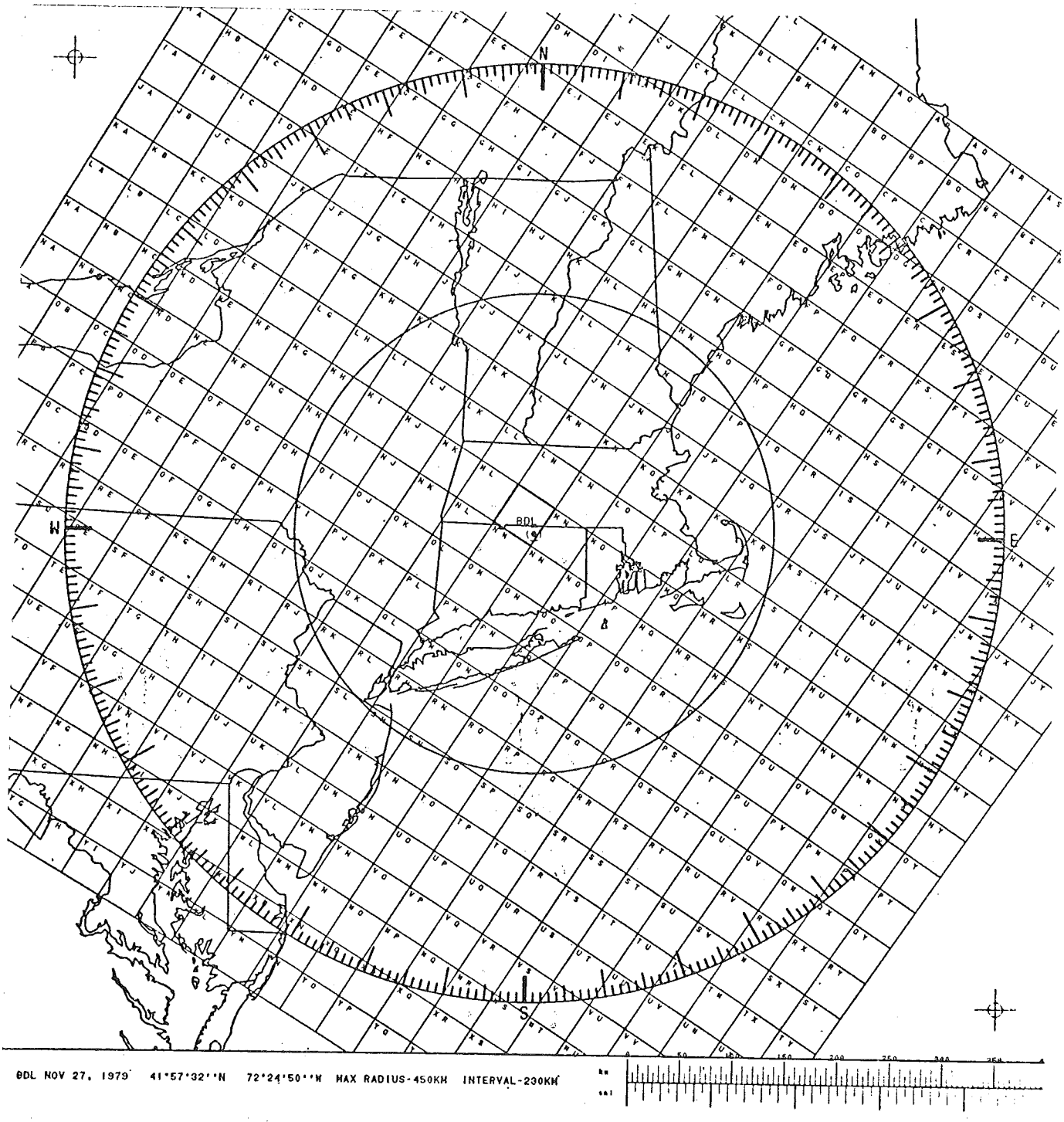

Figure 95.--450 kilometer radar code grid for Hartford, Conn.

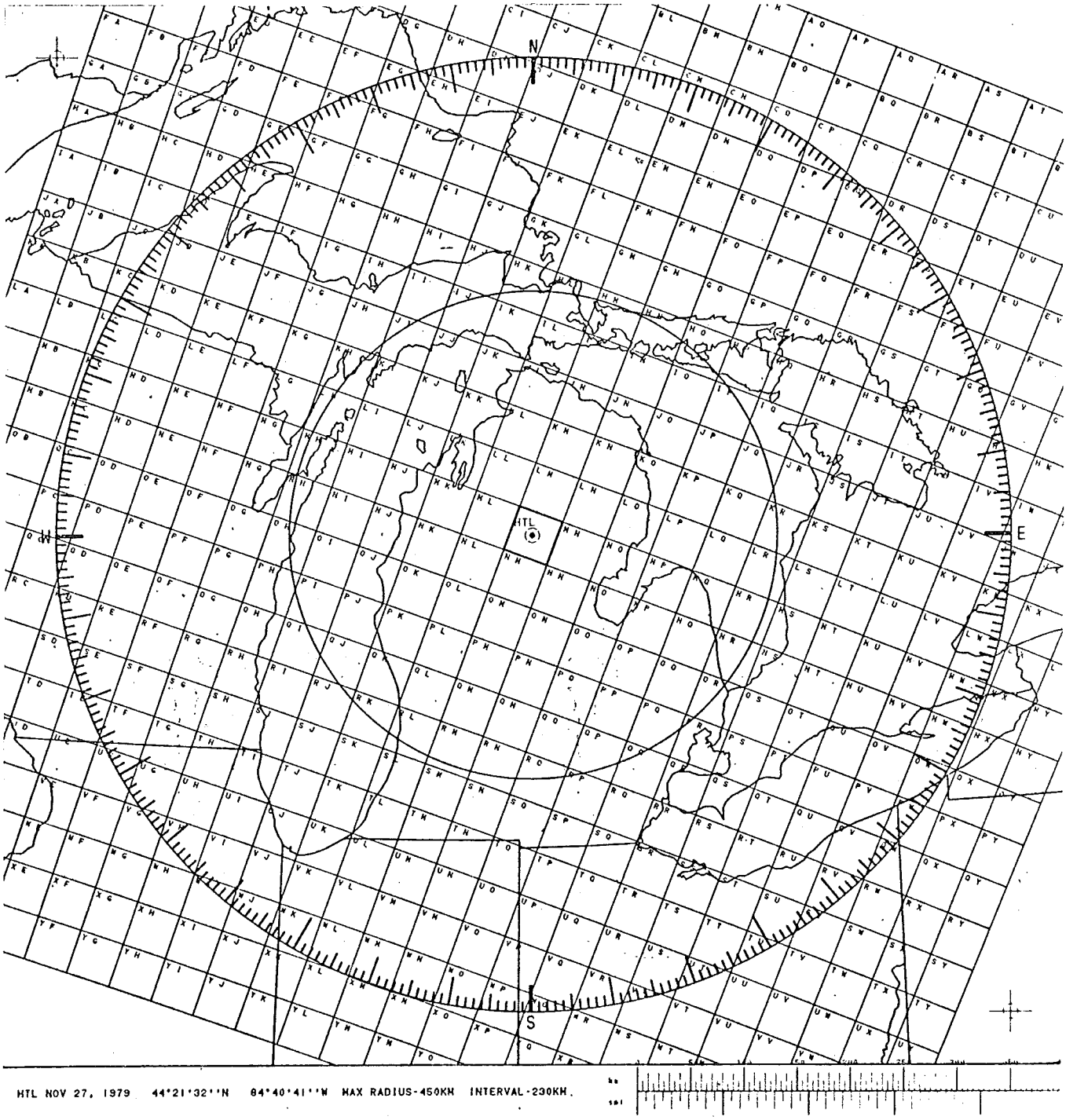

Figure 96.--450 kilometer radar code grid for Houghton Lake, Mich.

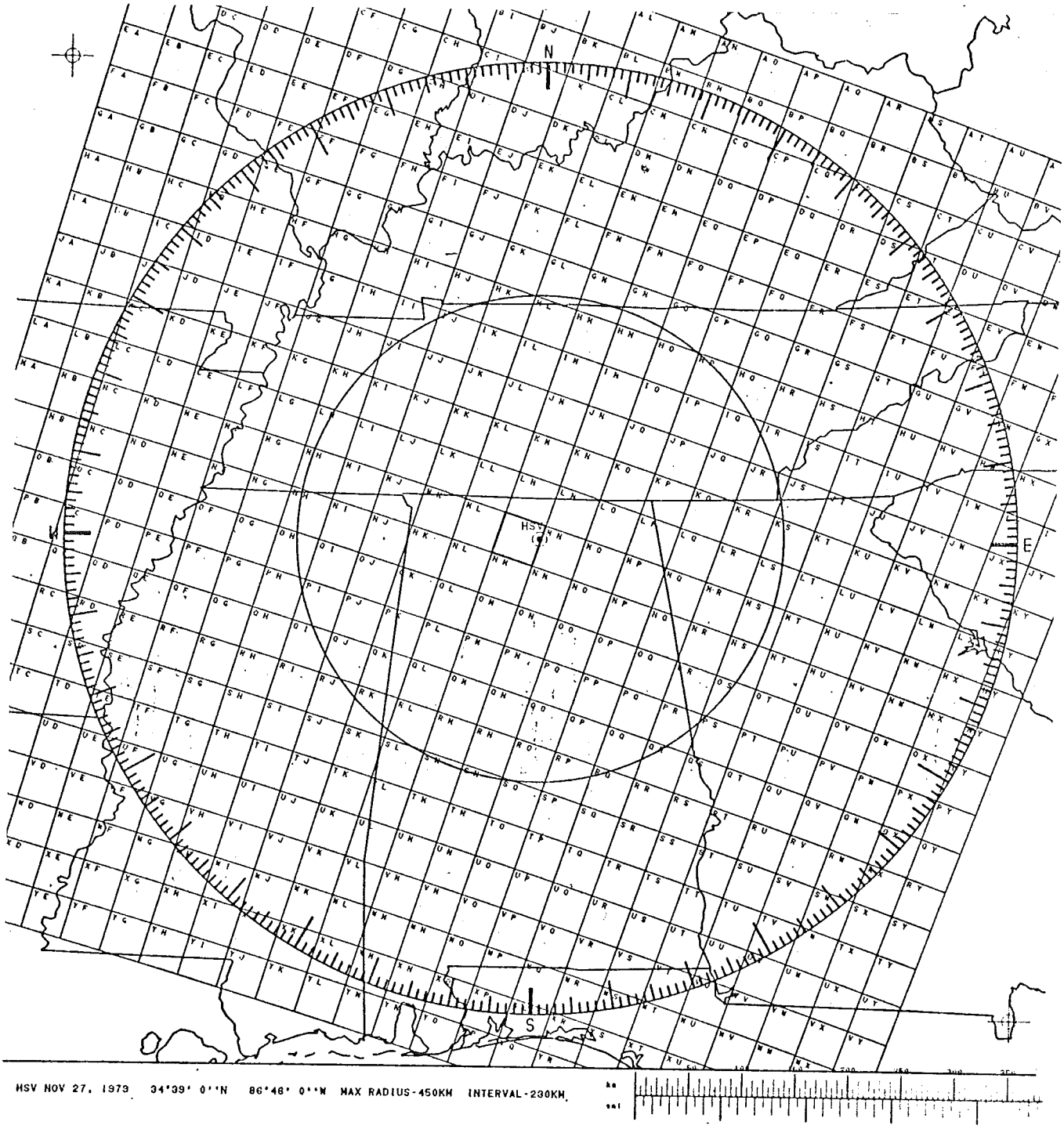

Figure 97.--450 kilometer radar code grid for Huntsville, Alabama.

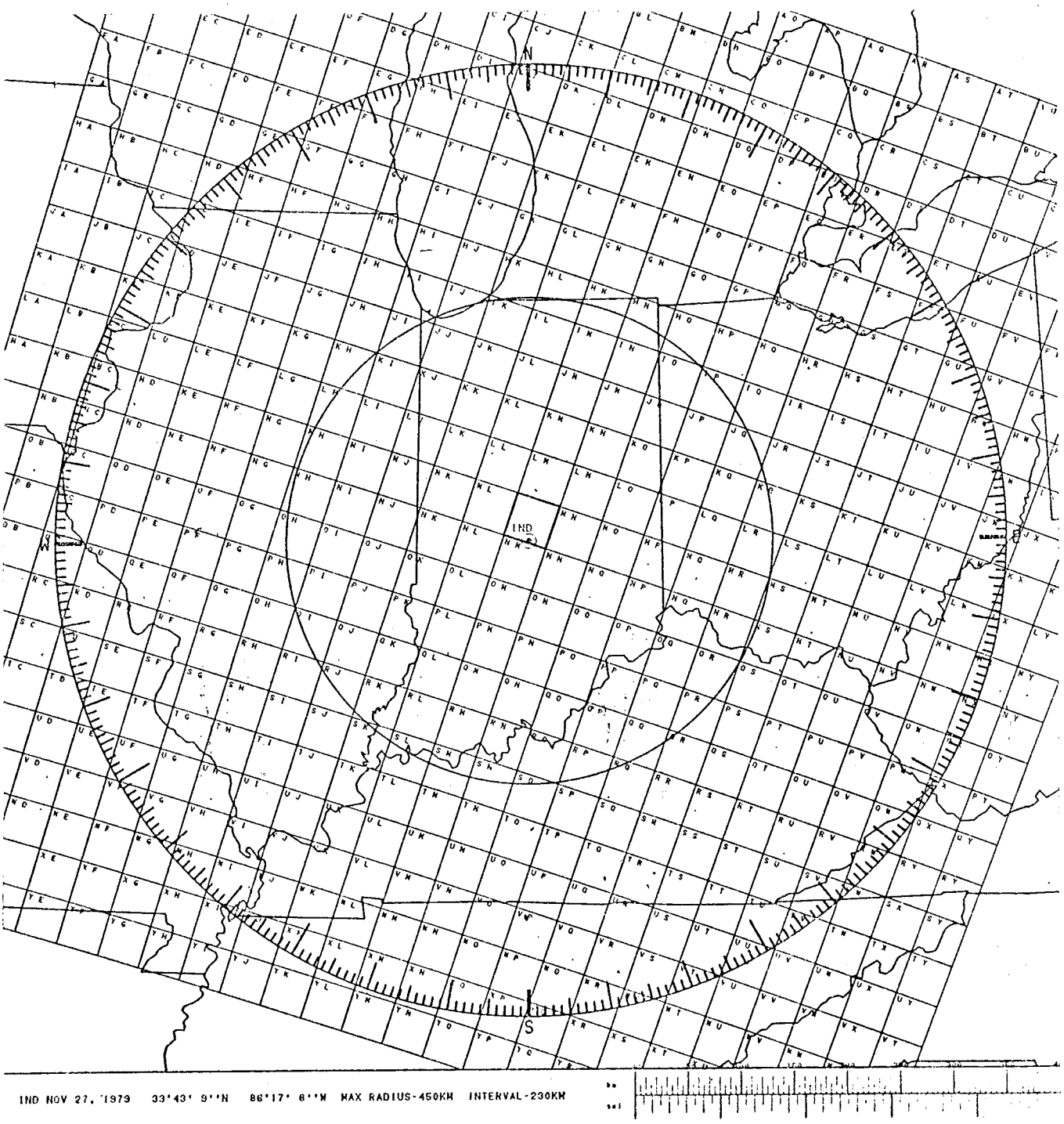

Figure 98.--450 kilometer radar code grid for Indianapolis, Ind.

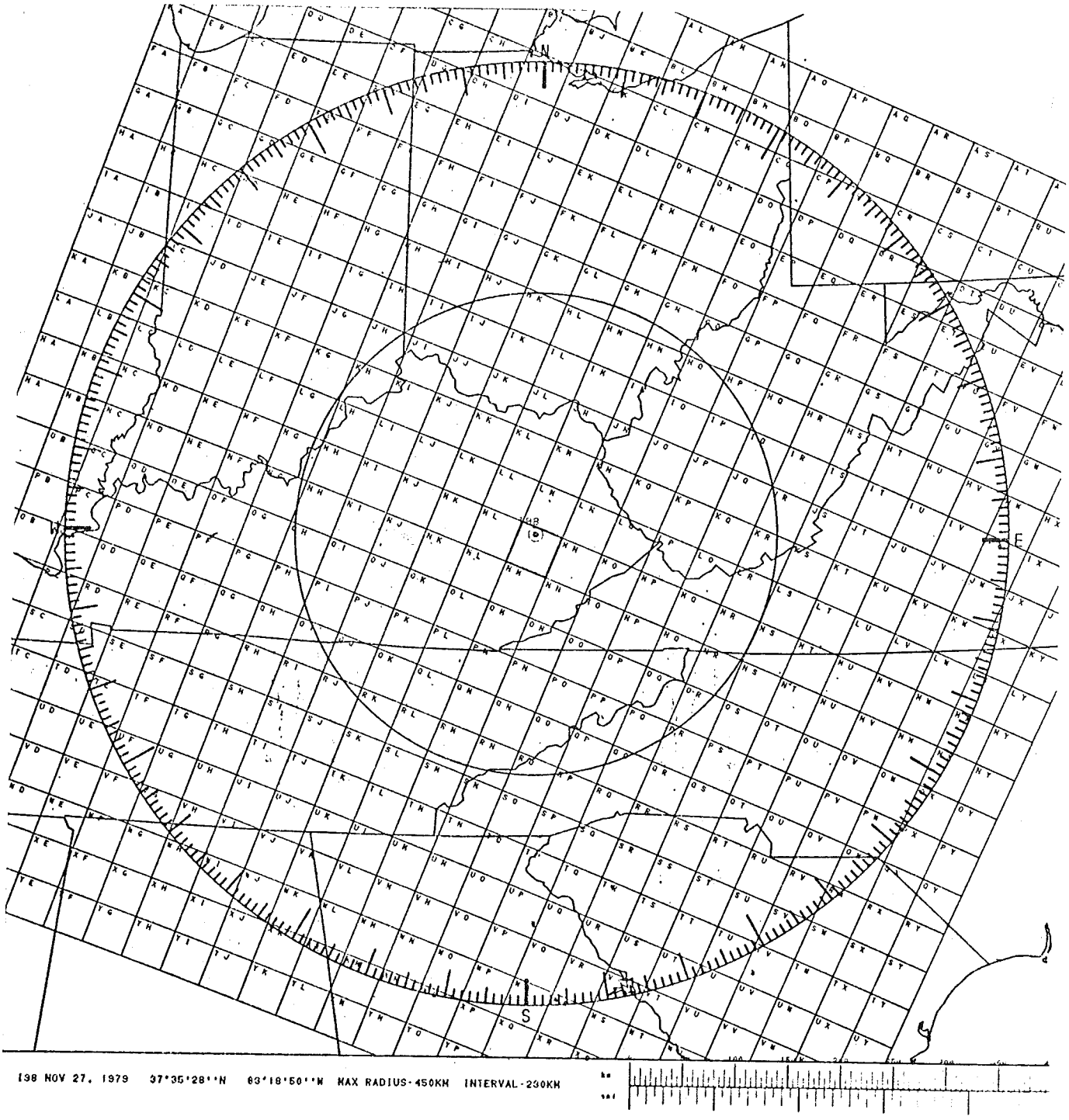

Figure 99.--450 kilometer radar code grid for Jackson, Kentucky.

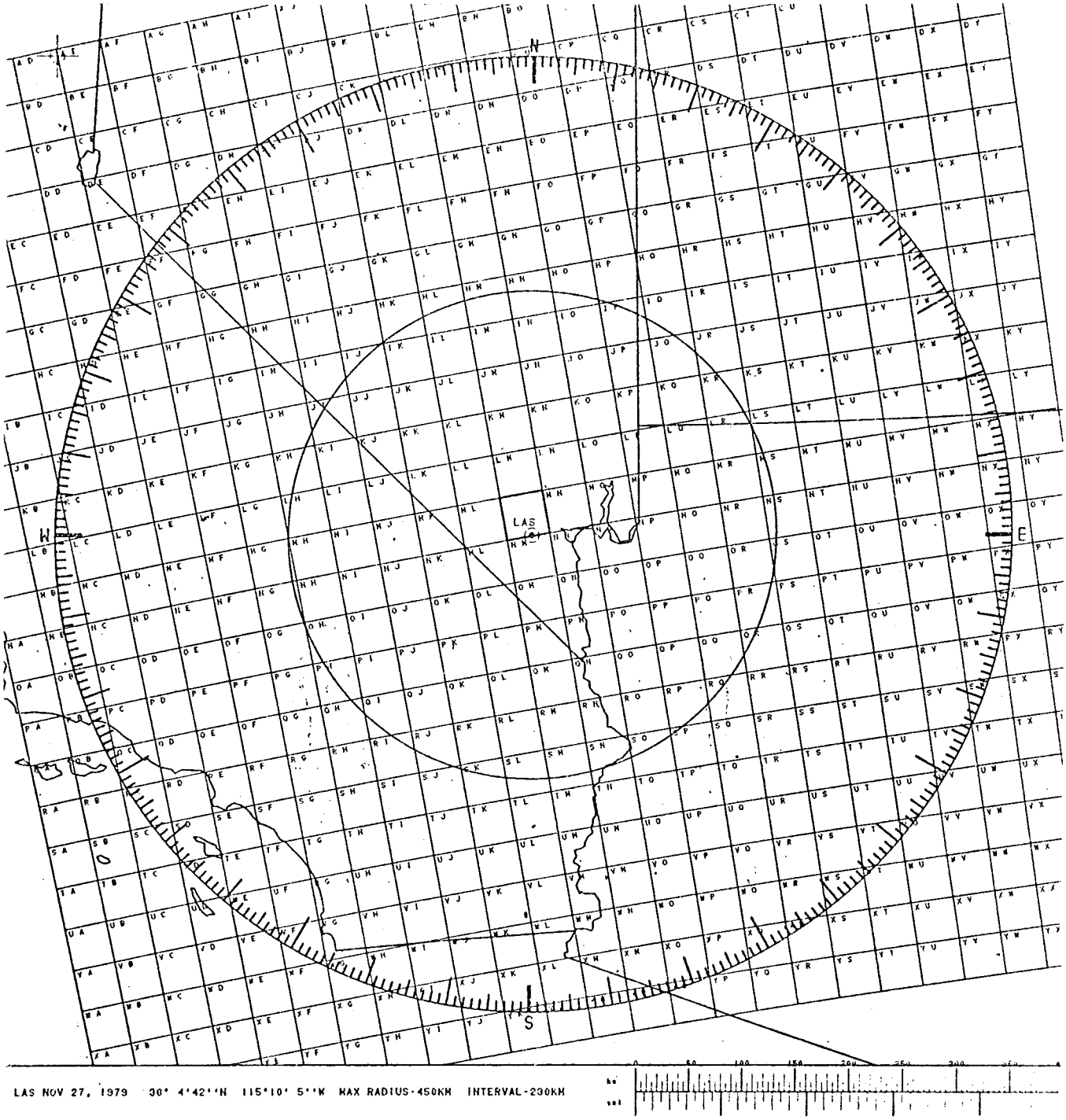

Figure 100.--450 kilometer radar code grid for Las Vegas, Nevada.

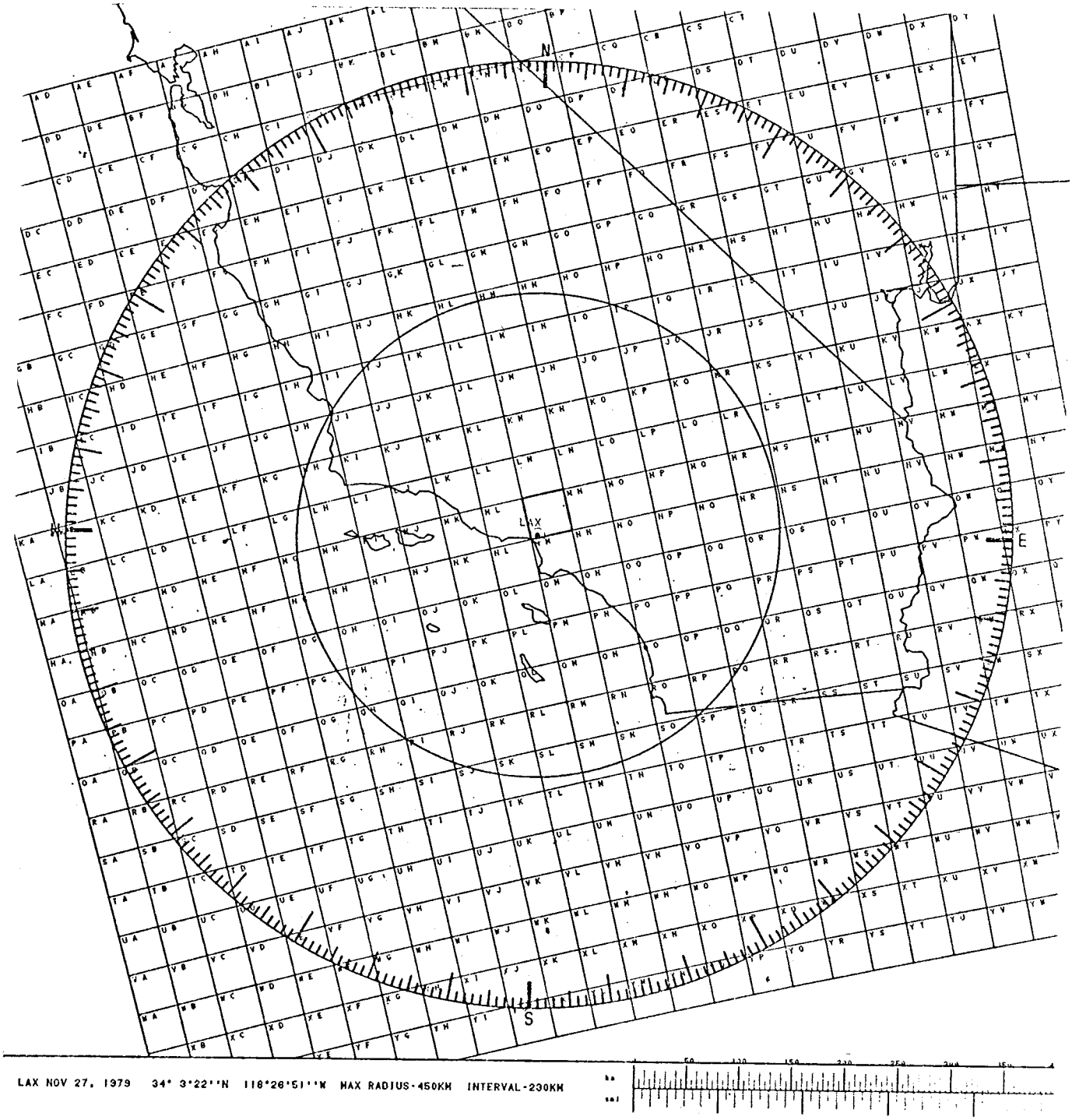

Figure 101.--450 kilometer radar code grid for Los Angeles, Calif.

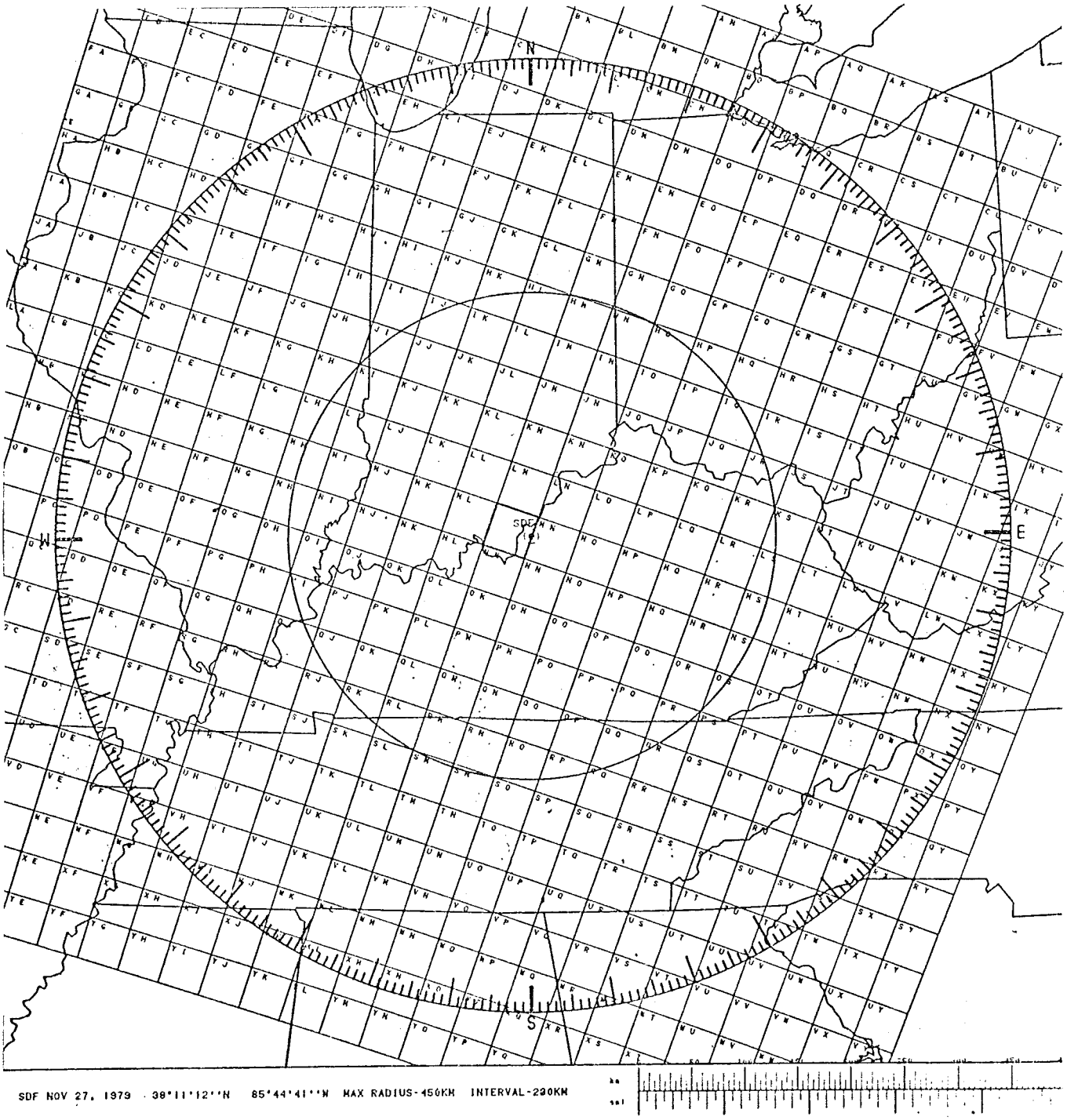

Figure 102.--450 kilometer radar code grid for Louisville, Kentucky.

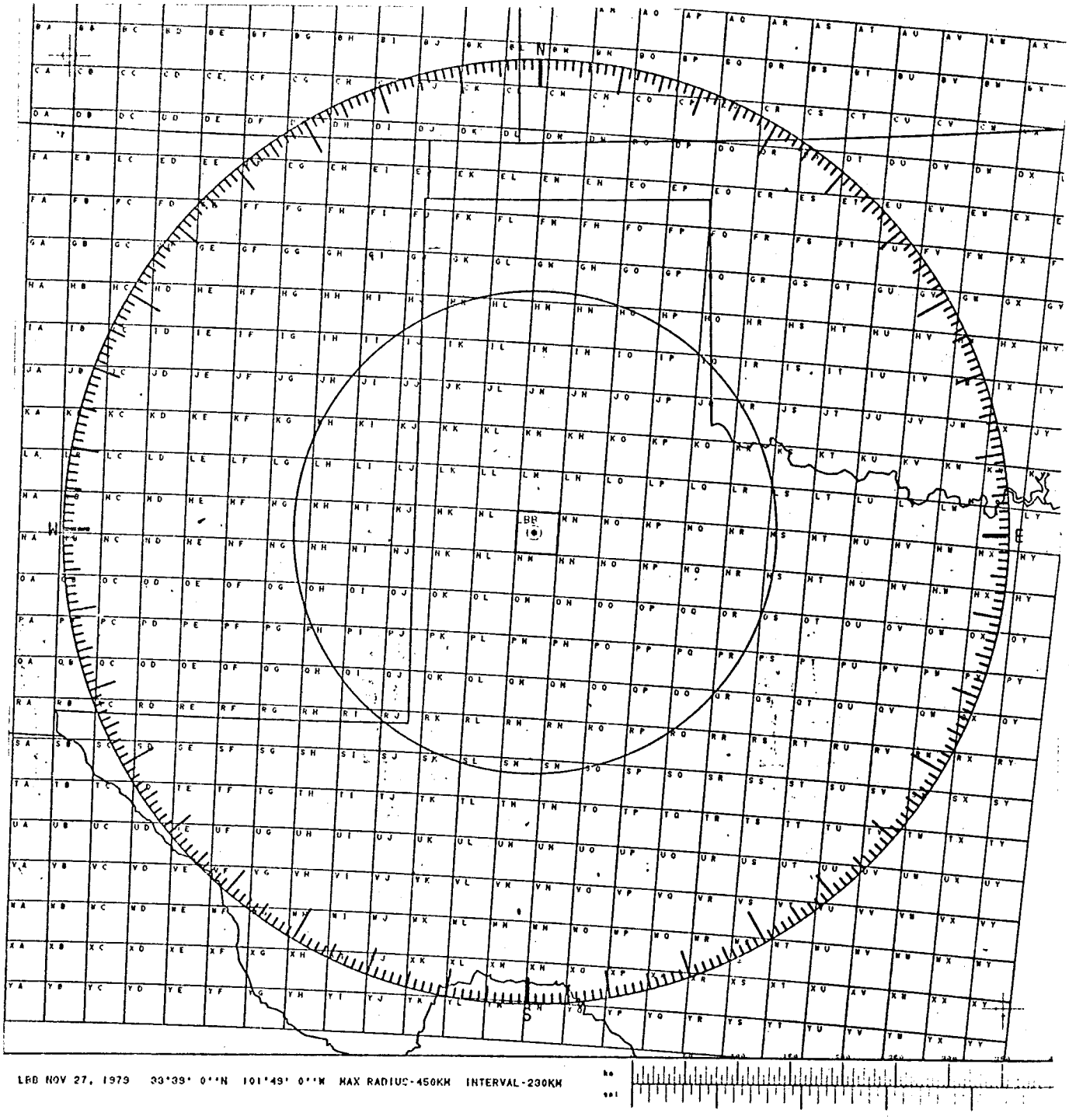

Figure 103.--450 kilometer radar code grid for Lubbock, Texas.

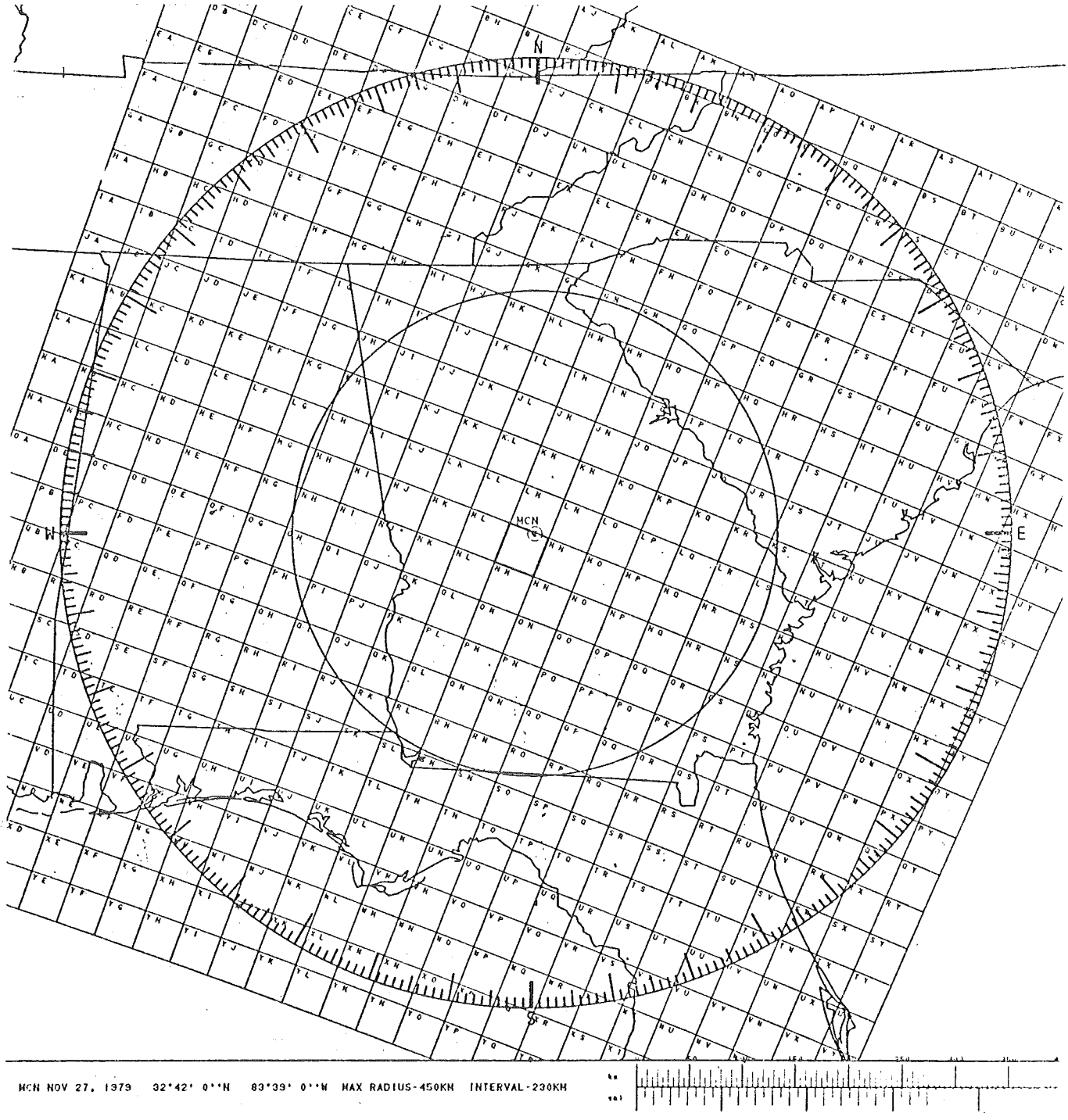

Figure 104.--450 kilometer radar code grid for Macon, Georgia.

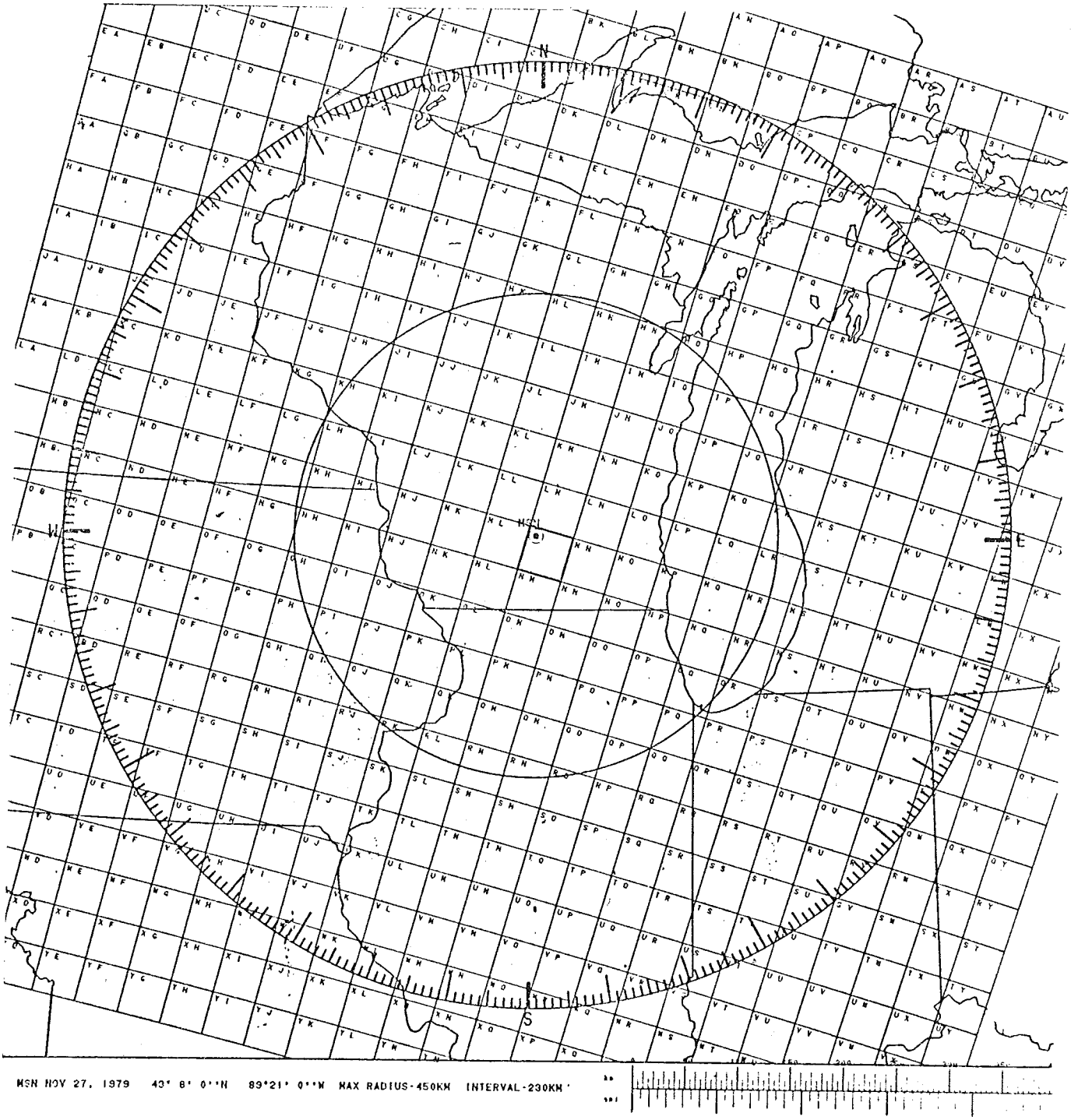

Figure 105.--450 kilometer radar code grid for Madison, Wisconsin.

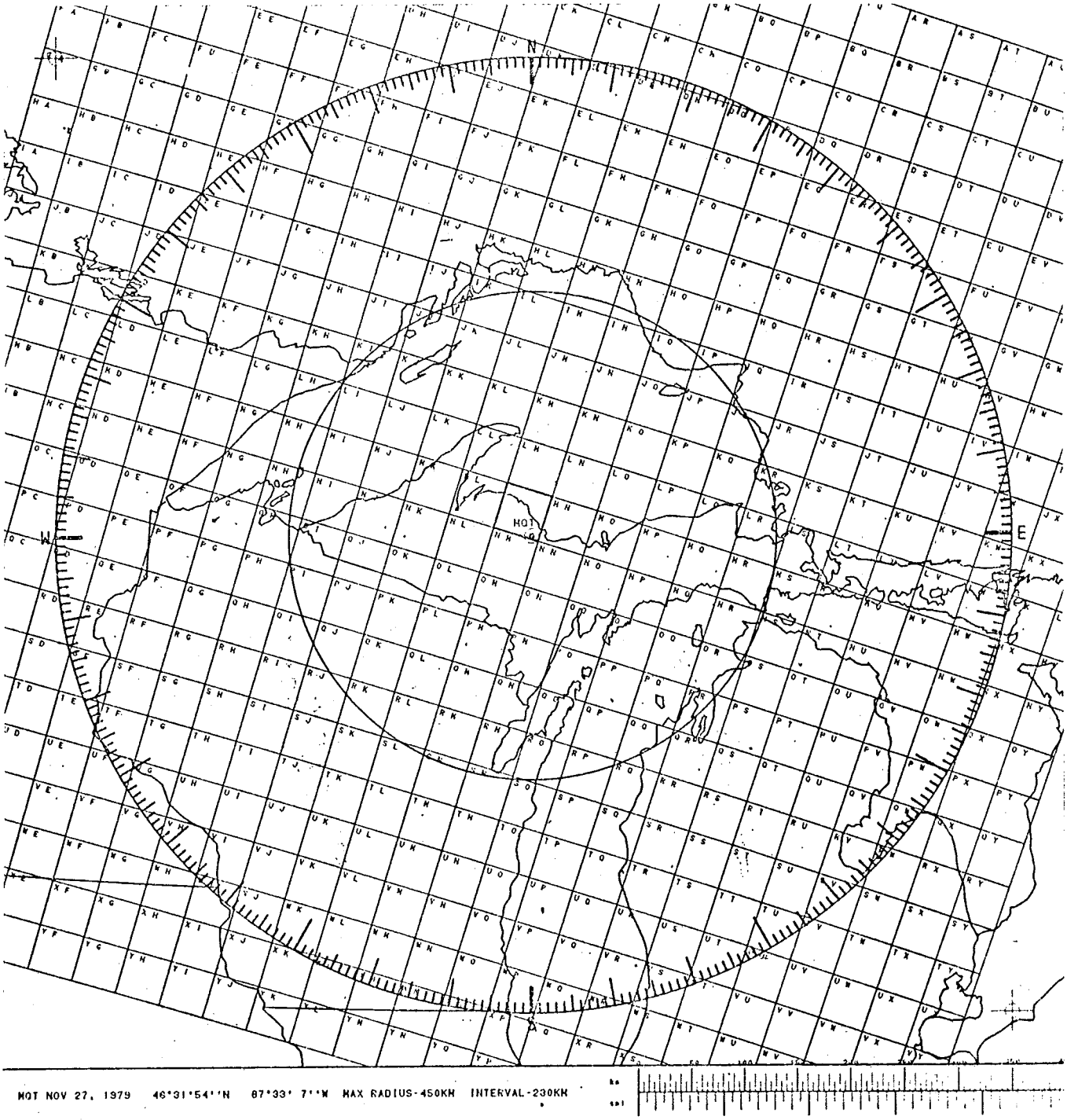

Figure 106.--450 kilometer radar code grid for Marquette, Michigan.

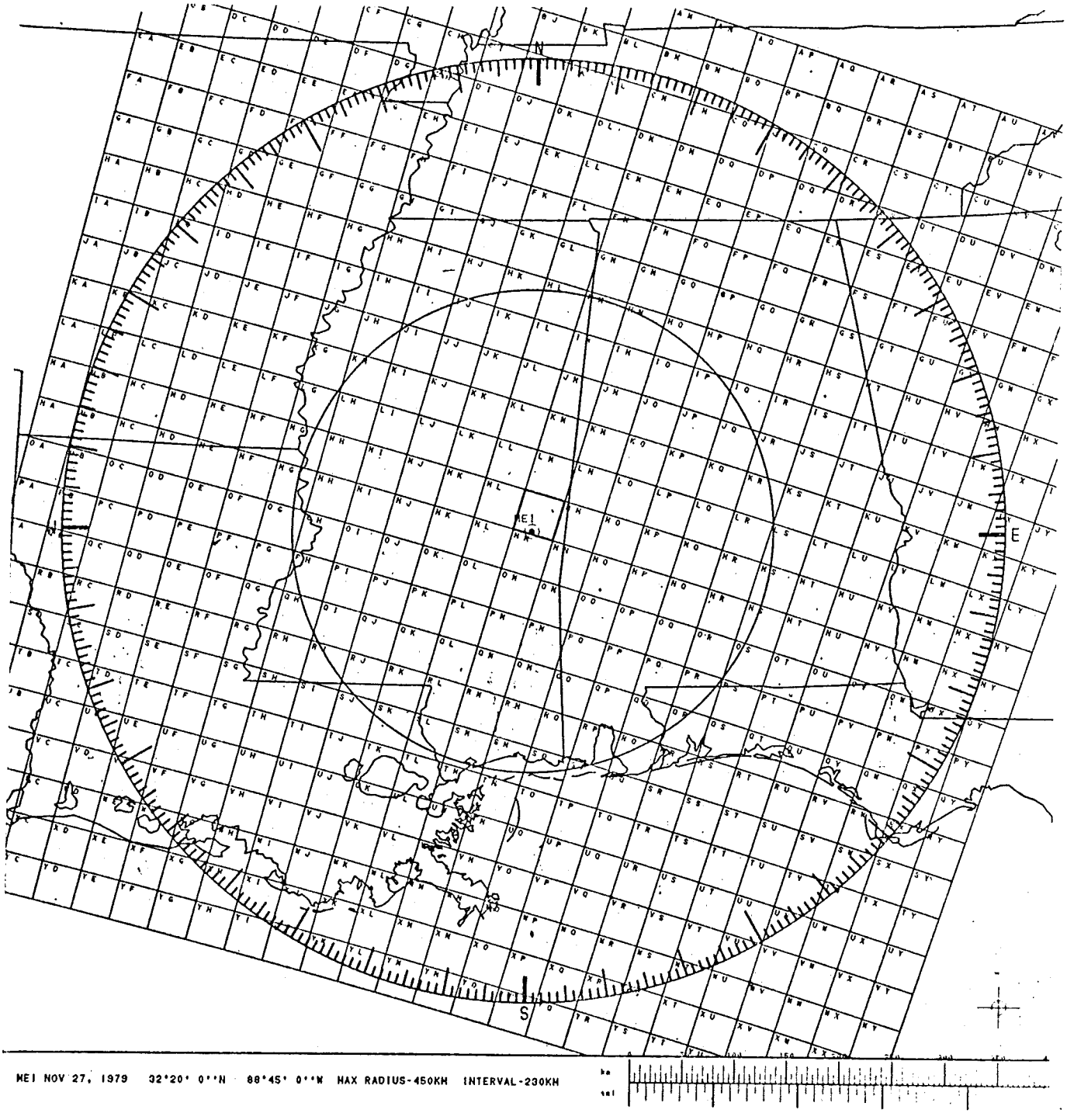

Figure 107.--450 kilometer radar code grid for Meridian, Miss.

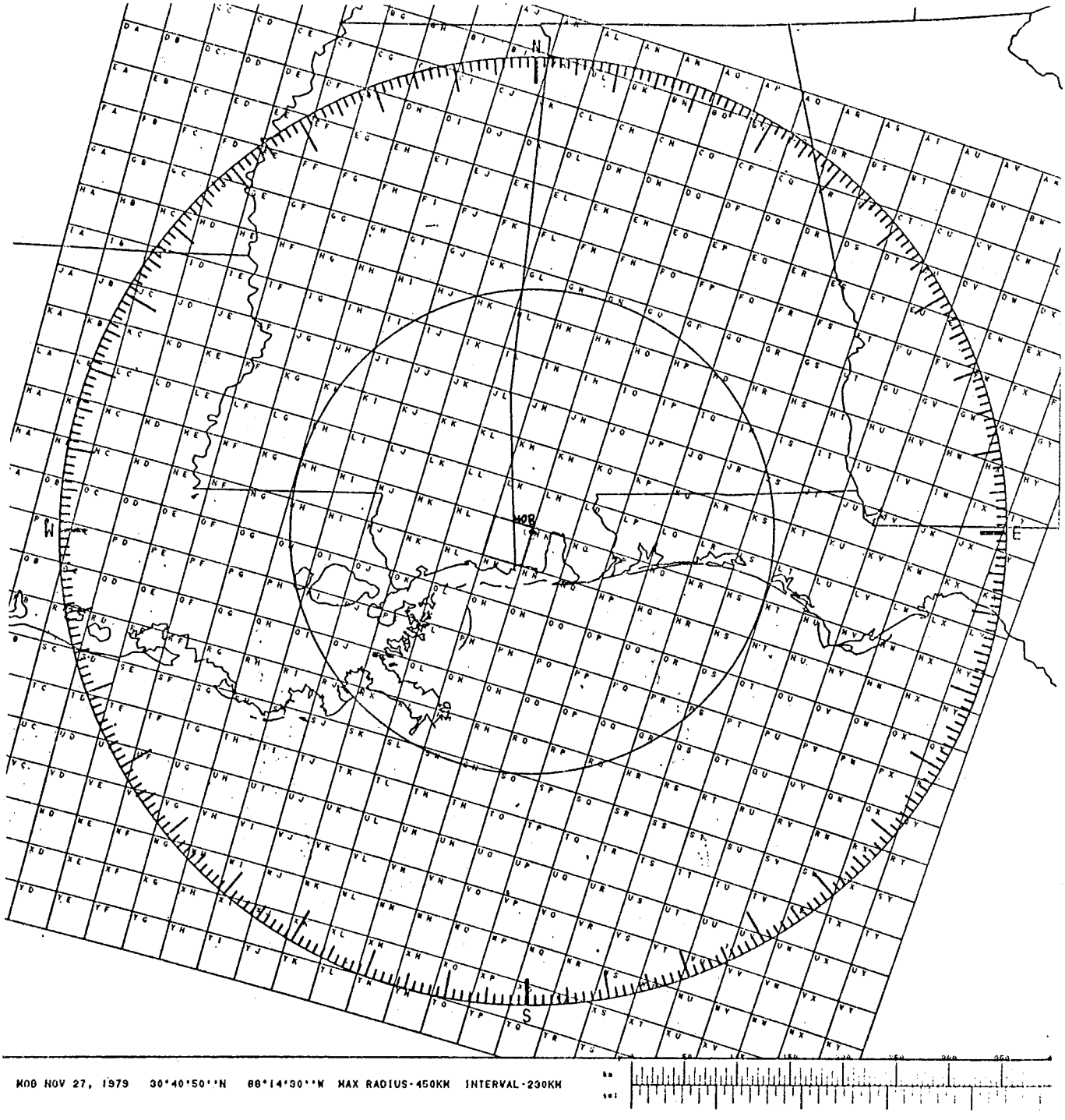

Figure 108.--450 kilometer radar code grid for Mobile, Alabama.

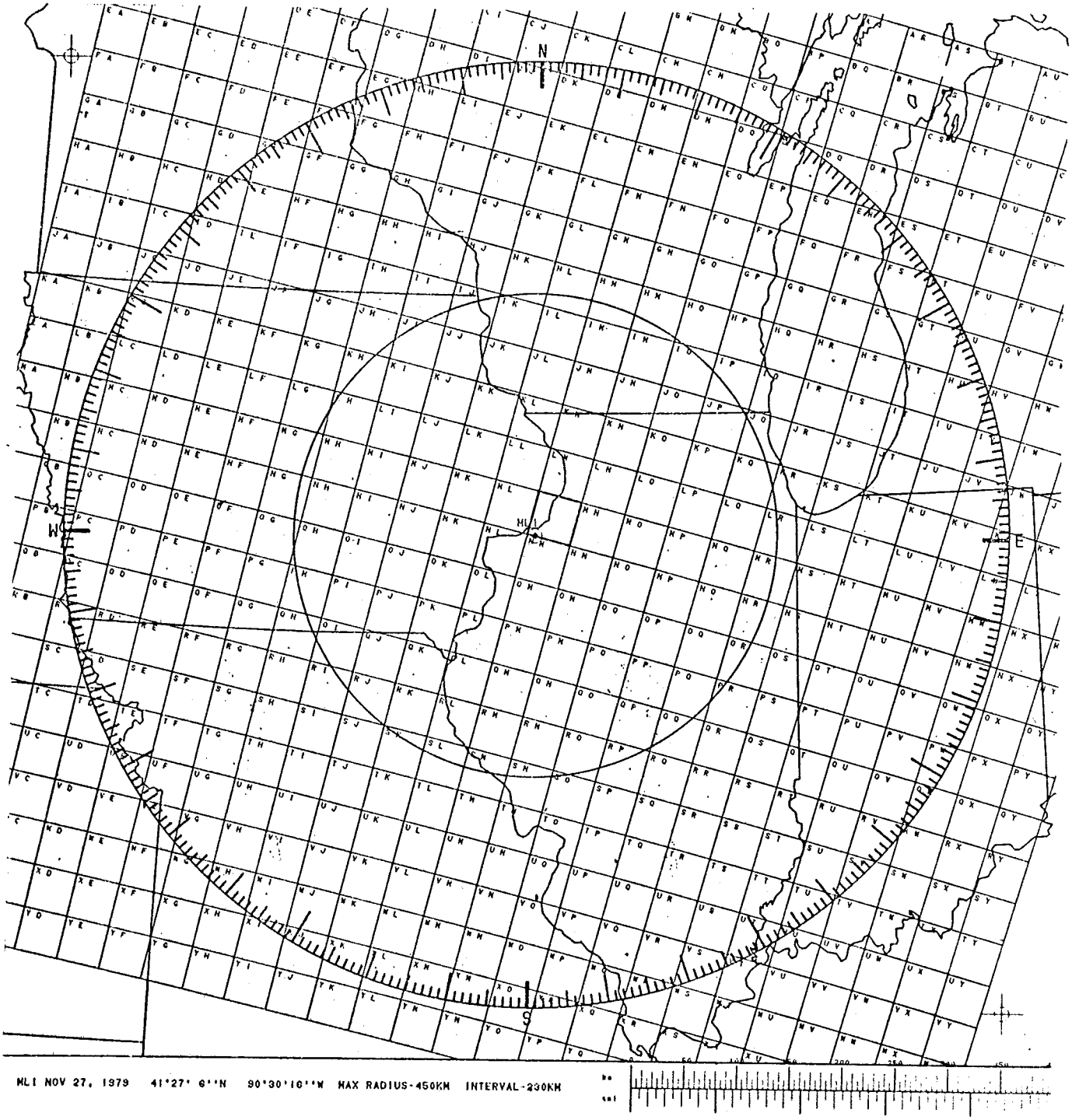

Figure 109.--450 kilometer radar code grid for Moline, Illinois.

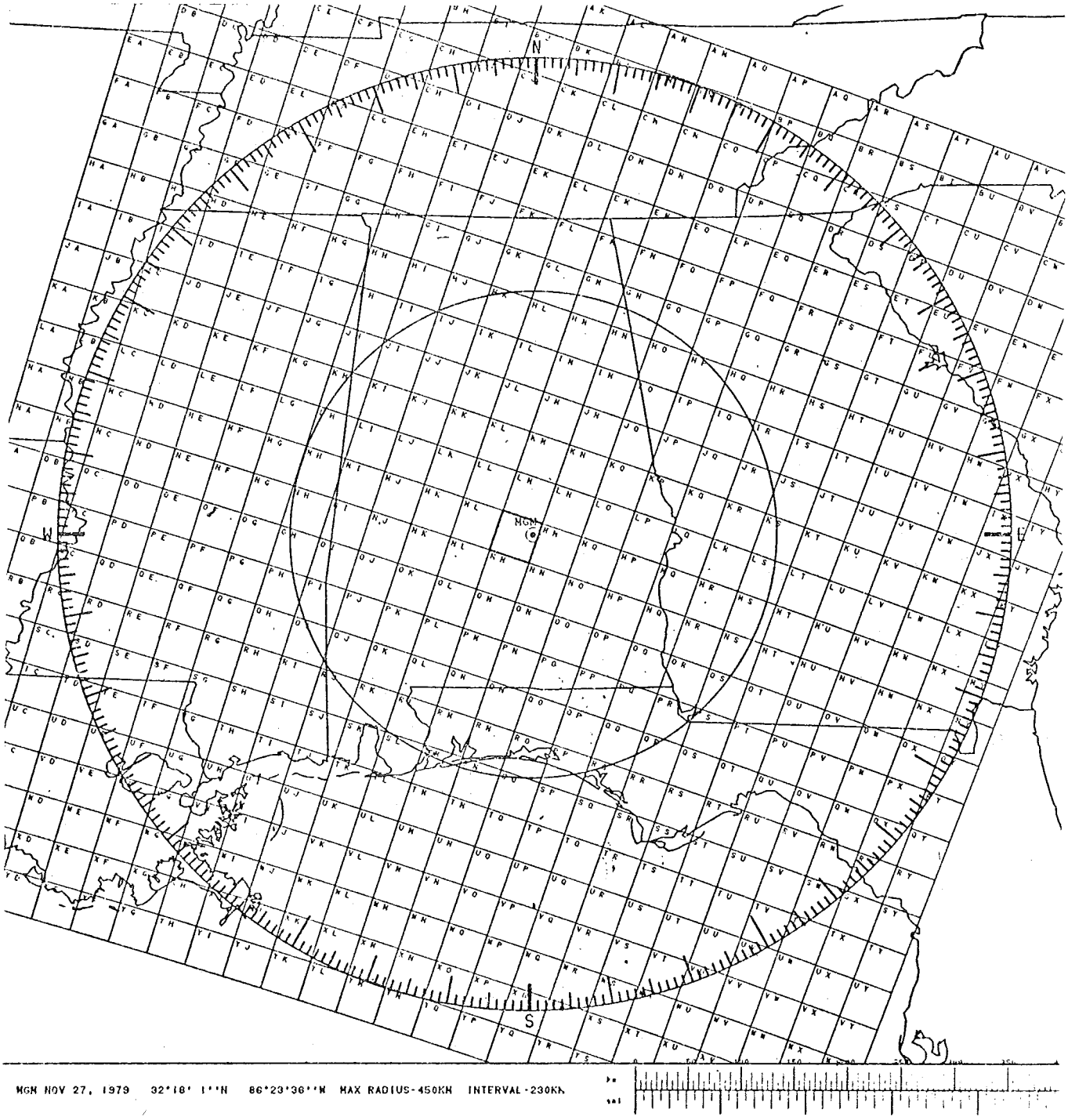

Figure 110.--450 kilometer radar code grid for Montgomery, Ala.

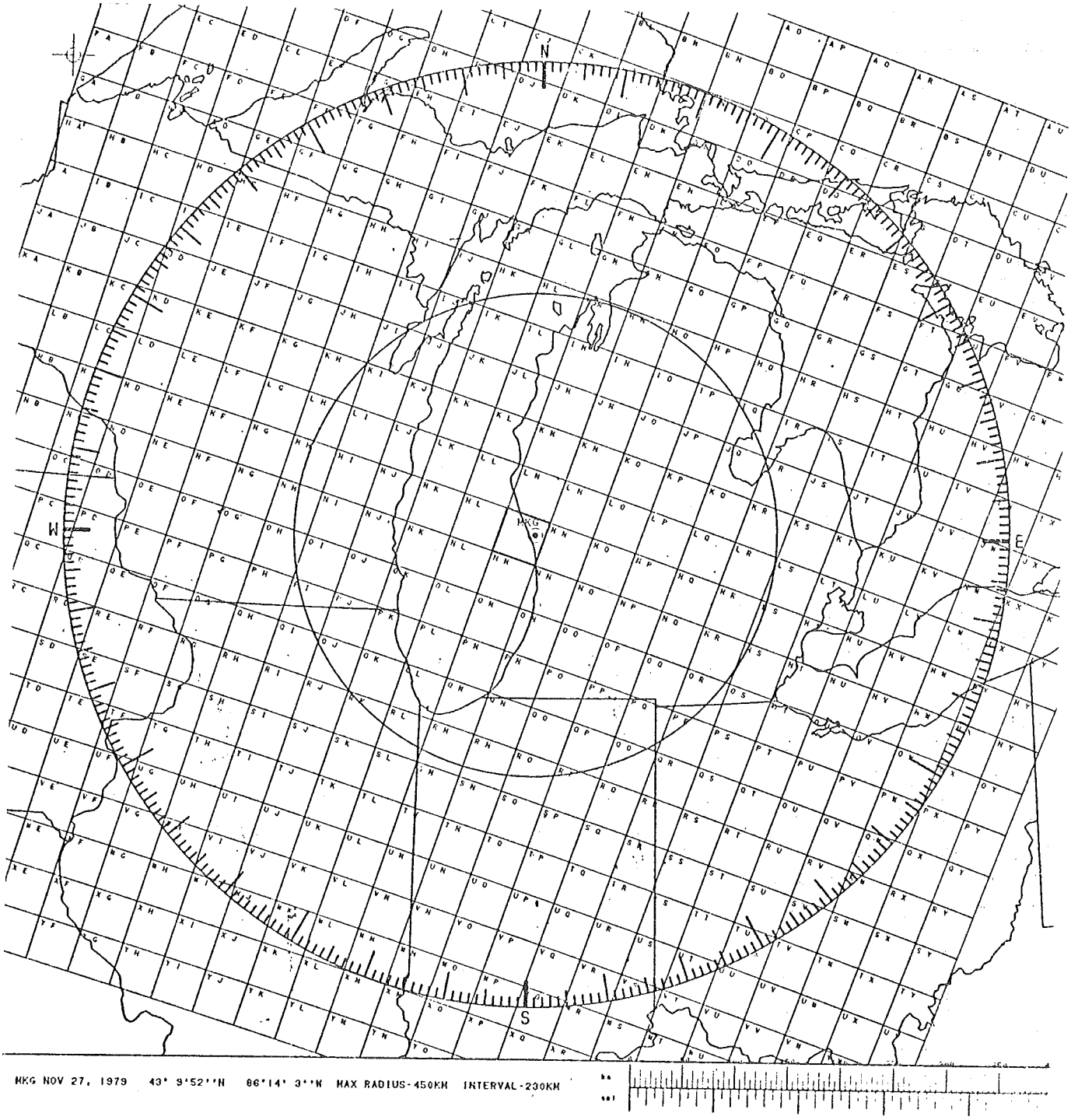

Figure 111.--450 kilometer radar code grid for Muskegon, Michigan.

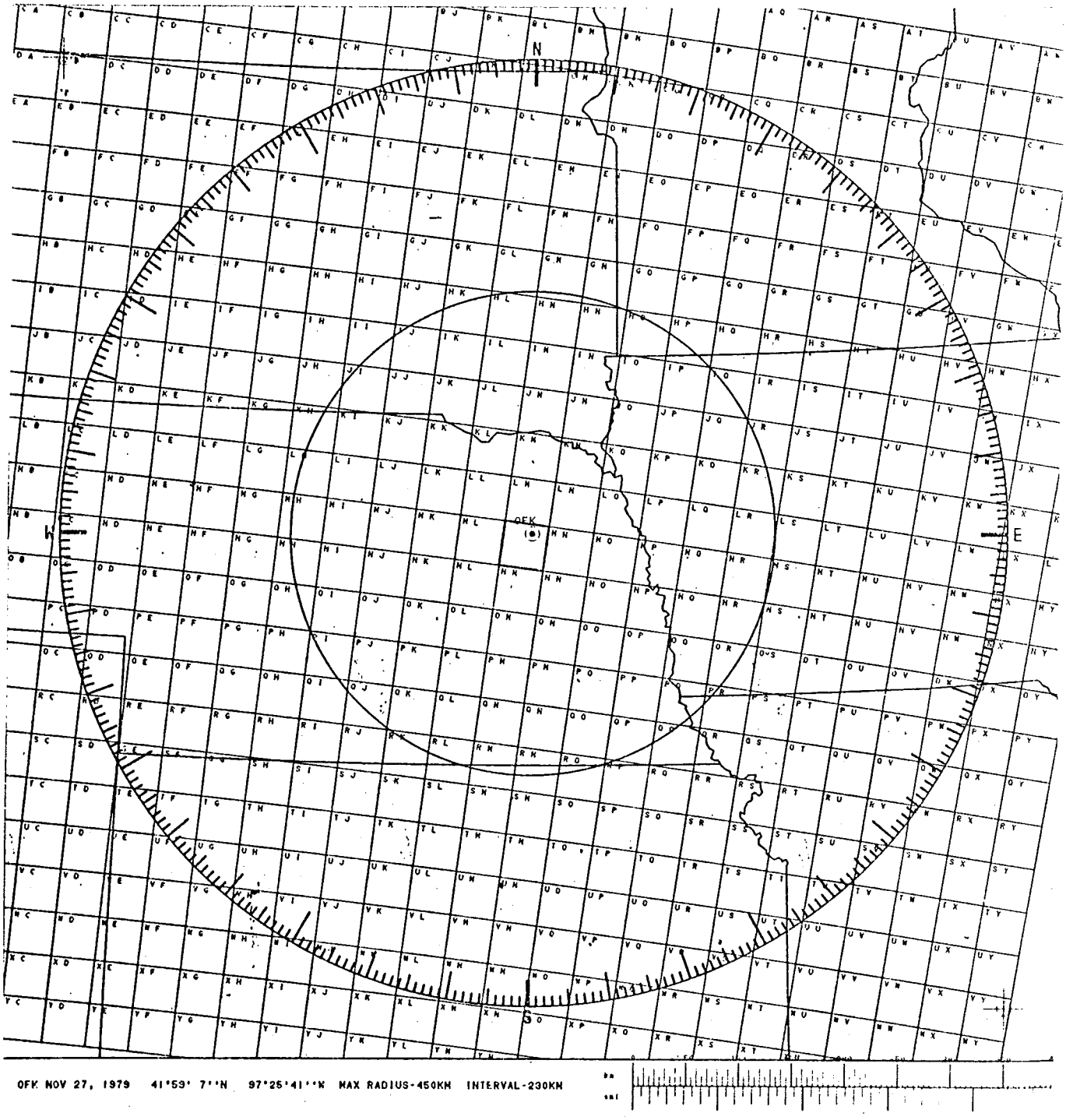

Figure 112.--450 kilometer radar code grid for Norfolk, Nebraska.

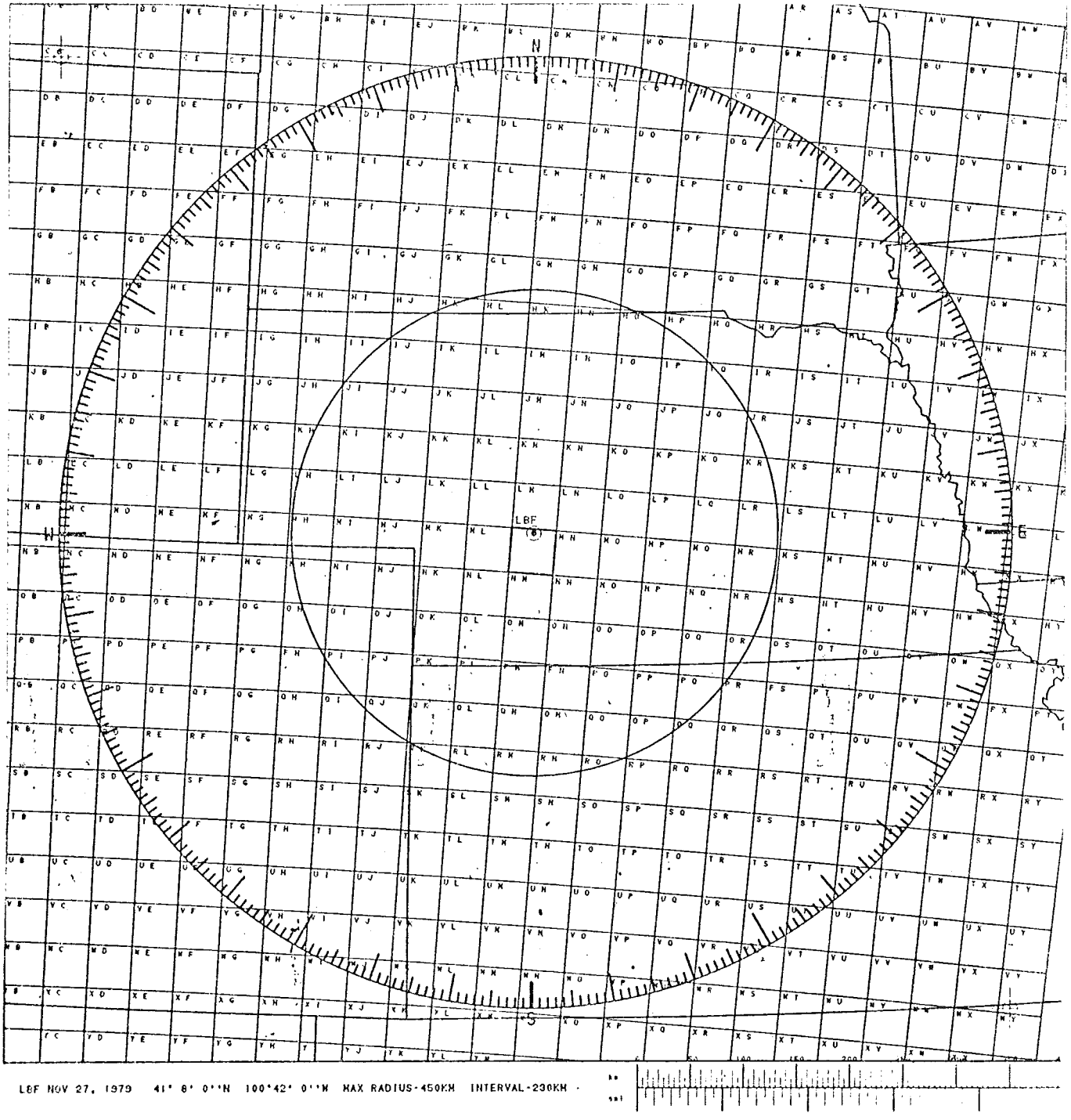

Figure 113.--450 kilometer radar code grid for North Platte, Nebr.

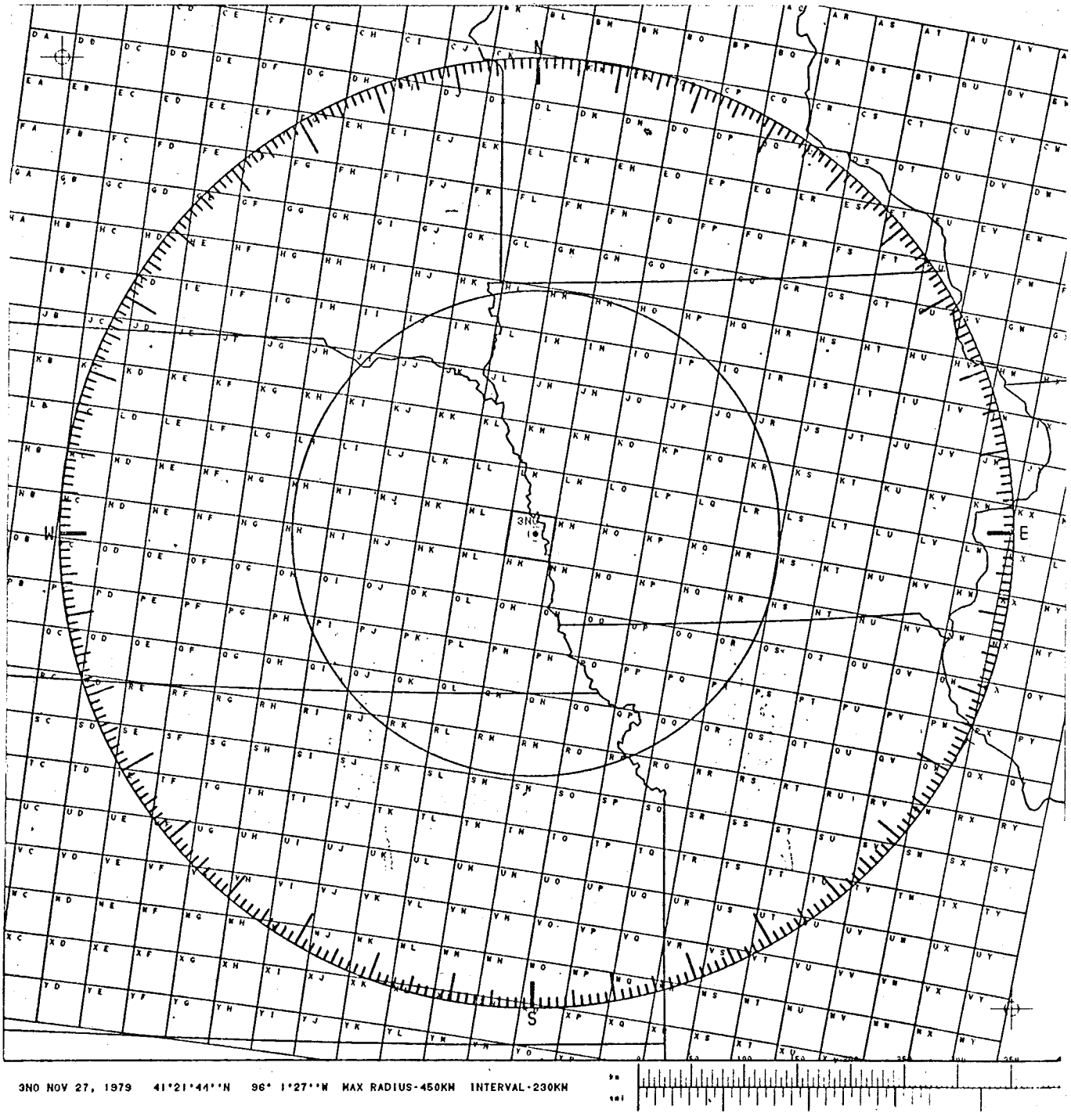

Figure 114.--450 kilometer radar code grid for Omaha, Nebraska.

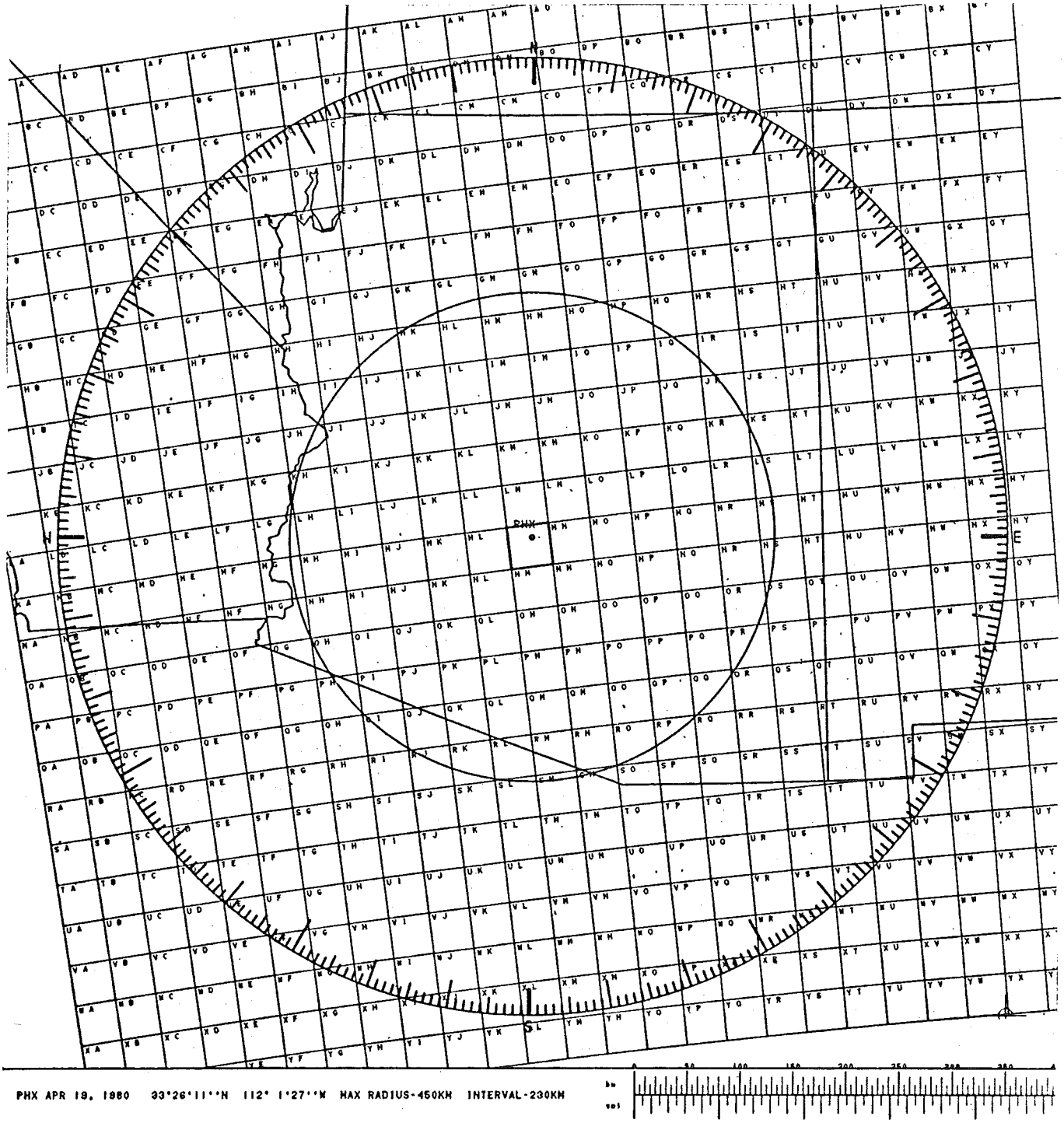

Figure 115.--450 kilometer radar code grid for Phoenix, Arizona.

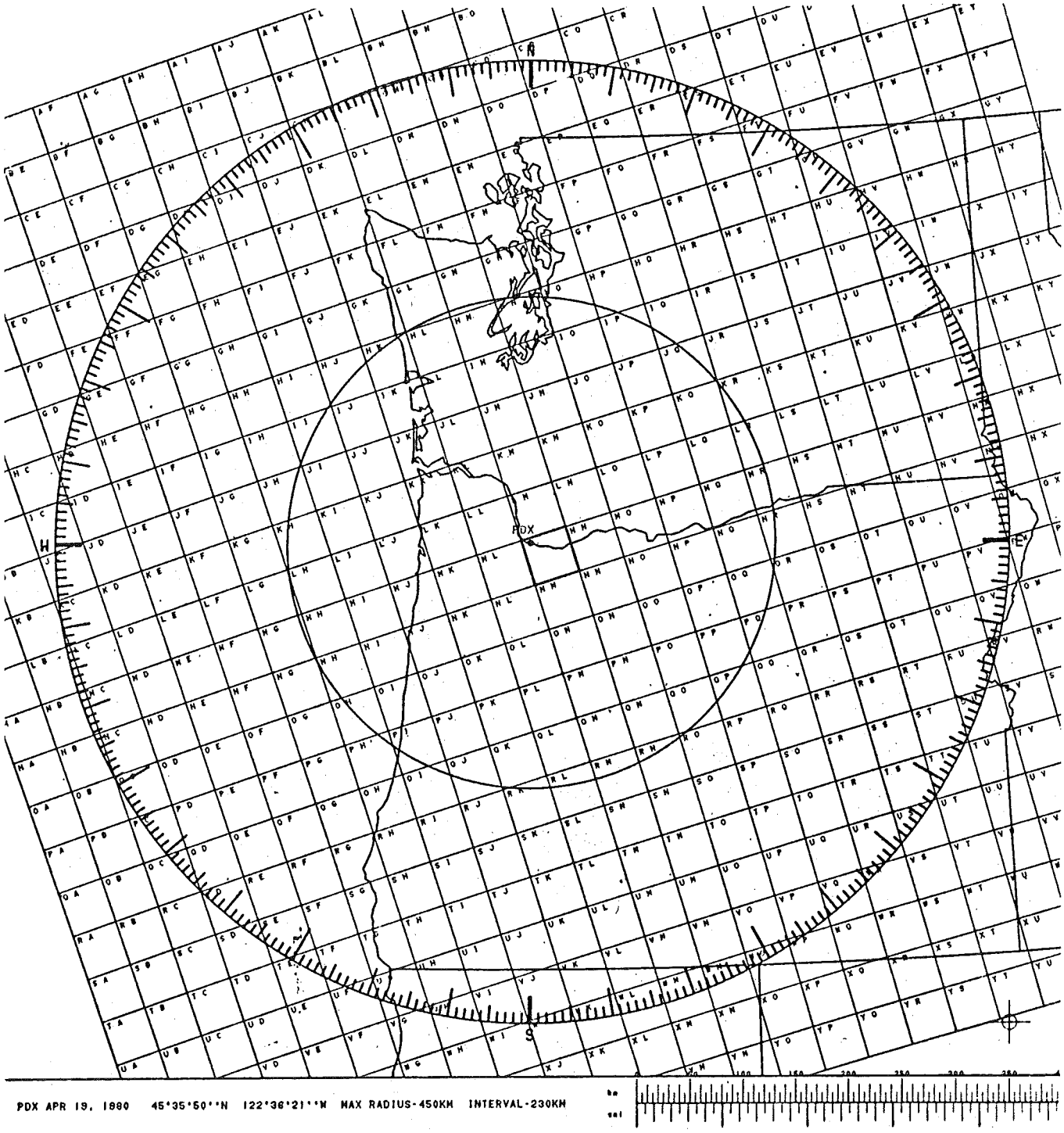

Figure 116.--450 kilometer radar code grid for Portland, Oregon.

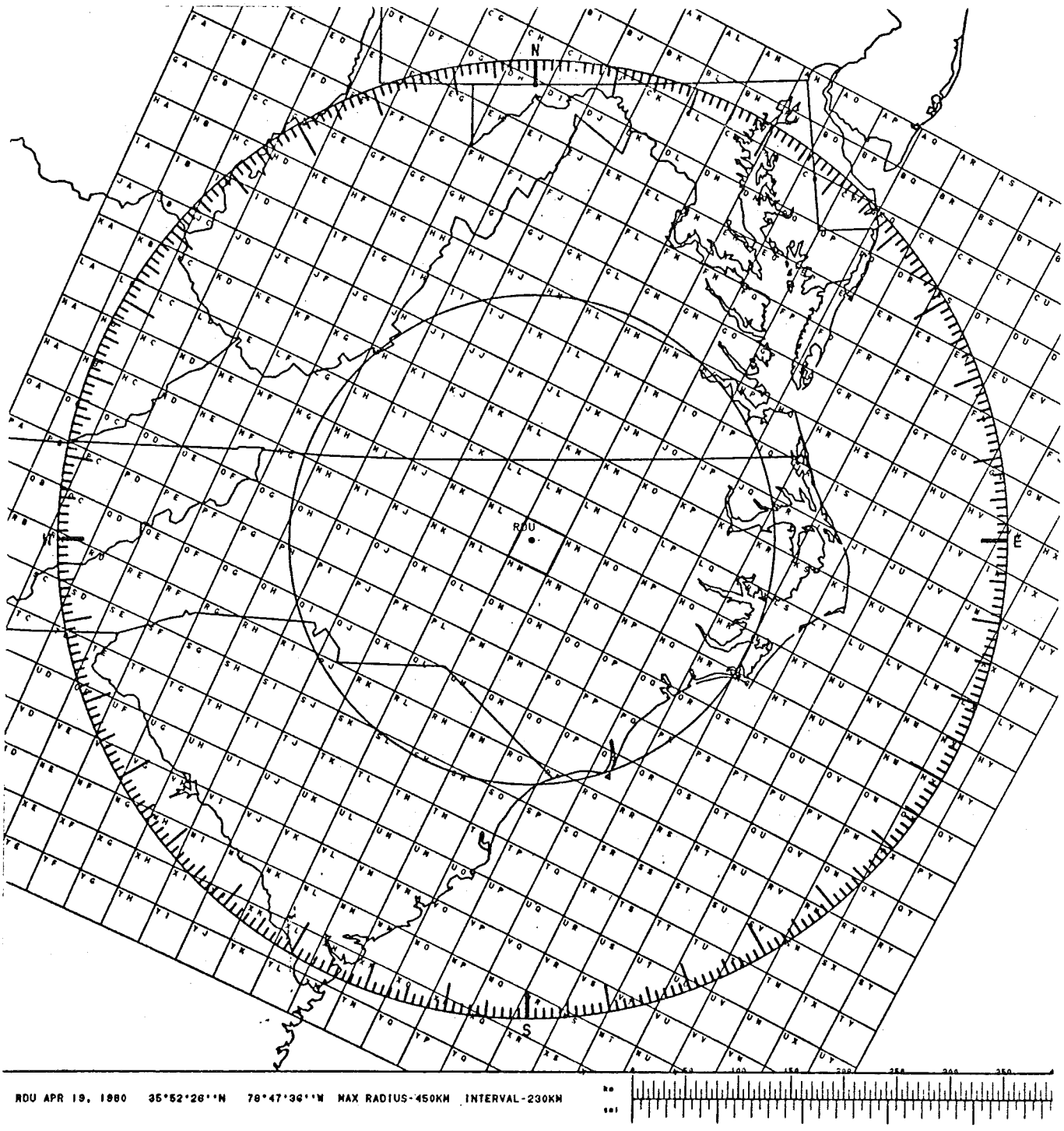

Figure 117.--450 kilometer radar code grid for Raleigh, N.C.

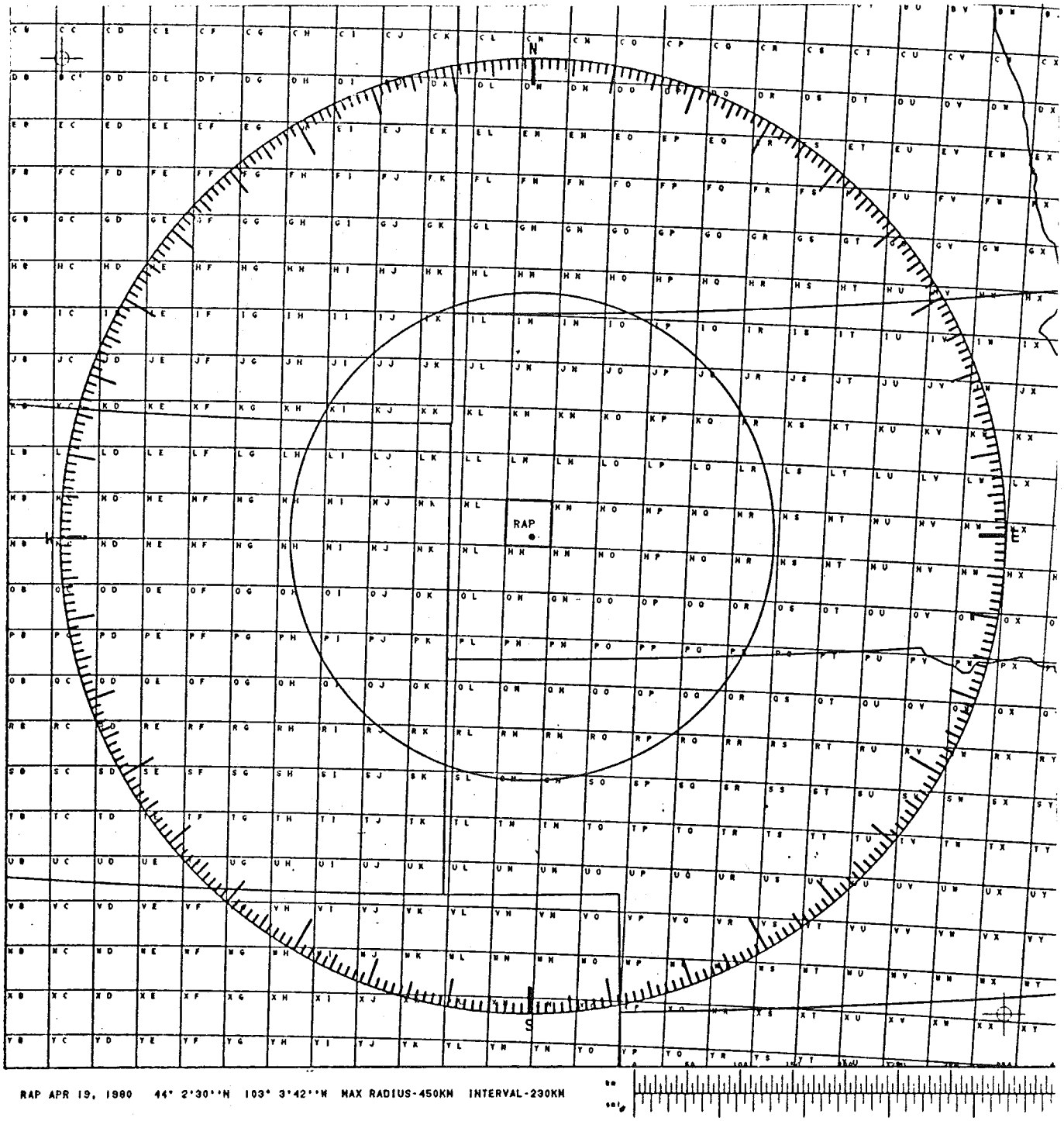

Figure 118.--450 kilometer radar code grid for Rapid City, S. Dak.

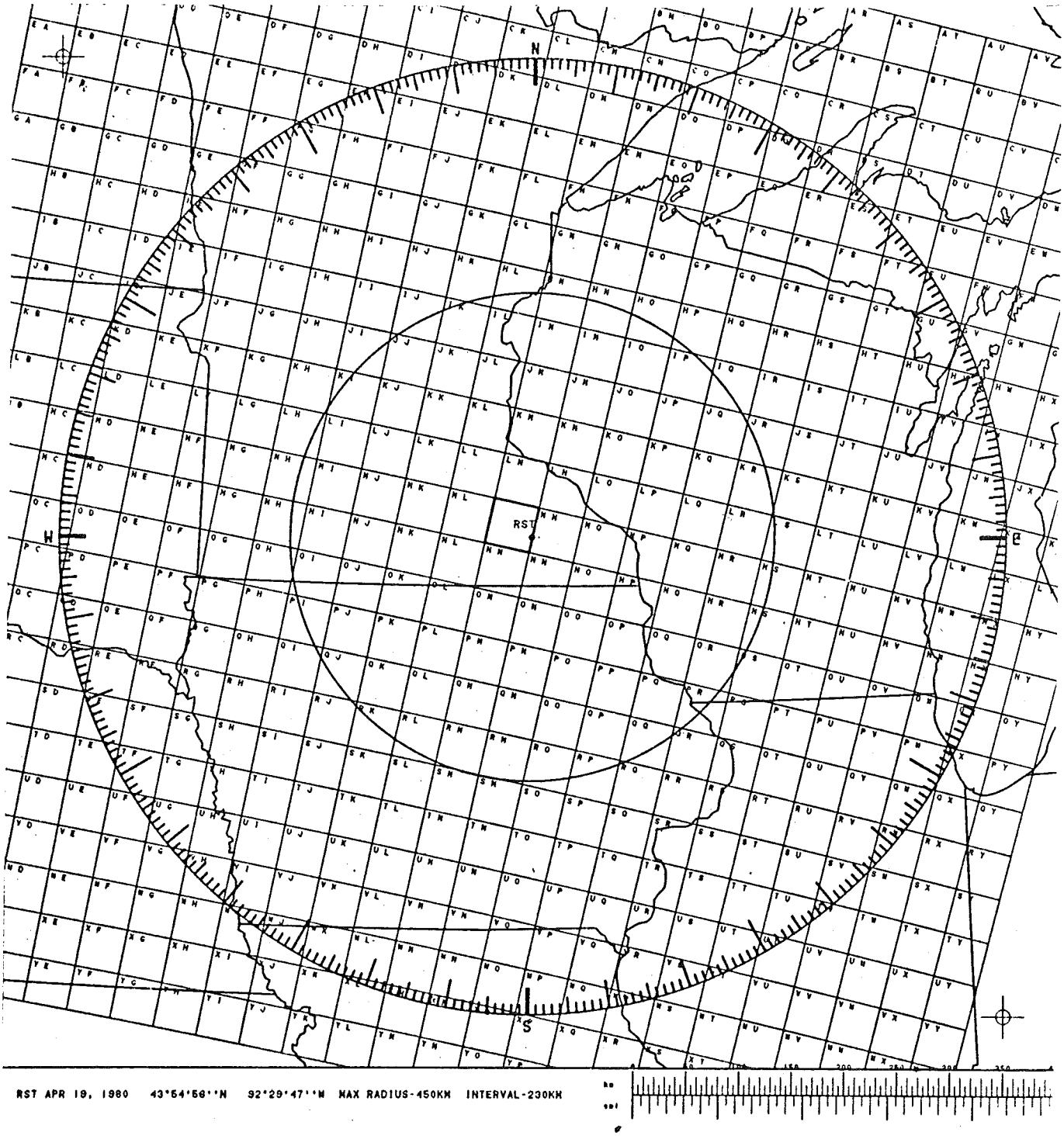

Figure 119.--450 kilometer radar code grid for Rochester, Minn.

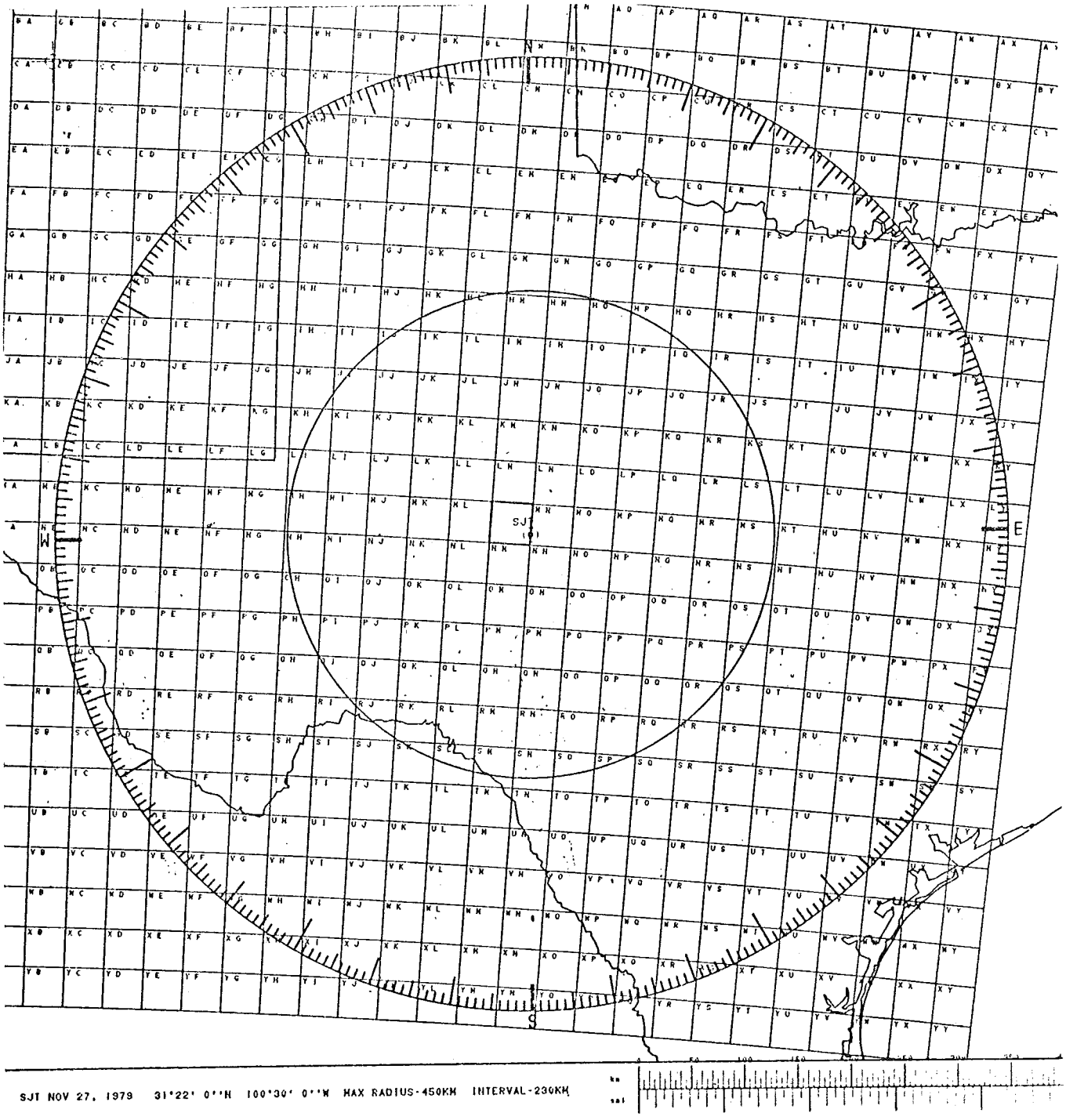

Figure 120.--450 kilometer radar code grid for San Angelo, Texas.

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is a network
RADAR

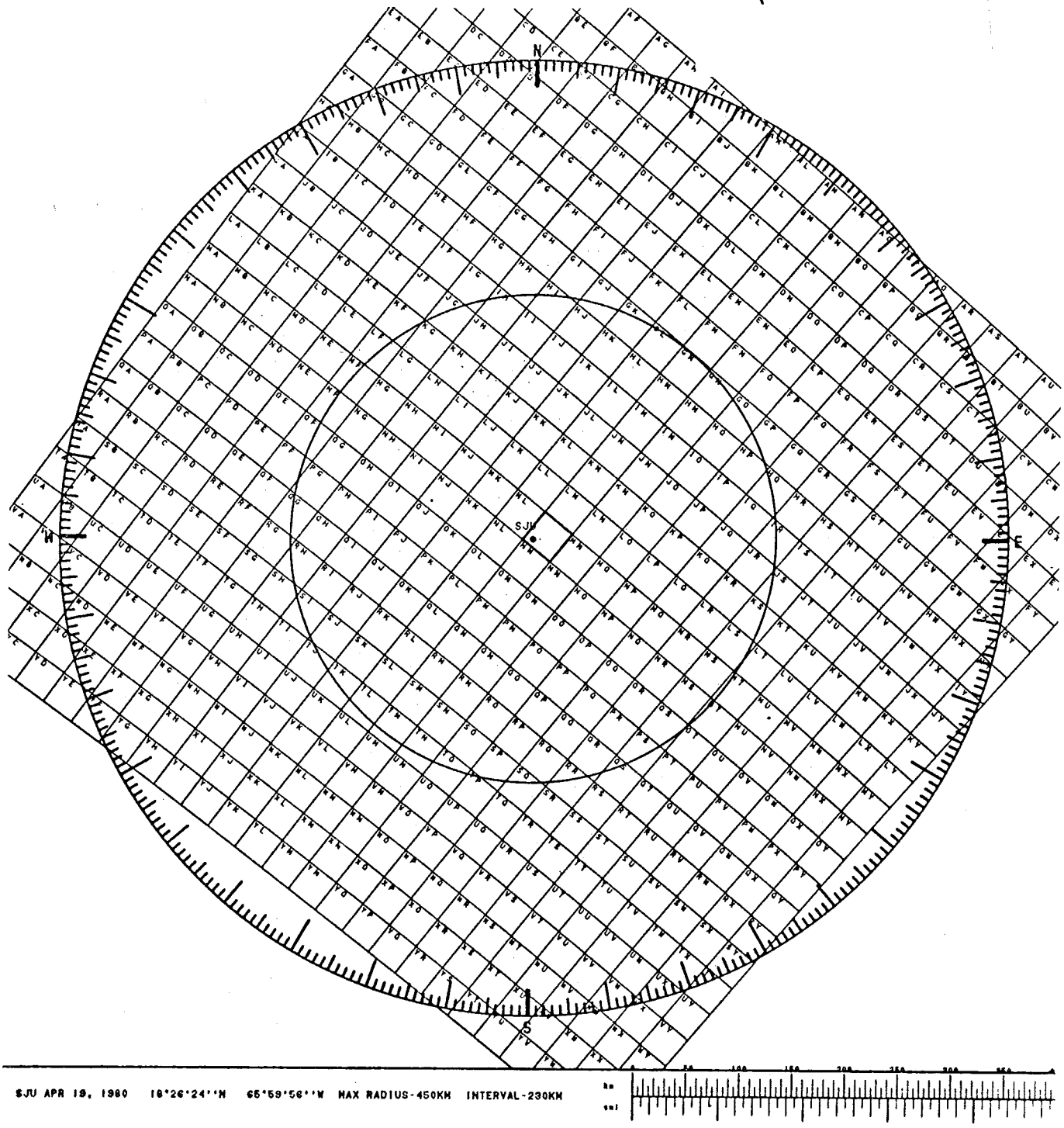

Figure 121.--450 kilometer radar code grid for San Juan, P.R.

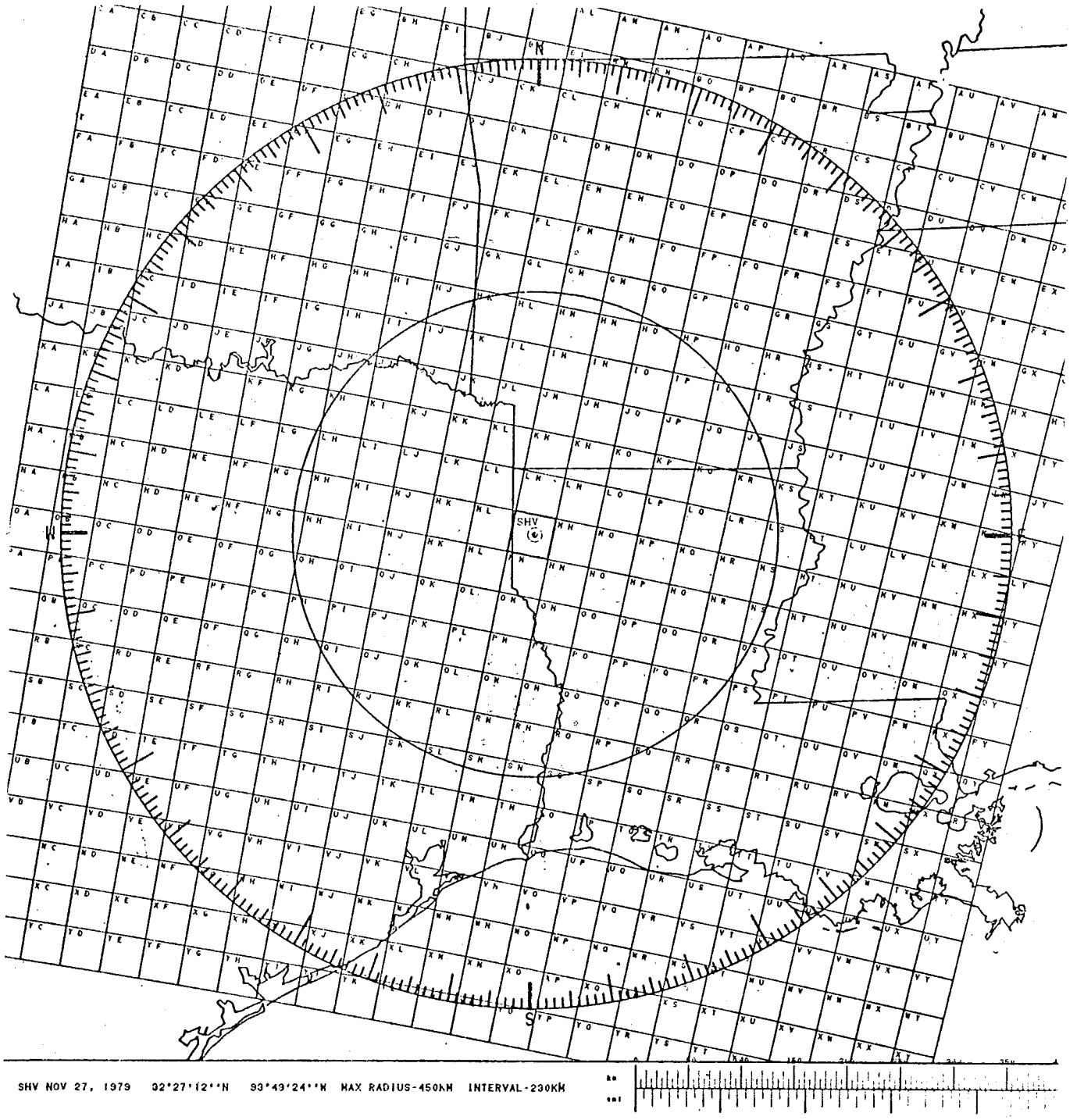

Figure 122.--450 kilometer radar code grid for Shreveport, La.

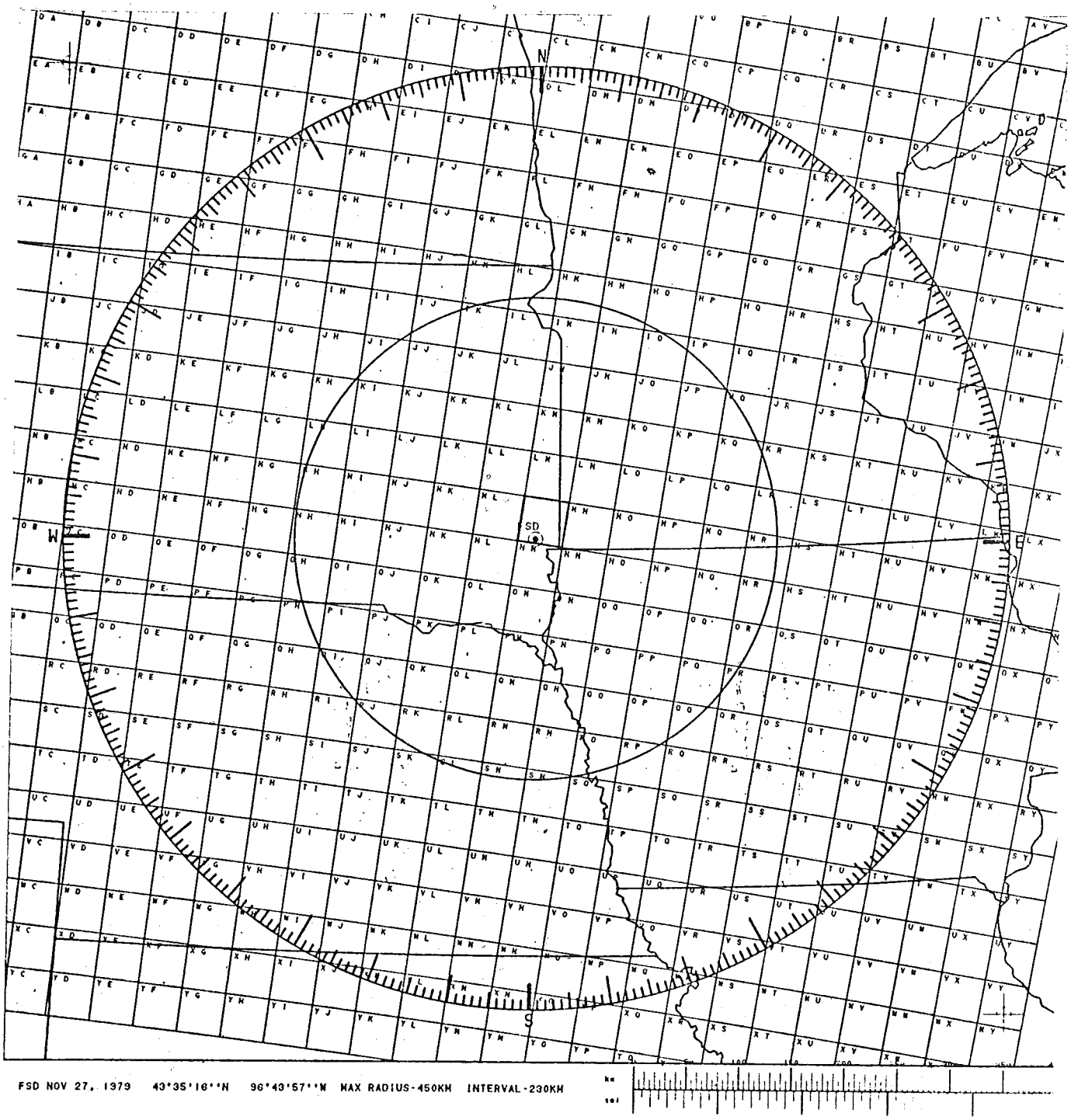

Figure 123.--450 kilometer radar code grid for Sioux Falls, S. Dak.

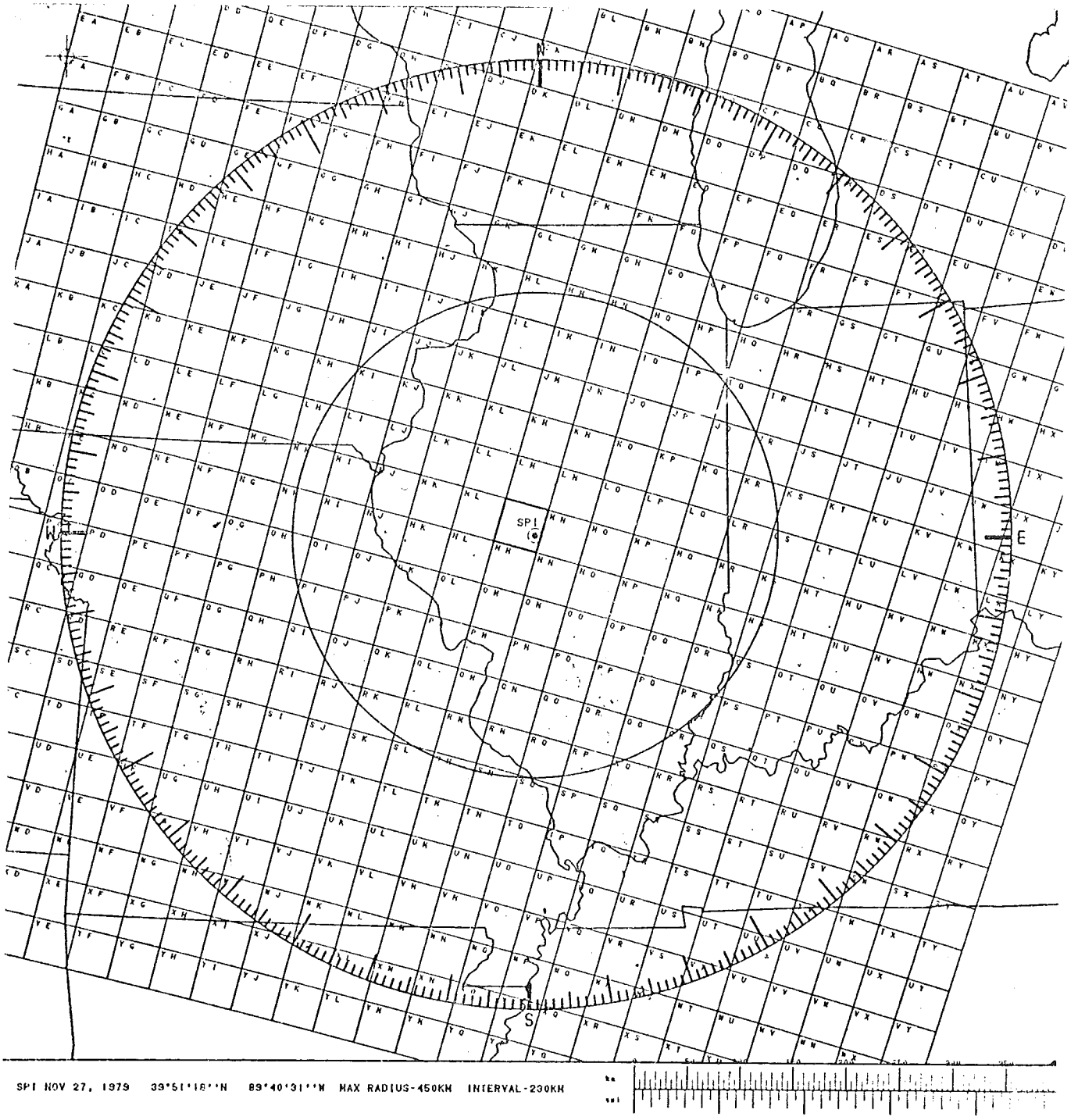

Figure 124.--450 kilometer radar code grid for Springfield, Ill.

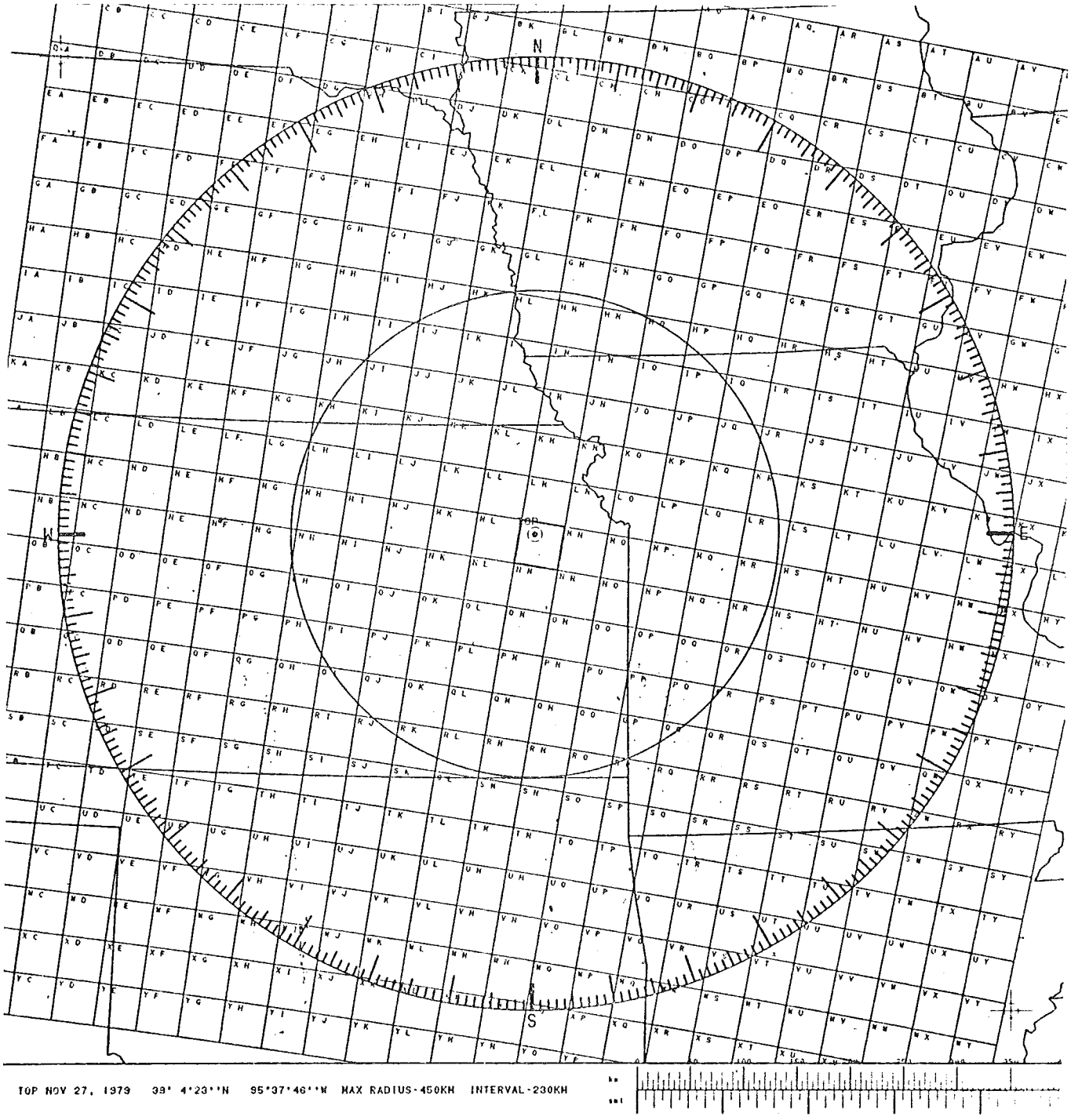

Figure 125.--450 kilometer radar code grid for Topeka, Kansas.

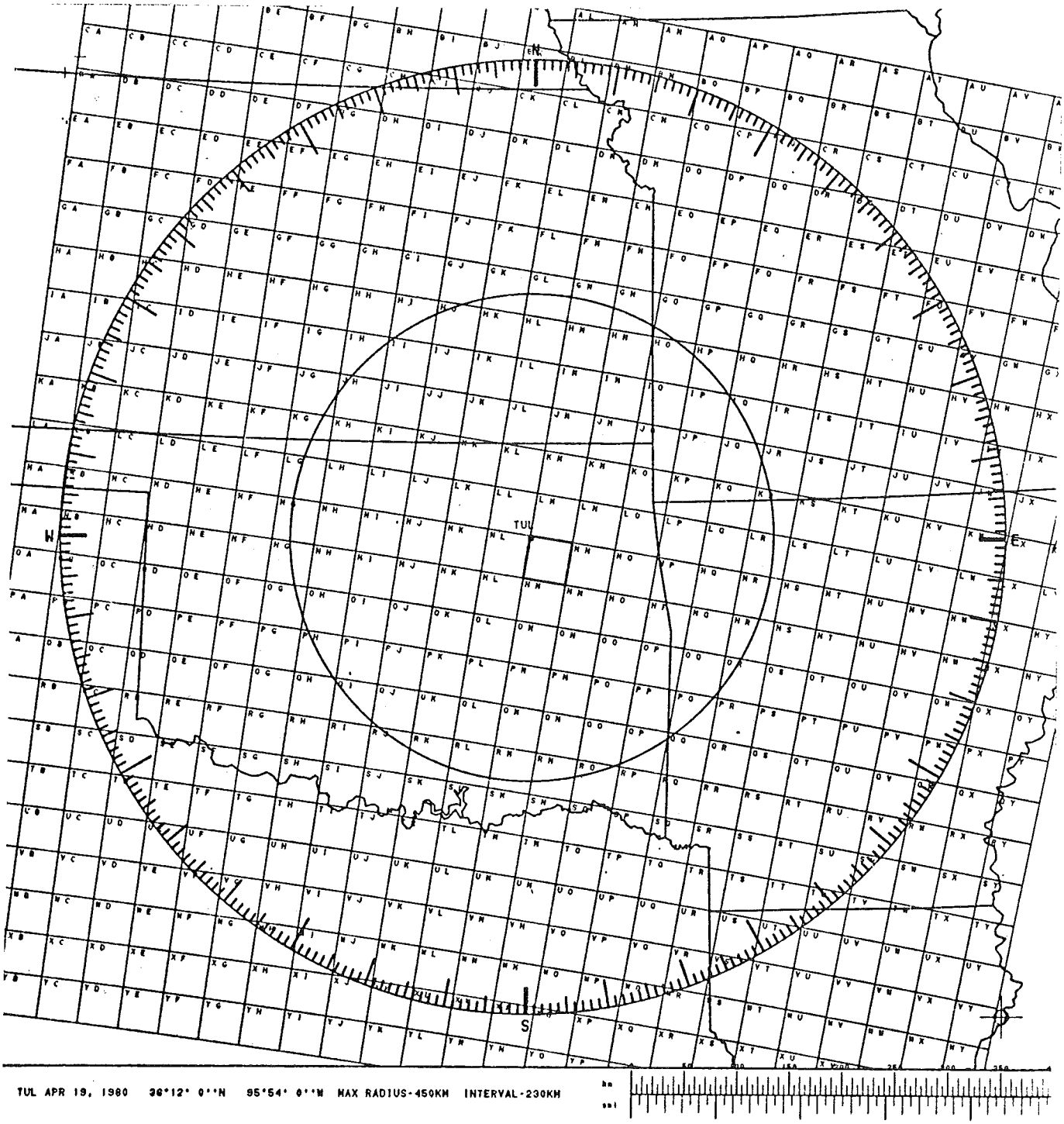

Figure 126.--450 kilometer radar code grid for Tulsa, Oklahoma.

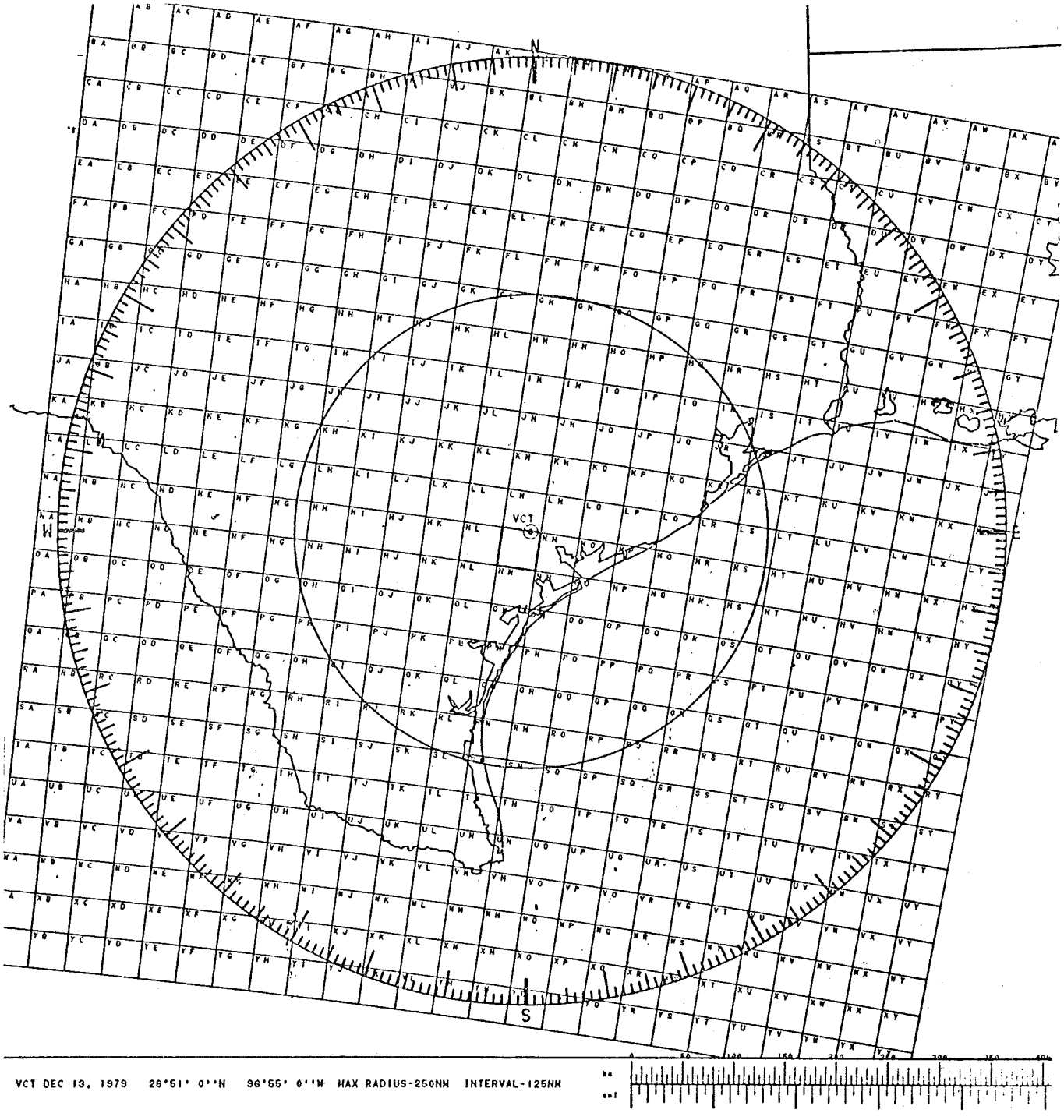

Figure 127.--450 kilometer radar code grid for Victoria, Texas.

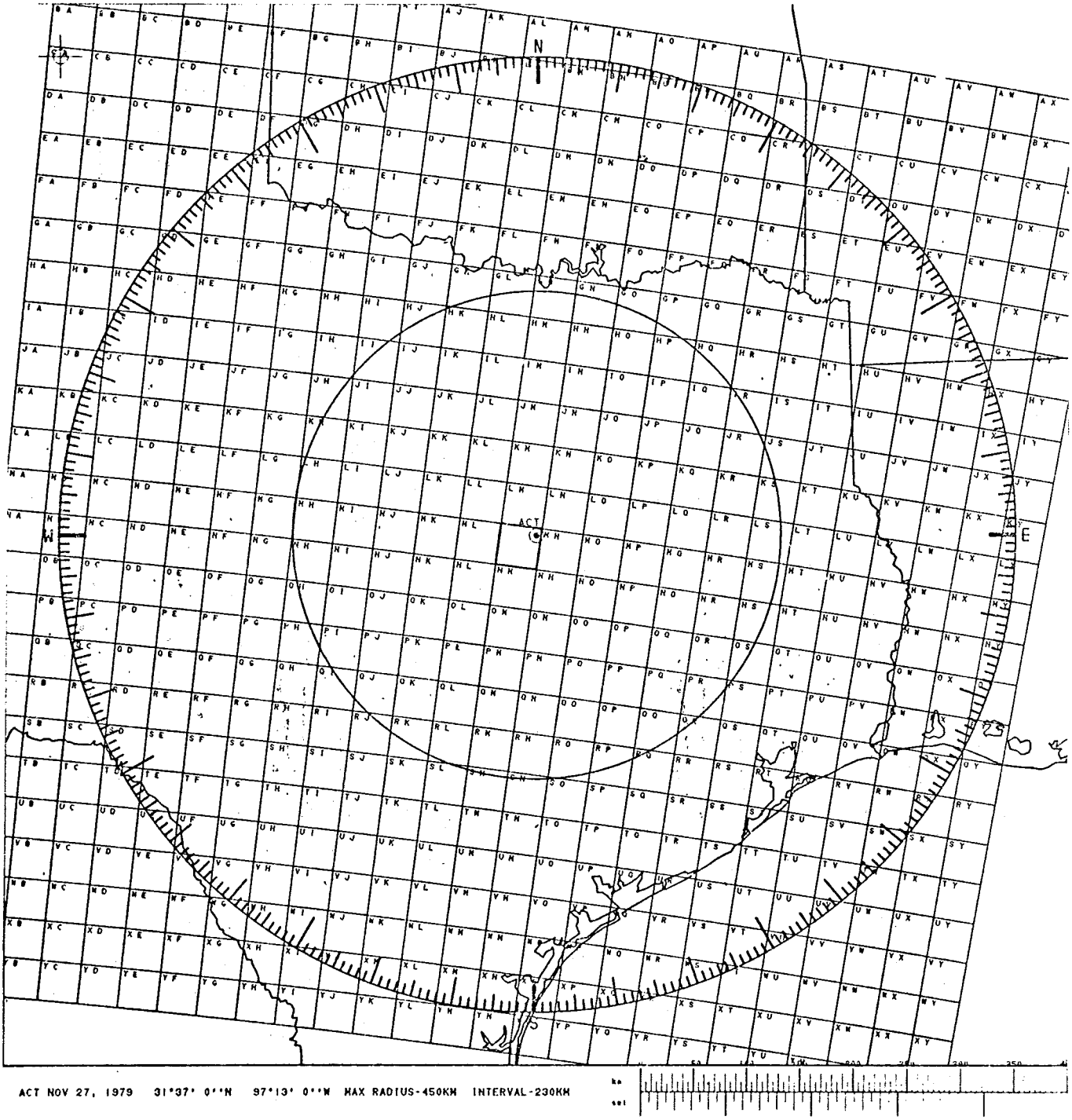

Figure 128.--450 kilometer radar code grid for Waco, Texas.

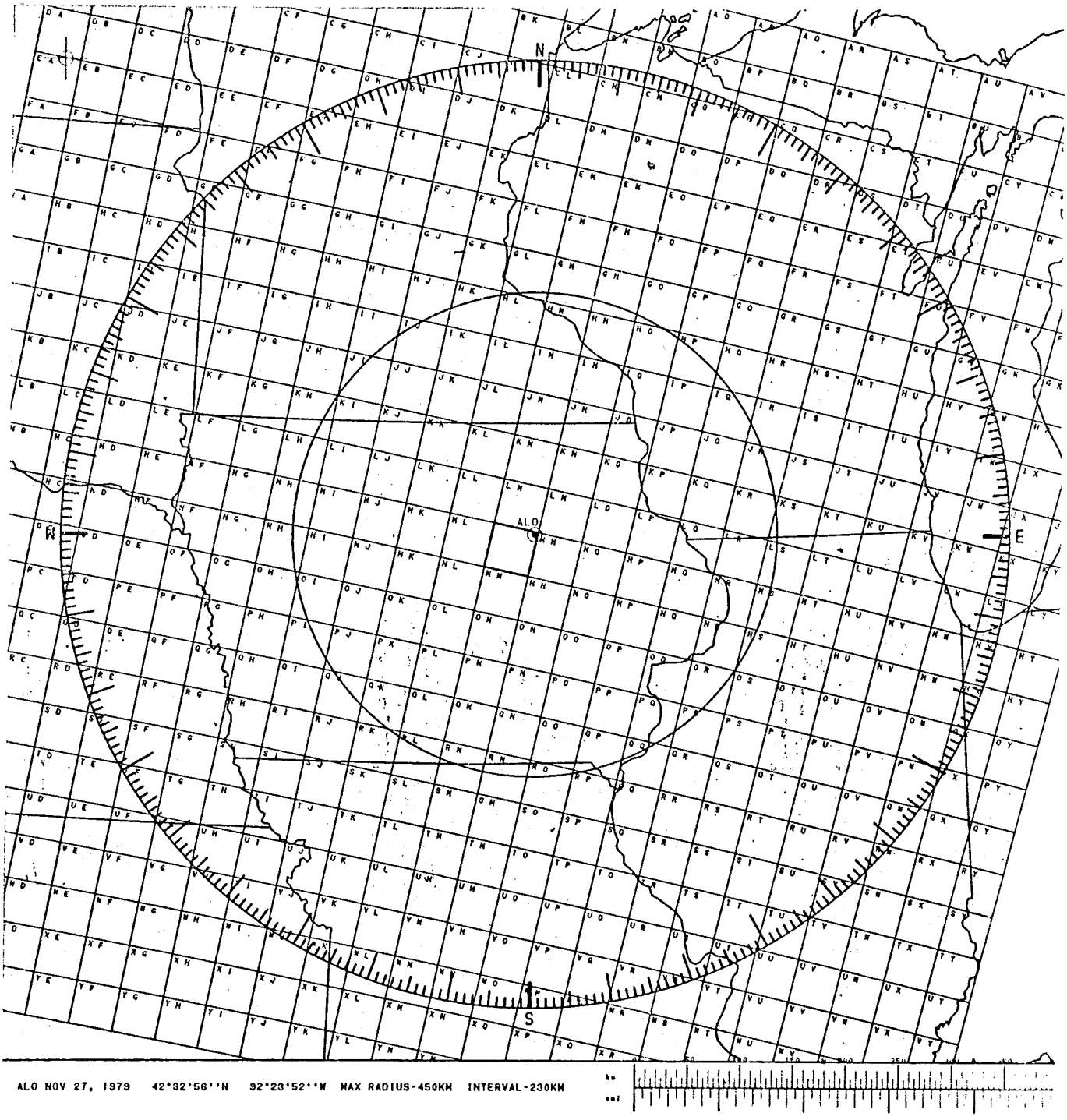

Figure 129.--450 kilometer radar code grid for Waterloo, Iowa.

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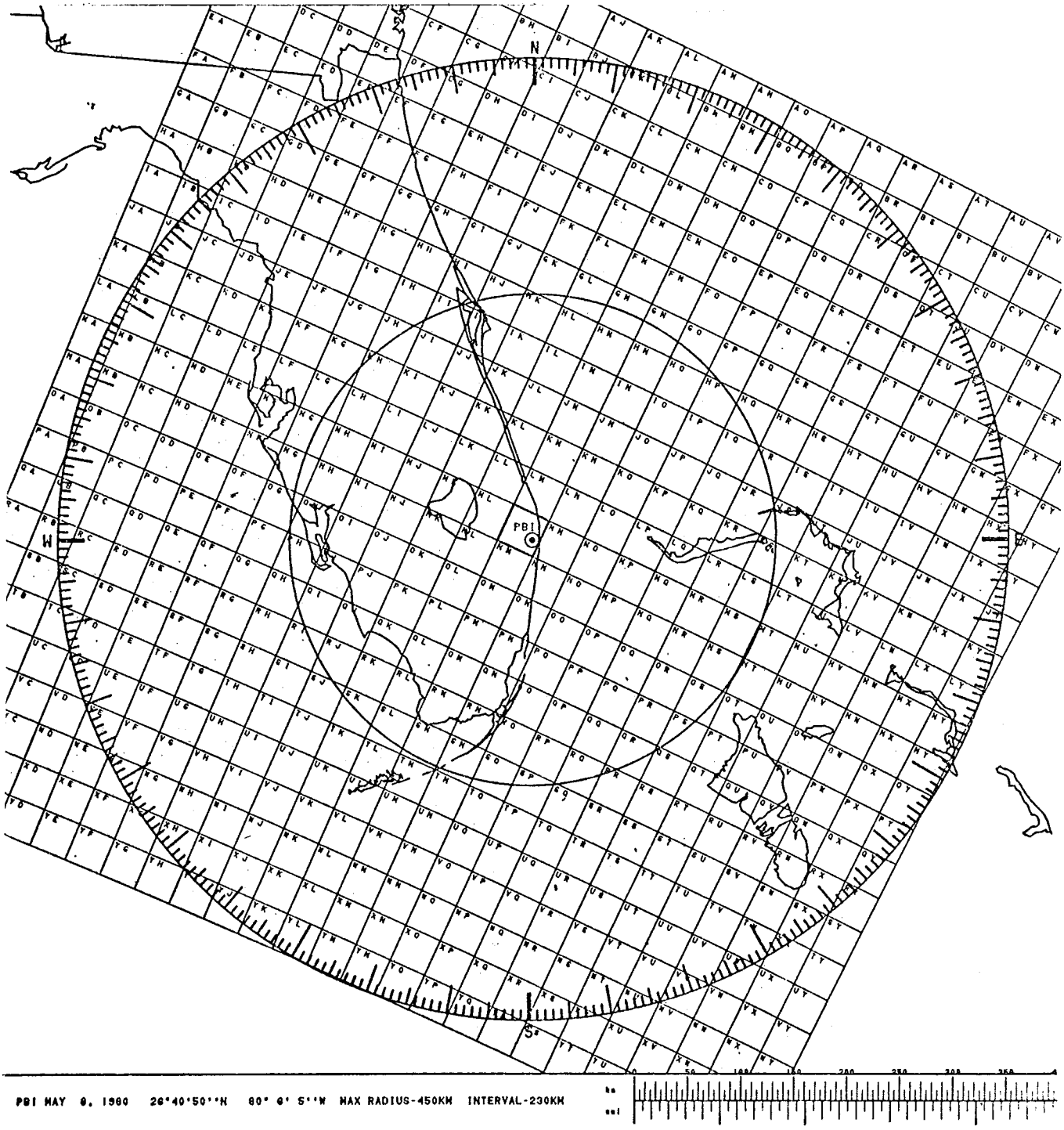

Figure 130.--450 kilometer radar code grid for West Palm Beach, Fla.

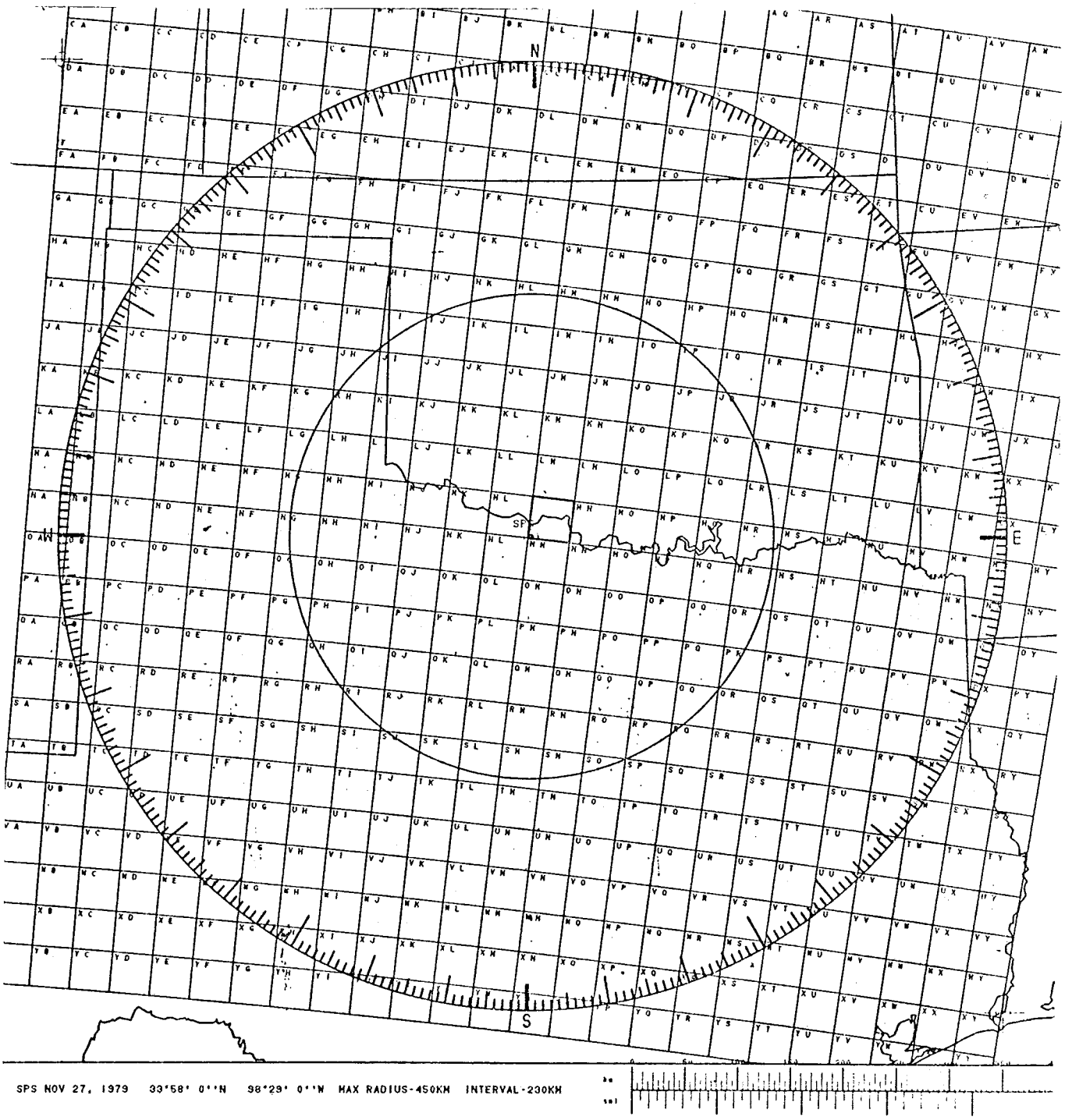

Figure 131.--450 kilometer radar code grid for Wichita Falls, Tex.

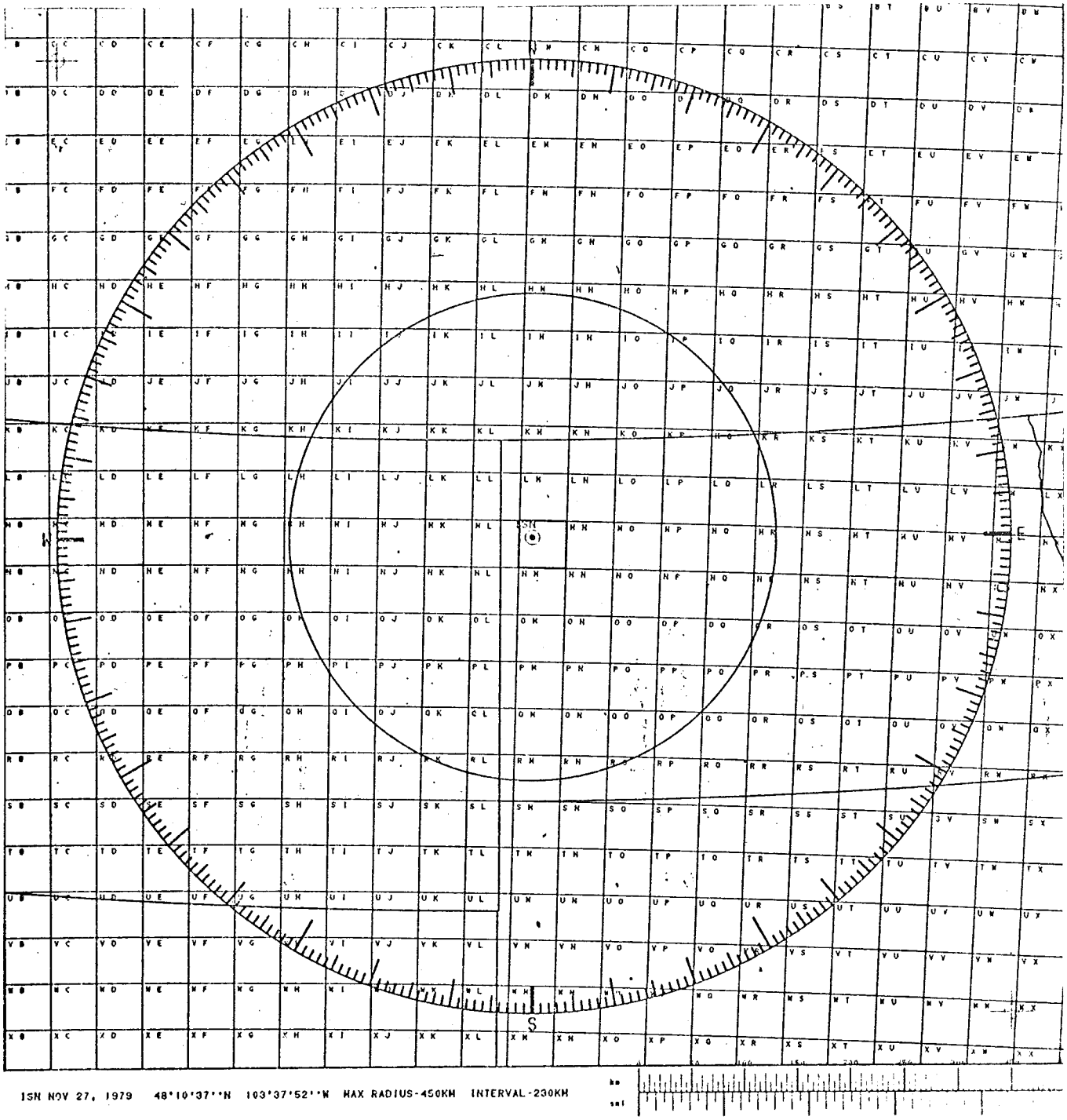

Figure 132.--450 kilometer radar code grid for Williston, N.Dak.

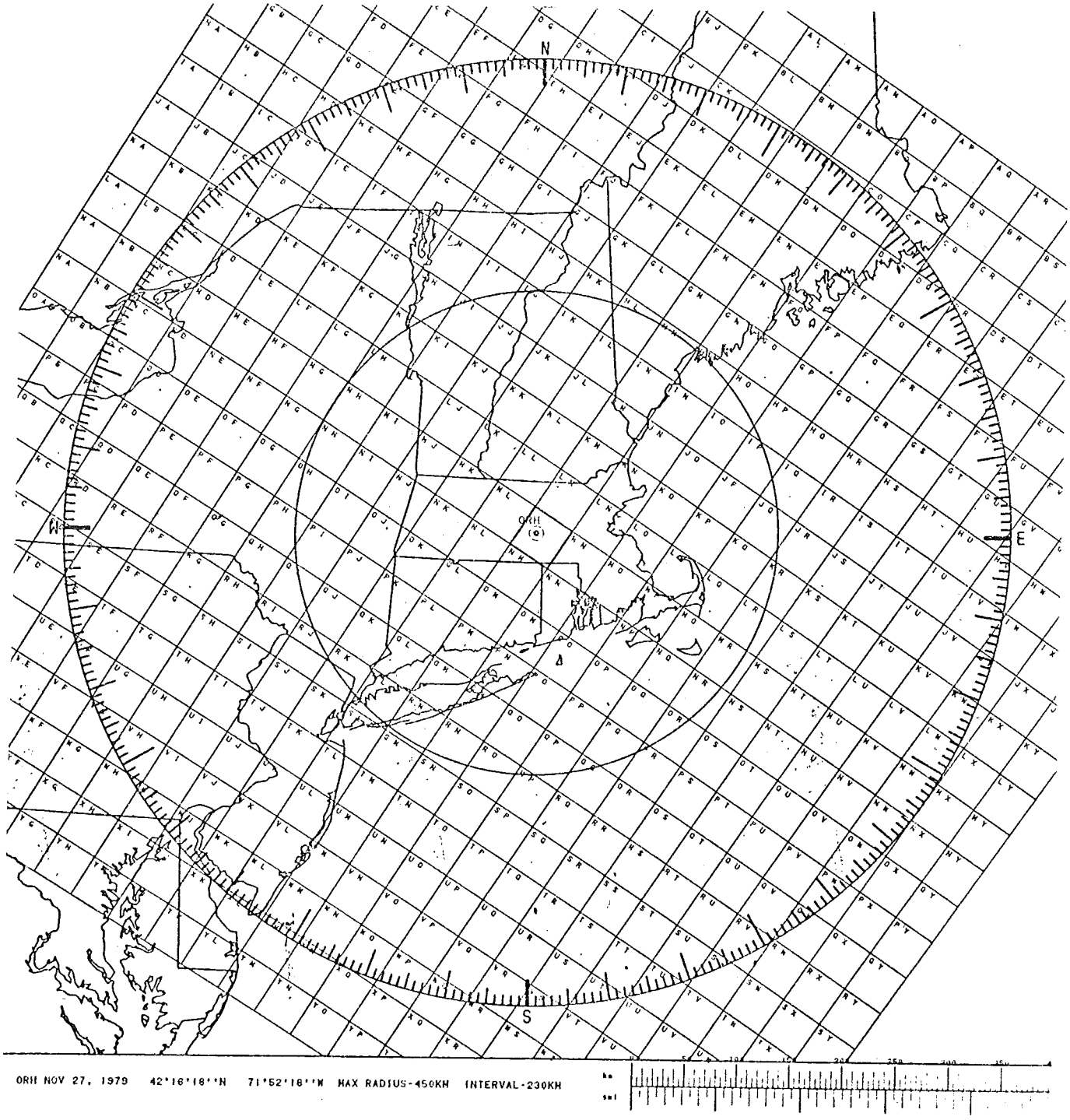

Figure 133.--450 kilometer radar code grid for Worcester, Mass.

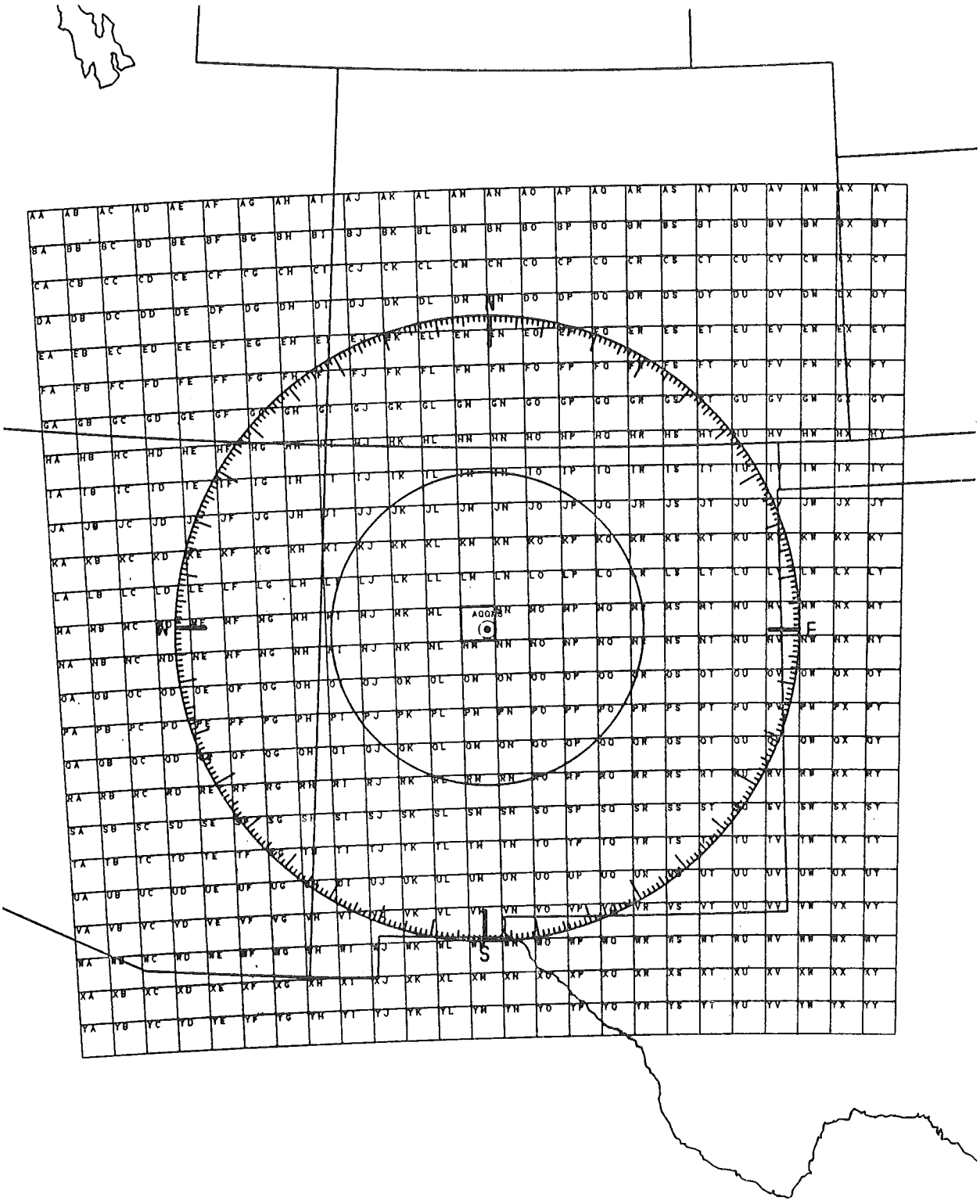

Figure 134.--200 nautical mile radar code grid for Albuquerque, N. Mex.

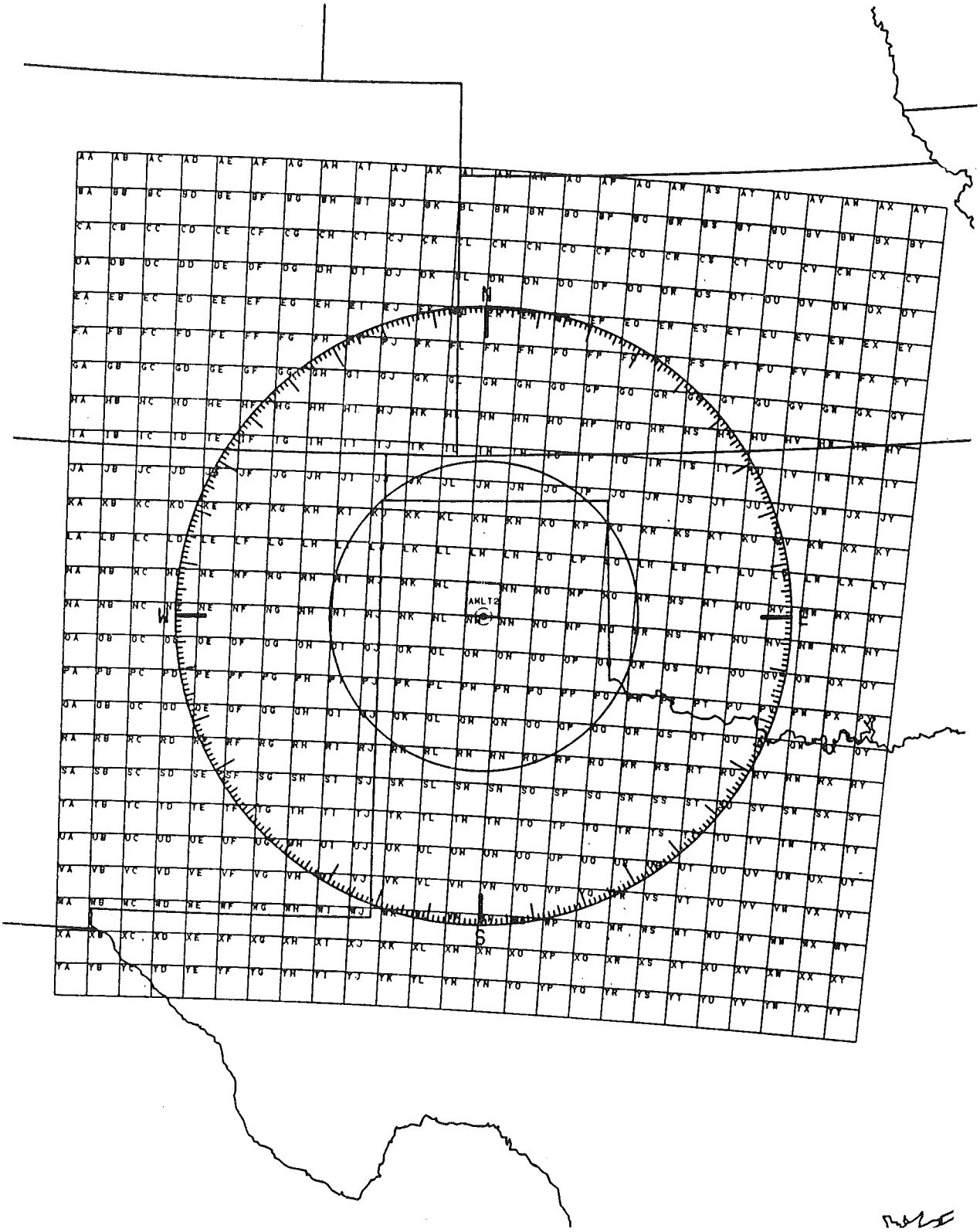

Figure 135.--200 nautical mile radar code grid for Amarillo, Tex.

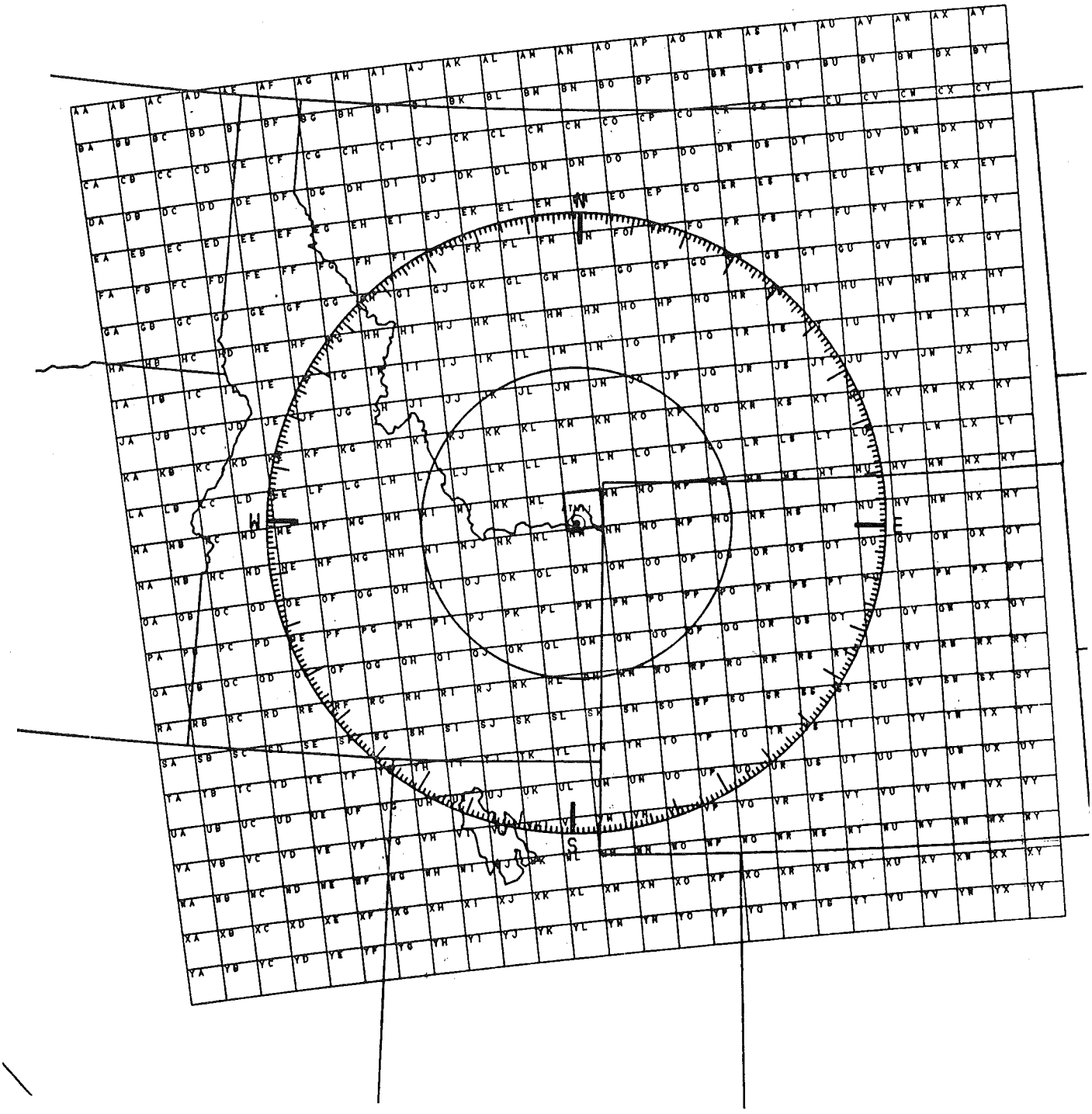

Figure 136.--200 nautical mile radar code grid for Ashton, Idaho.

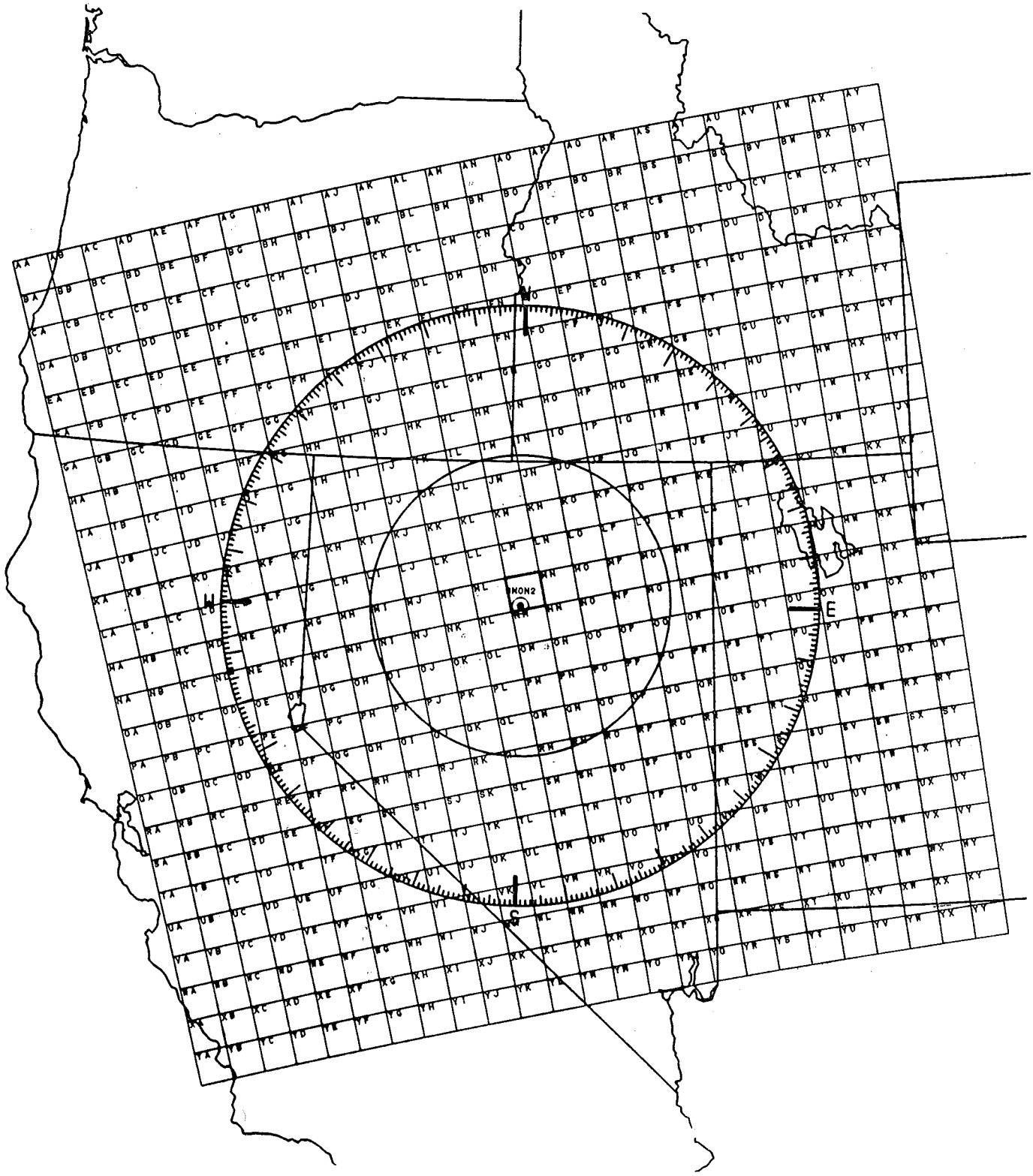

Figure 137.--200 nautical mile radar code grid for Battle Mountain, Nevada.

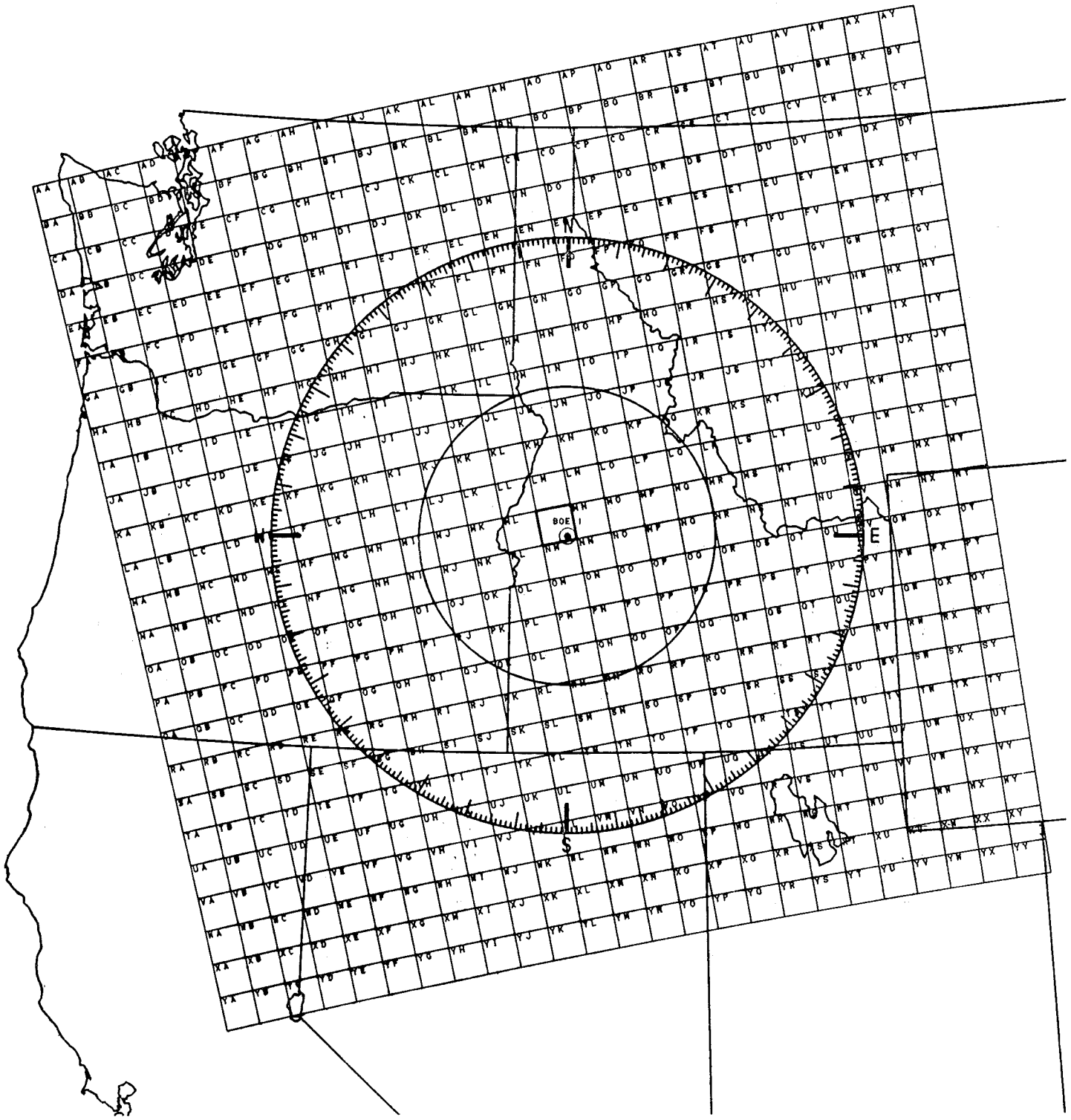

Figure 138.--200 nautical mile radar code grid for Boise, Idaho.

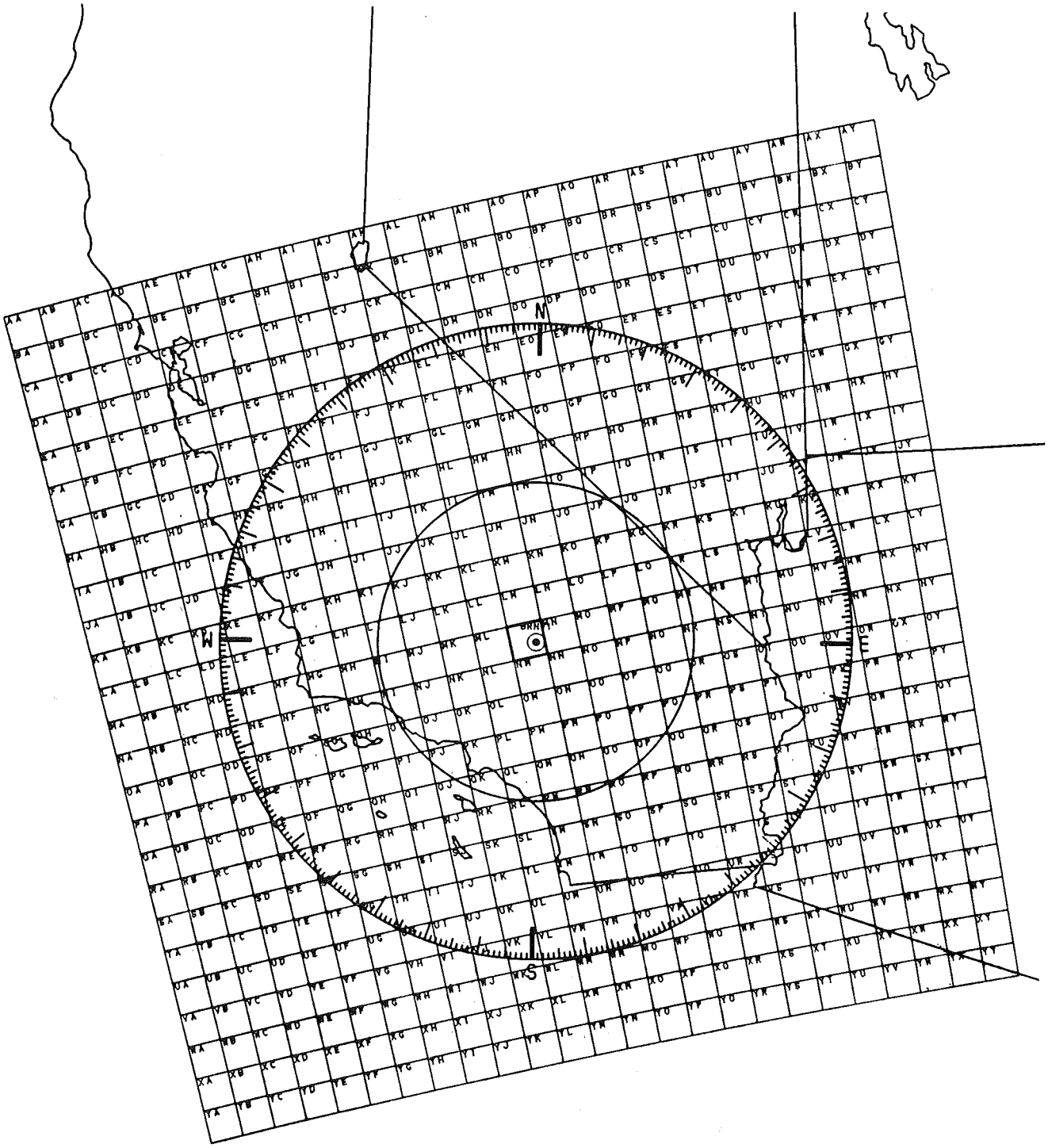

Figure 139.--200 nautical mile radar code grid for Boron, Calif.

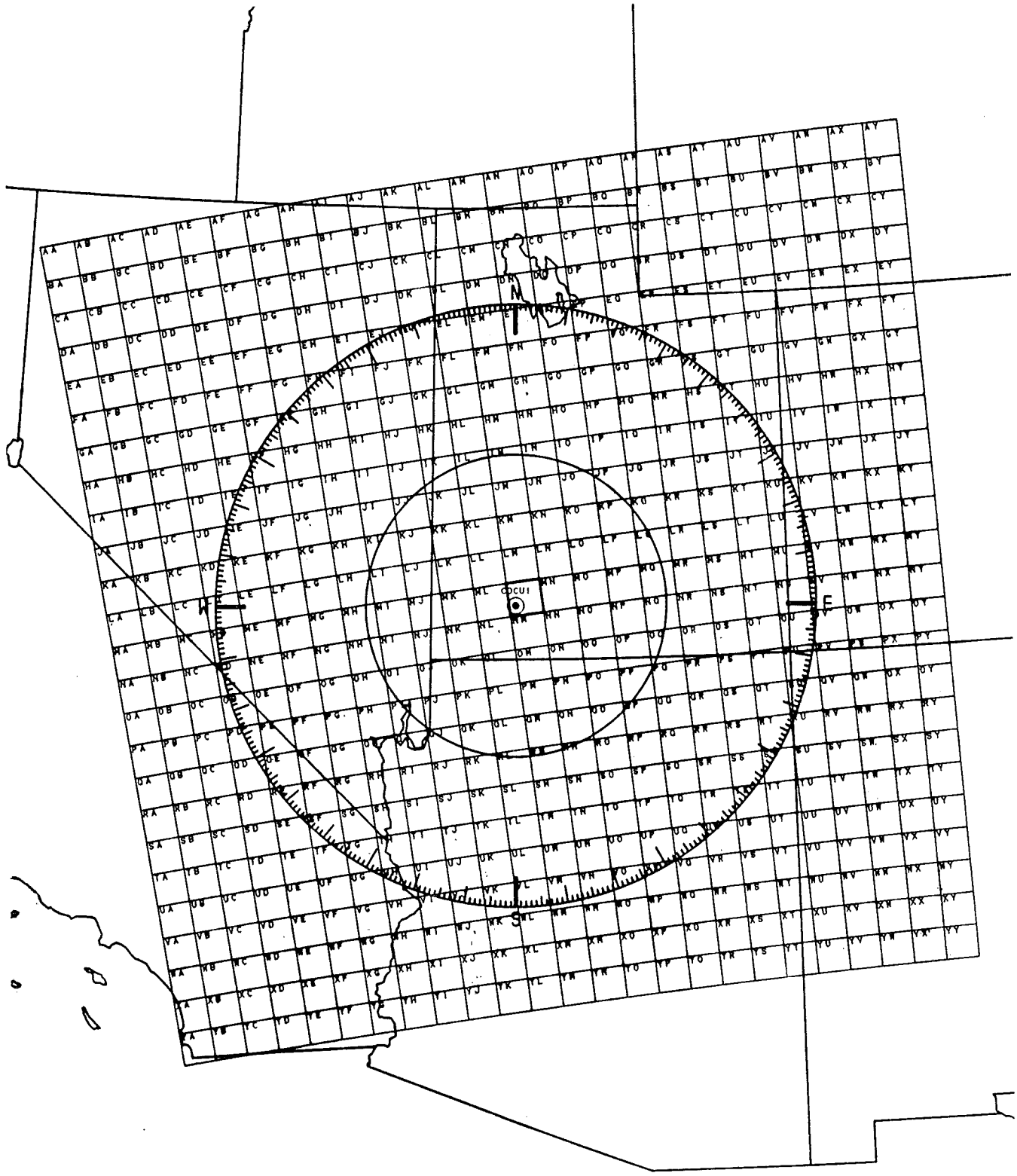

Figure 140.--200 nautical mile radar code grid for Cedar City, Utah.

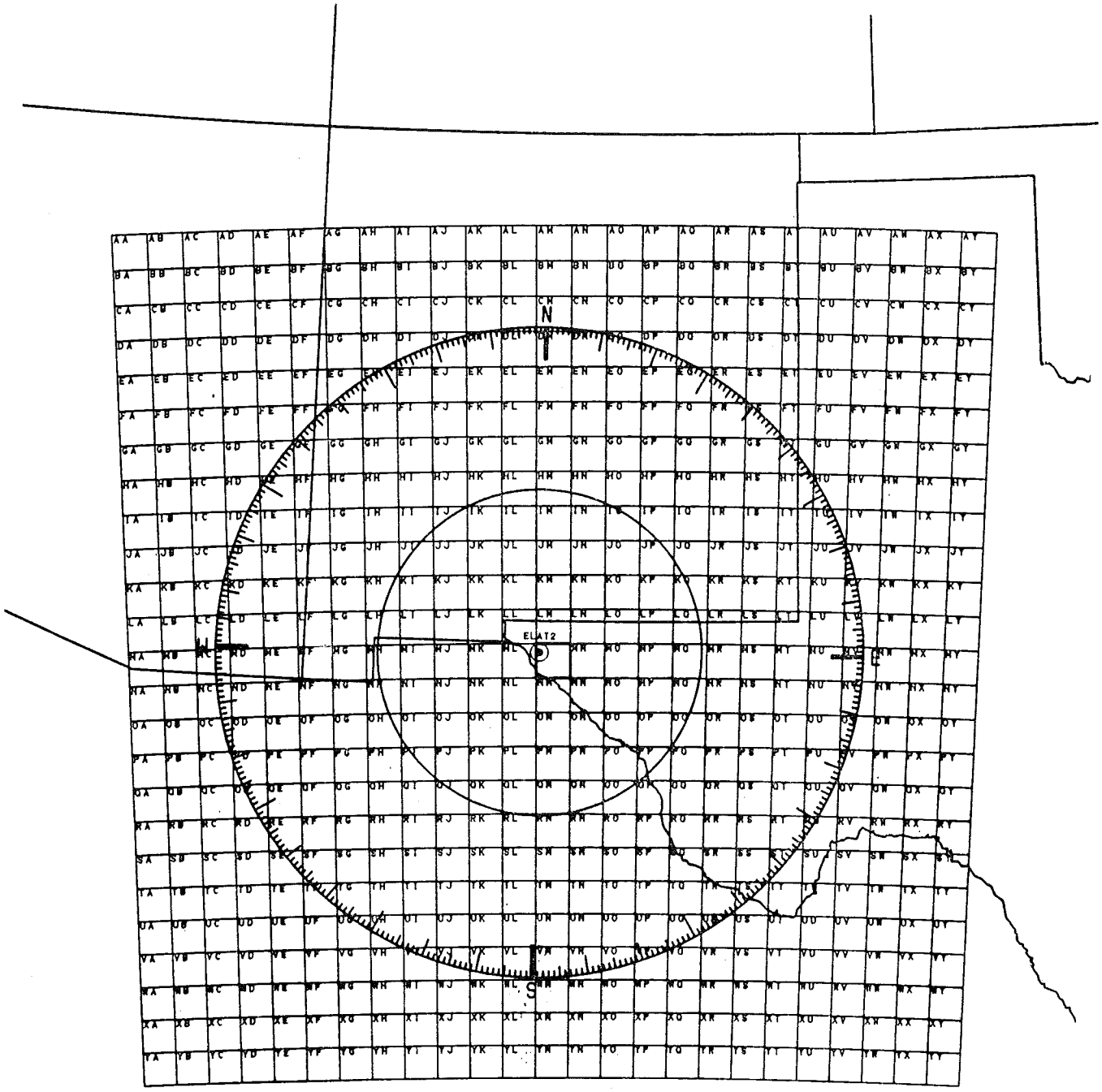

Figure 141.--200 nautical mile radar code grid for El Paso, Texas.

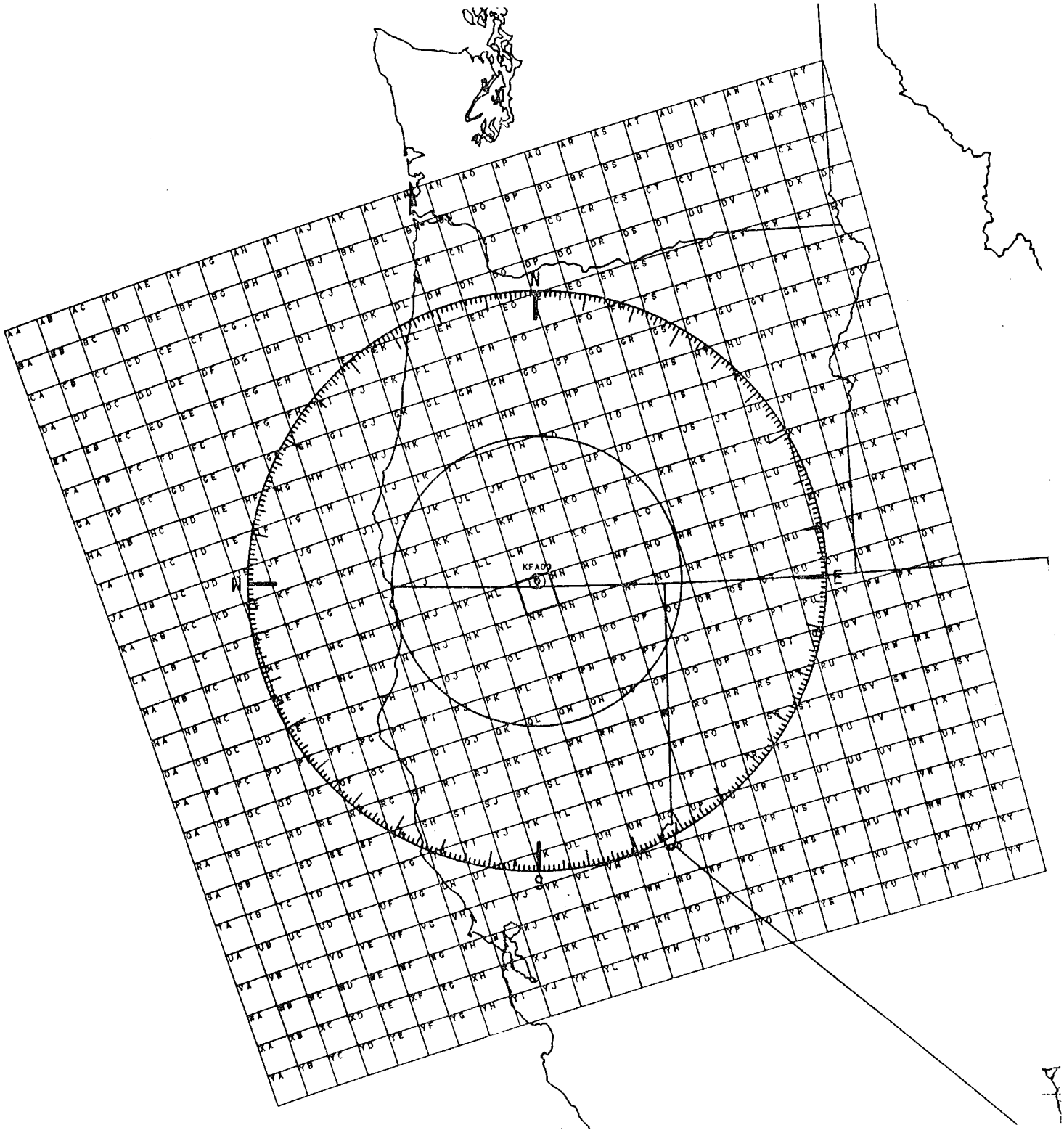

Figure 142.--200 nautical mile radar code grid for Klamath Falls, Oregon.

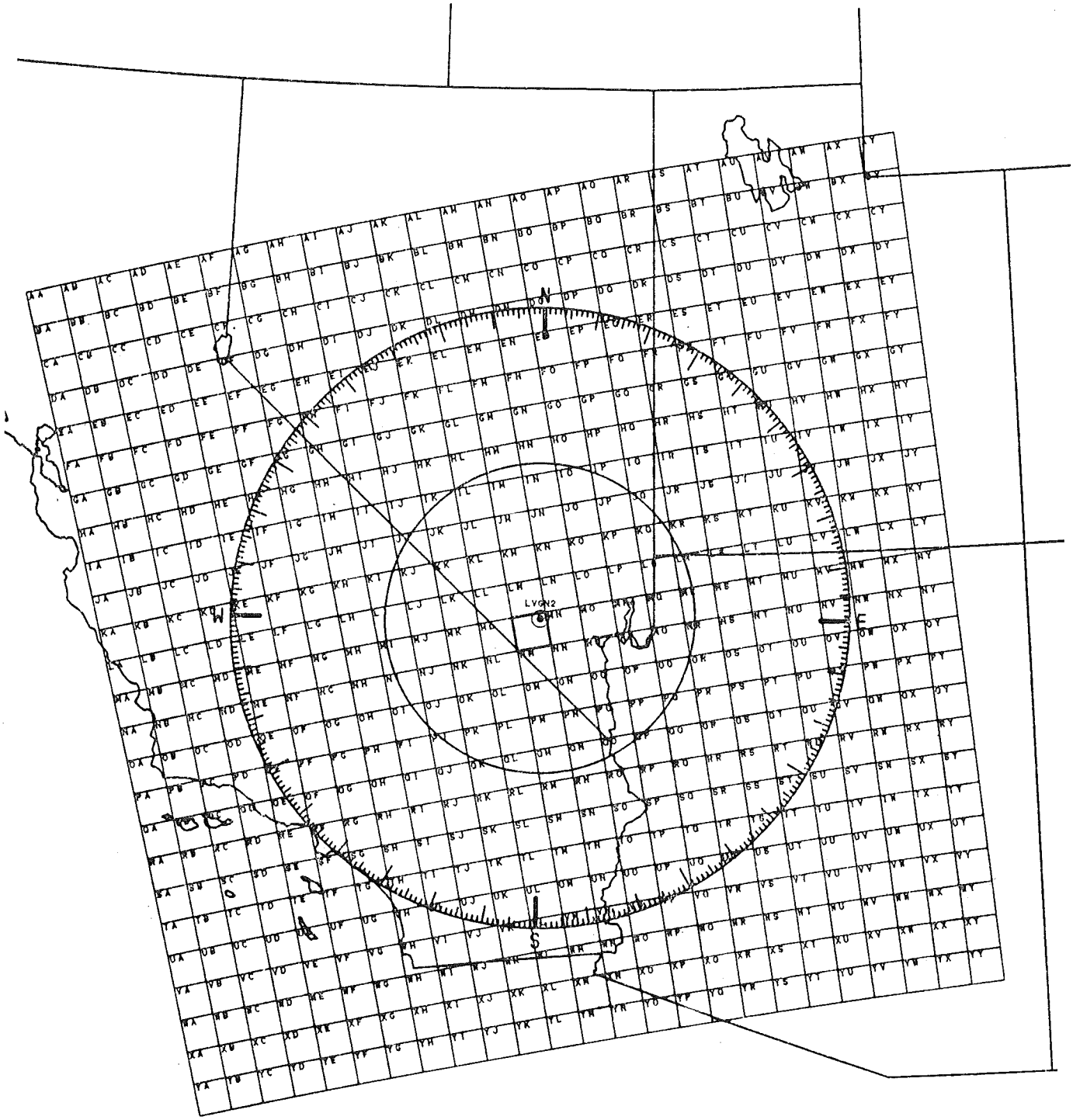

Figure 143.--200 nautical mile radar code grid for Las Vegas, Nev.

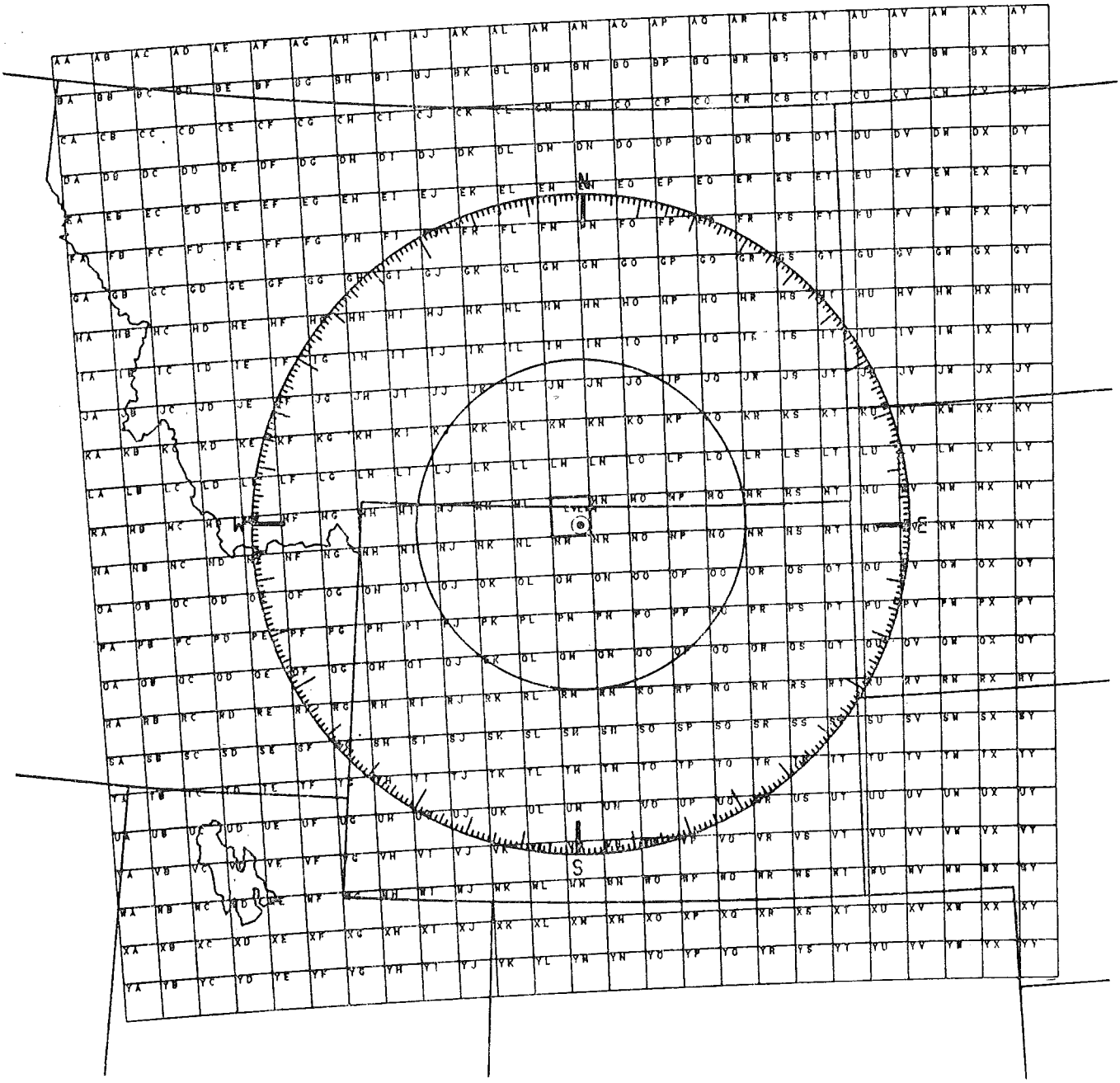

Figure 144.--200 nautical mile radar code grid for Lovell, Wyo.

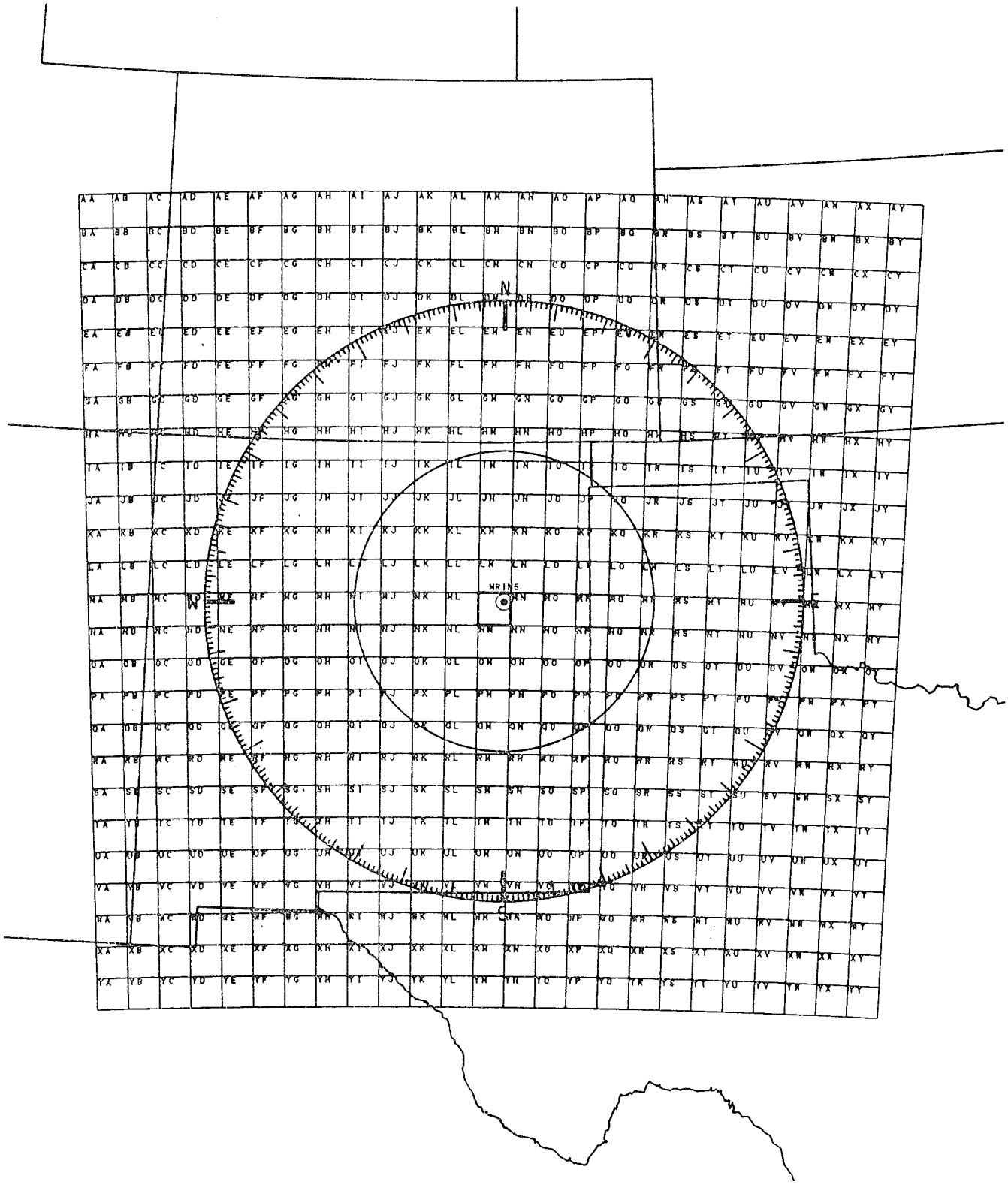

Figure 145.--200 nautical mile radar code grid for Mesa Rica, N.Mex.

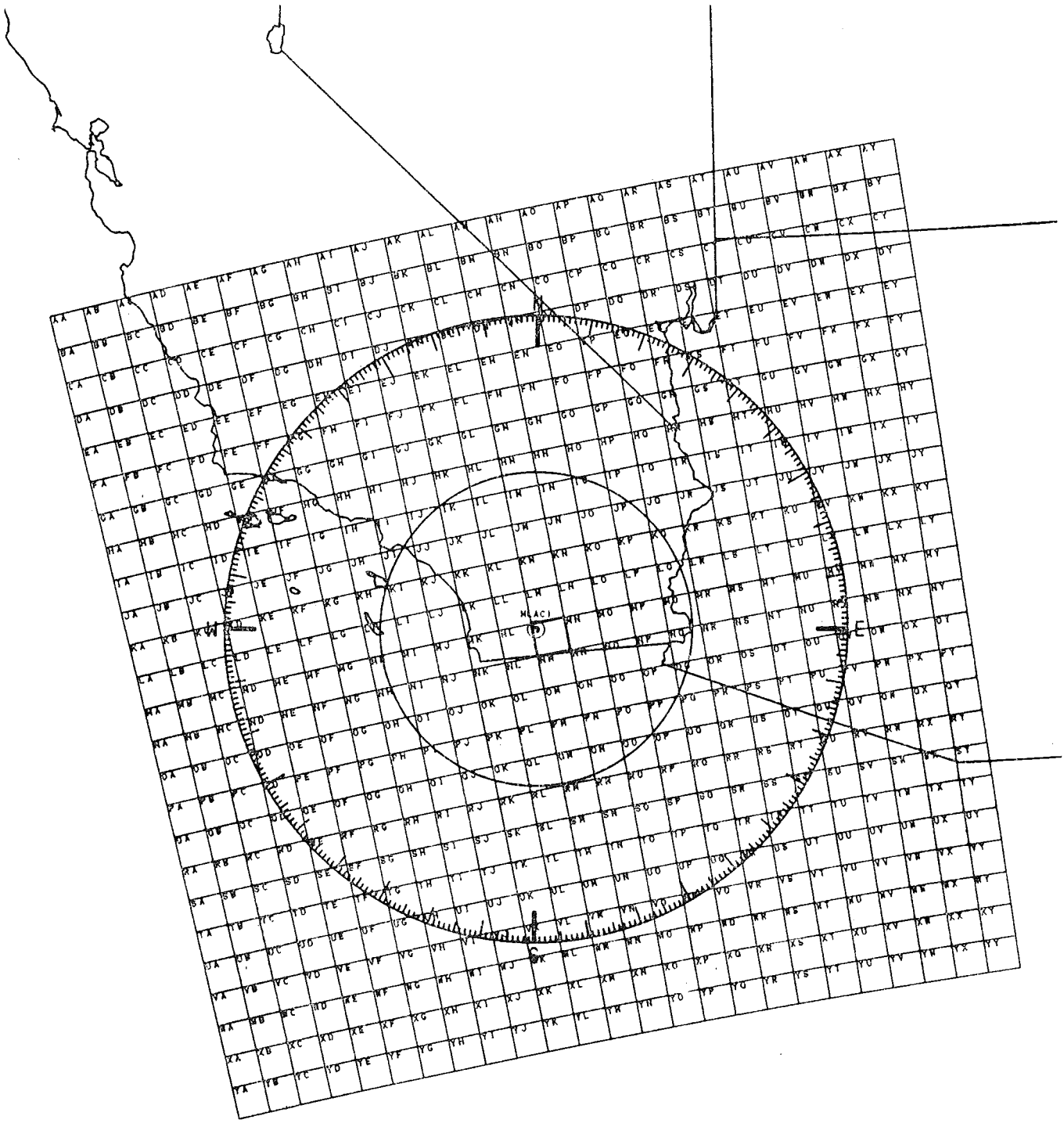

Figure 146.--200 nautical mile radar code grid for Mt. Laguna, Calif.

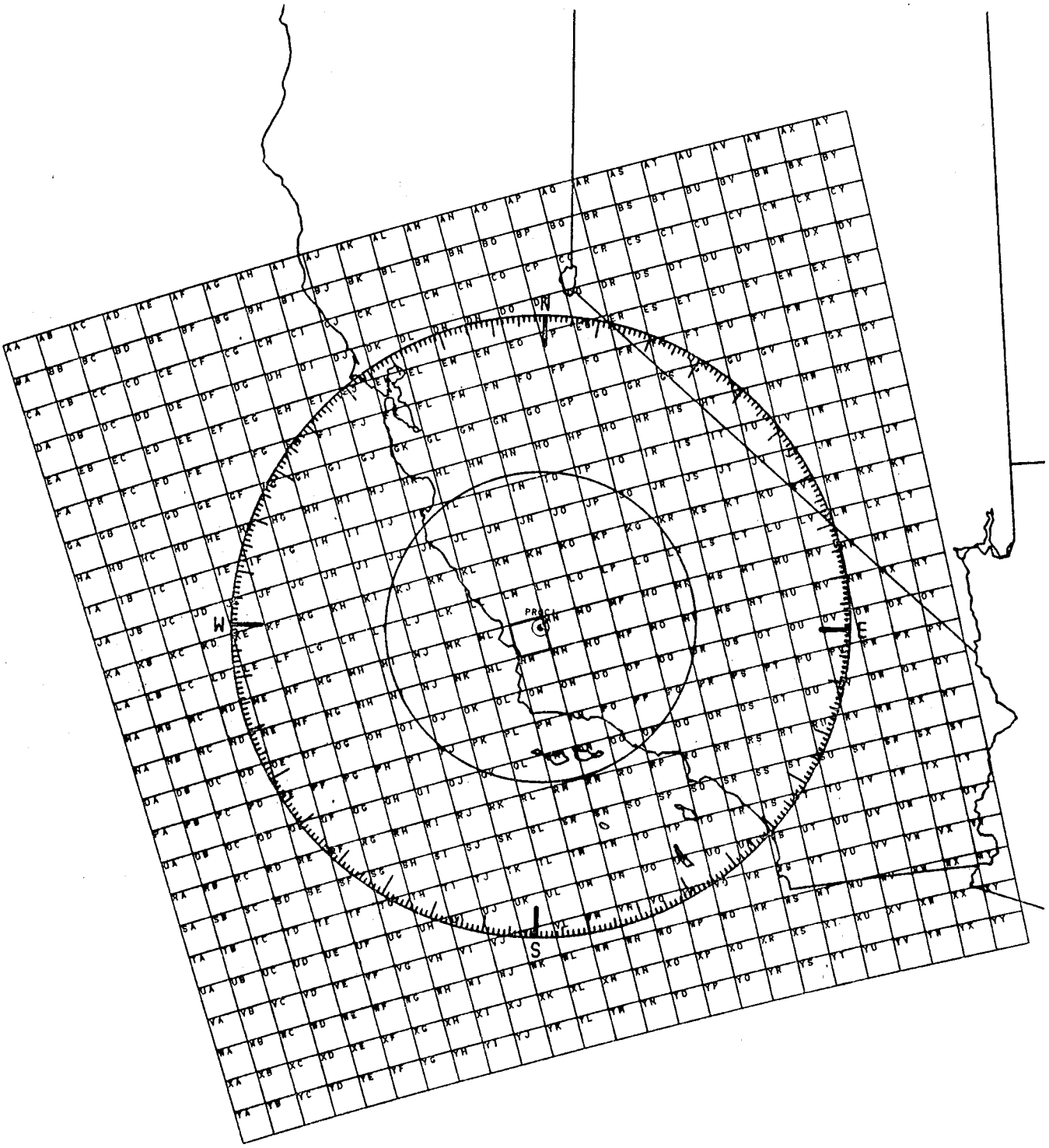

Figure 147.--200 nautical mile radar code grid for Paso Robles, Calif.

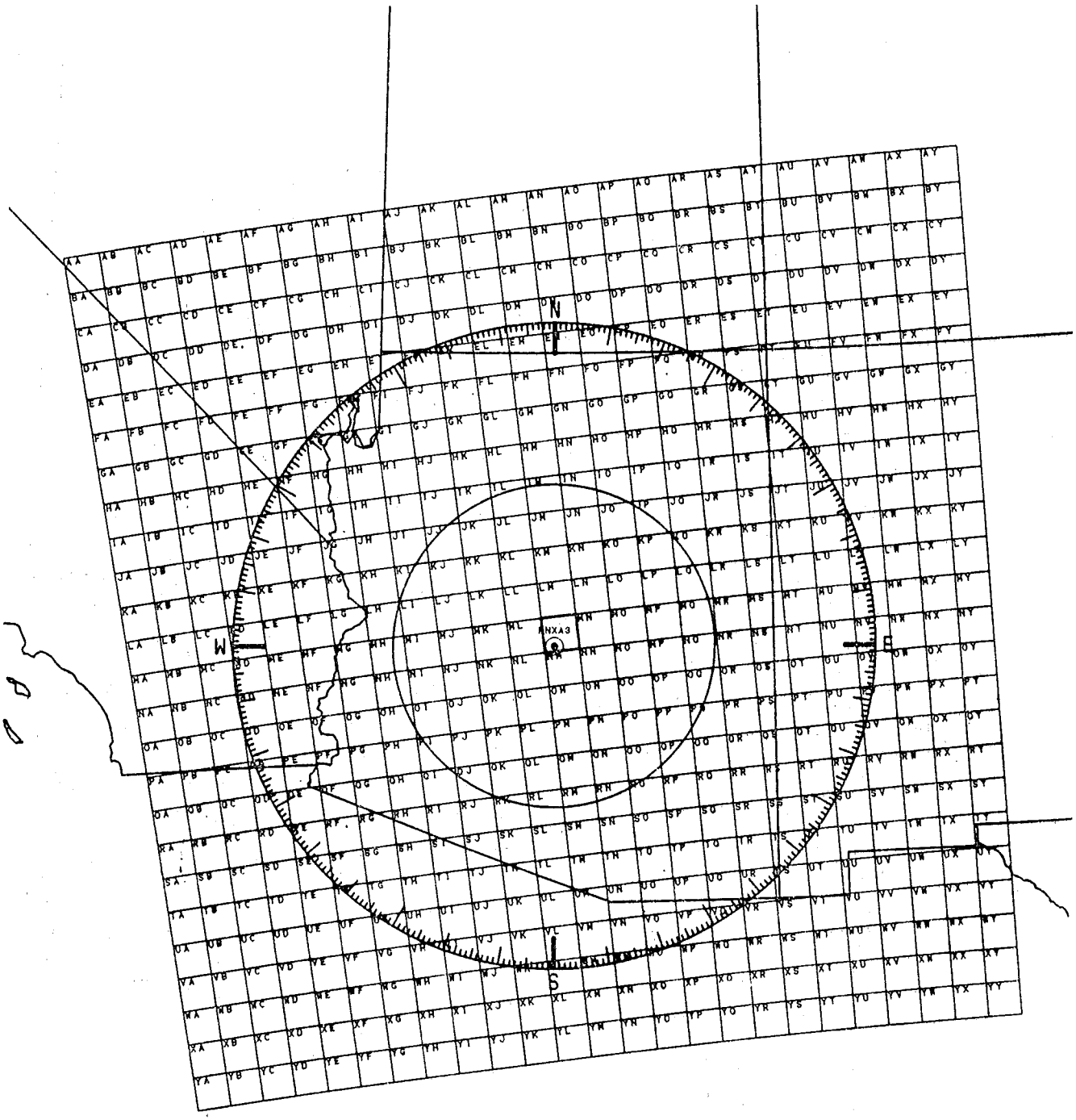

Figure 148.--200 nautical mile radar code grid for Phoenix, Ariz.

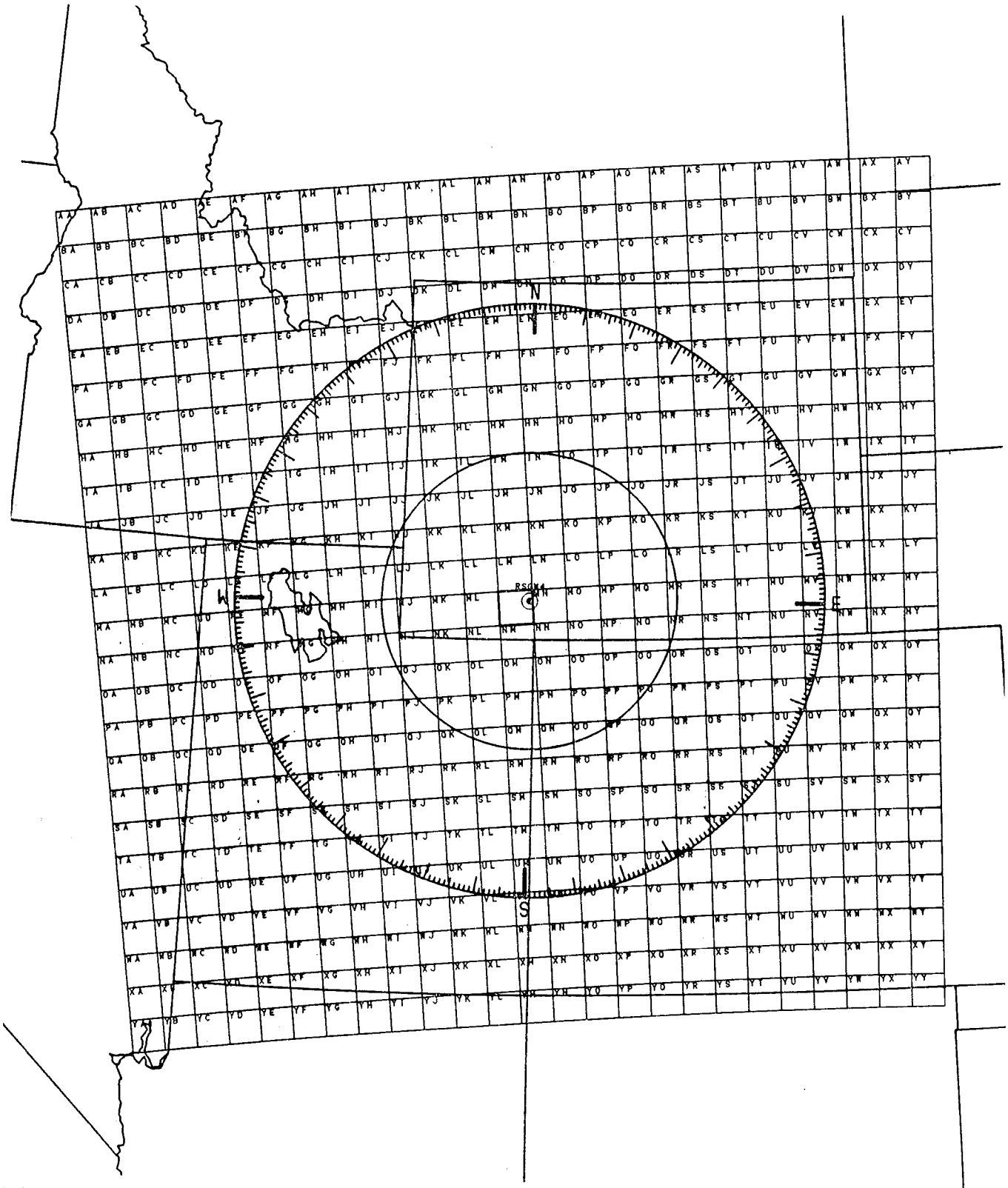

Figure 149.--200 nautical mile radar code grid for Rock Springs, Wyo.

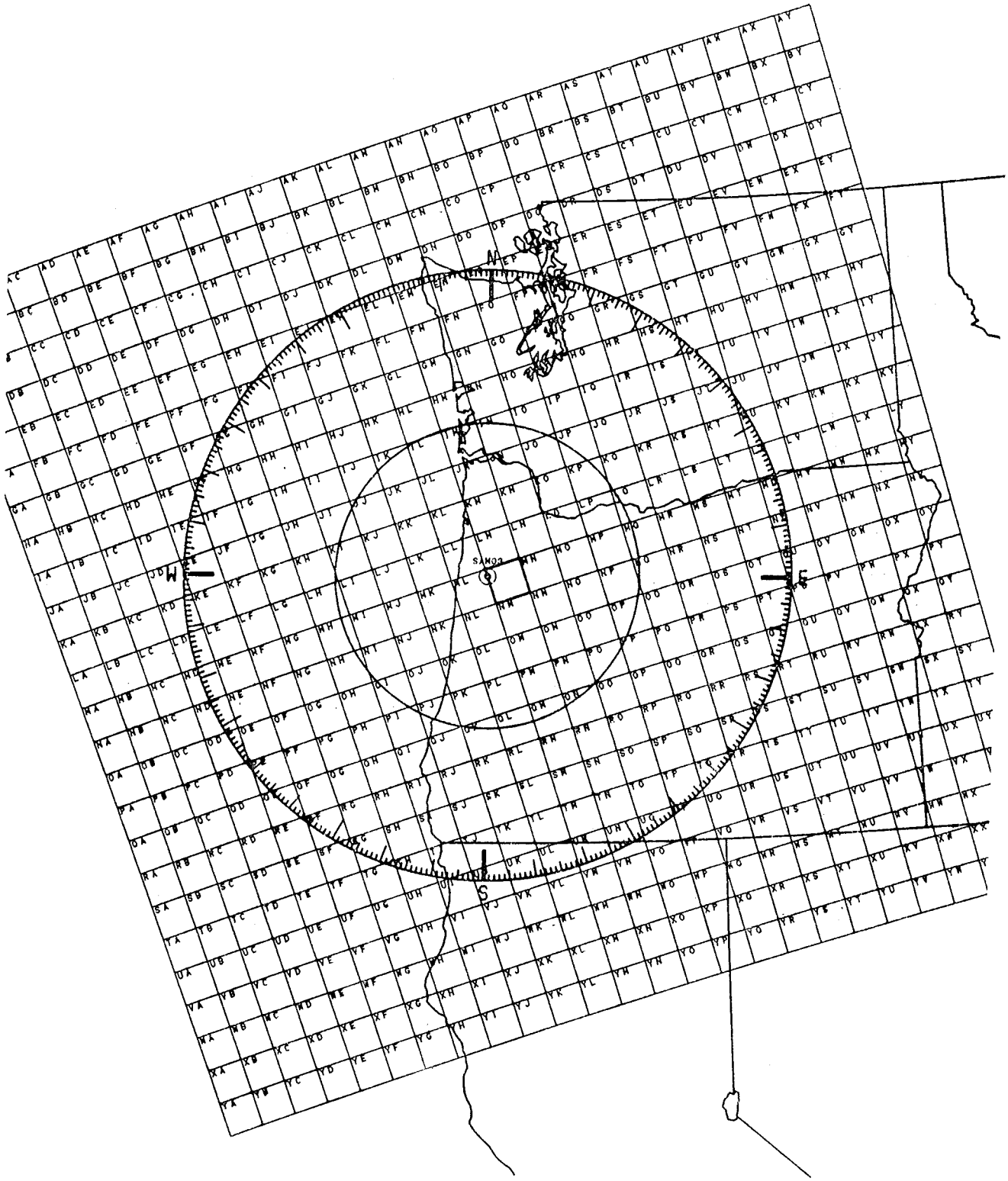

Figure 150.--200 nautical mile radar code grid for Salem, Oregon.

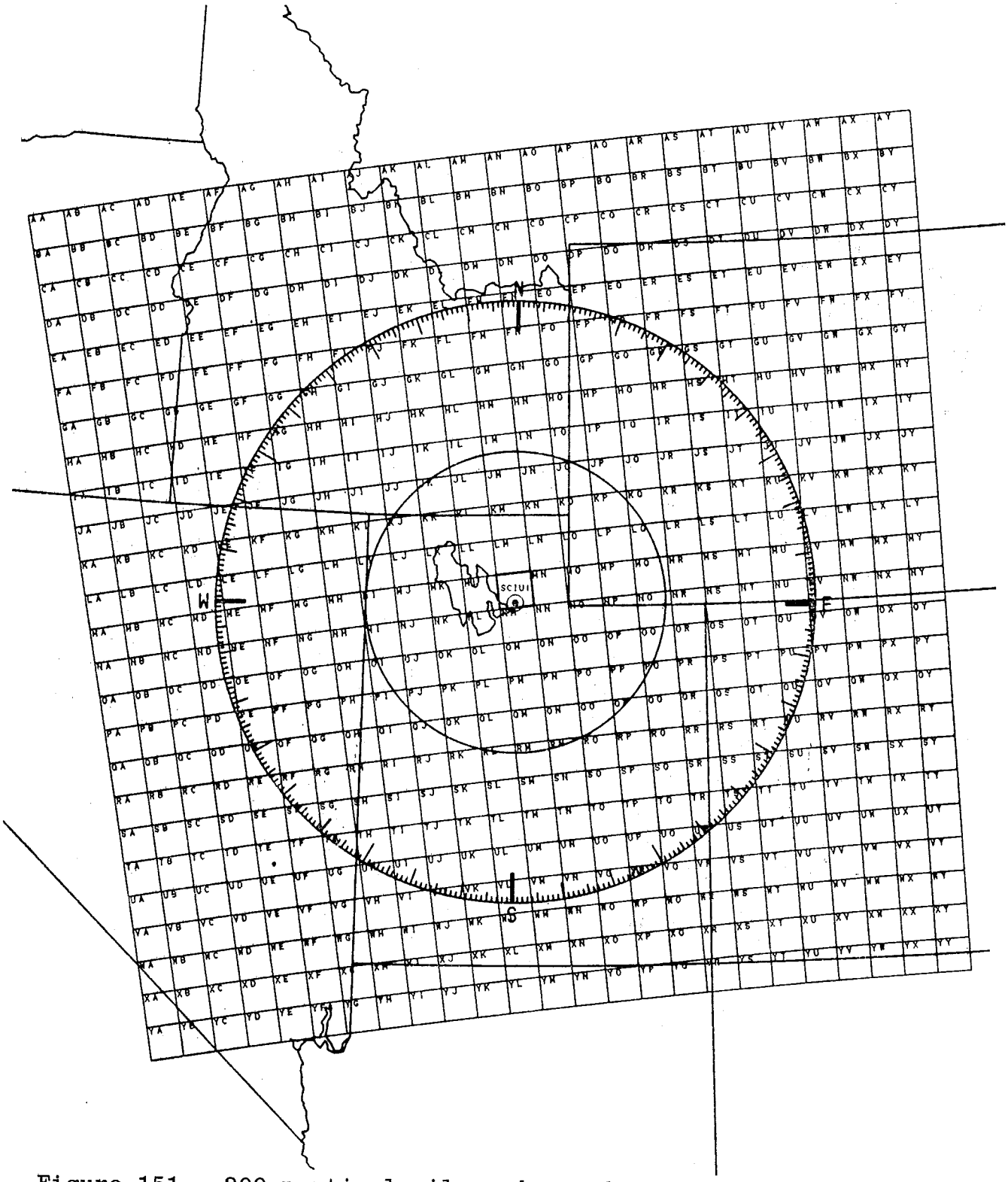

Figure 151.--200 nautical mile radar code grid for Salt Lake City, Utah.

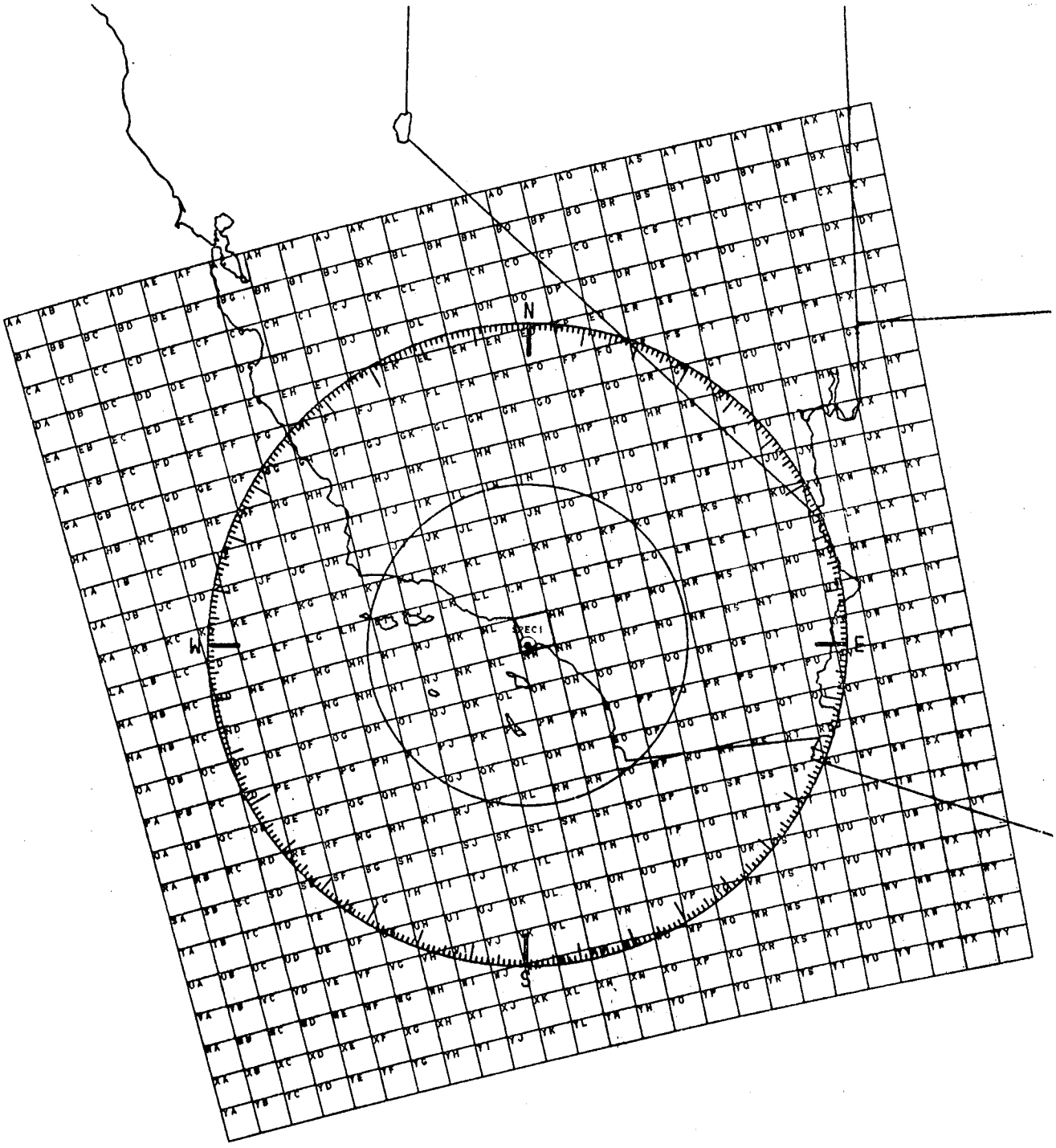

Figure 152.--200 nautical mile radar code grid for San Pedro, Calif.

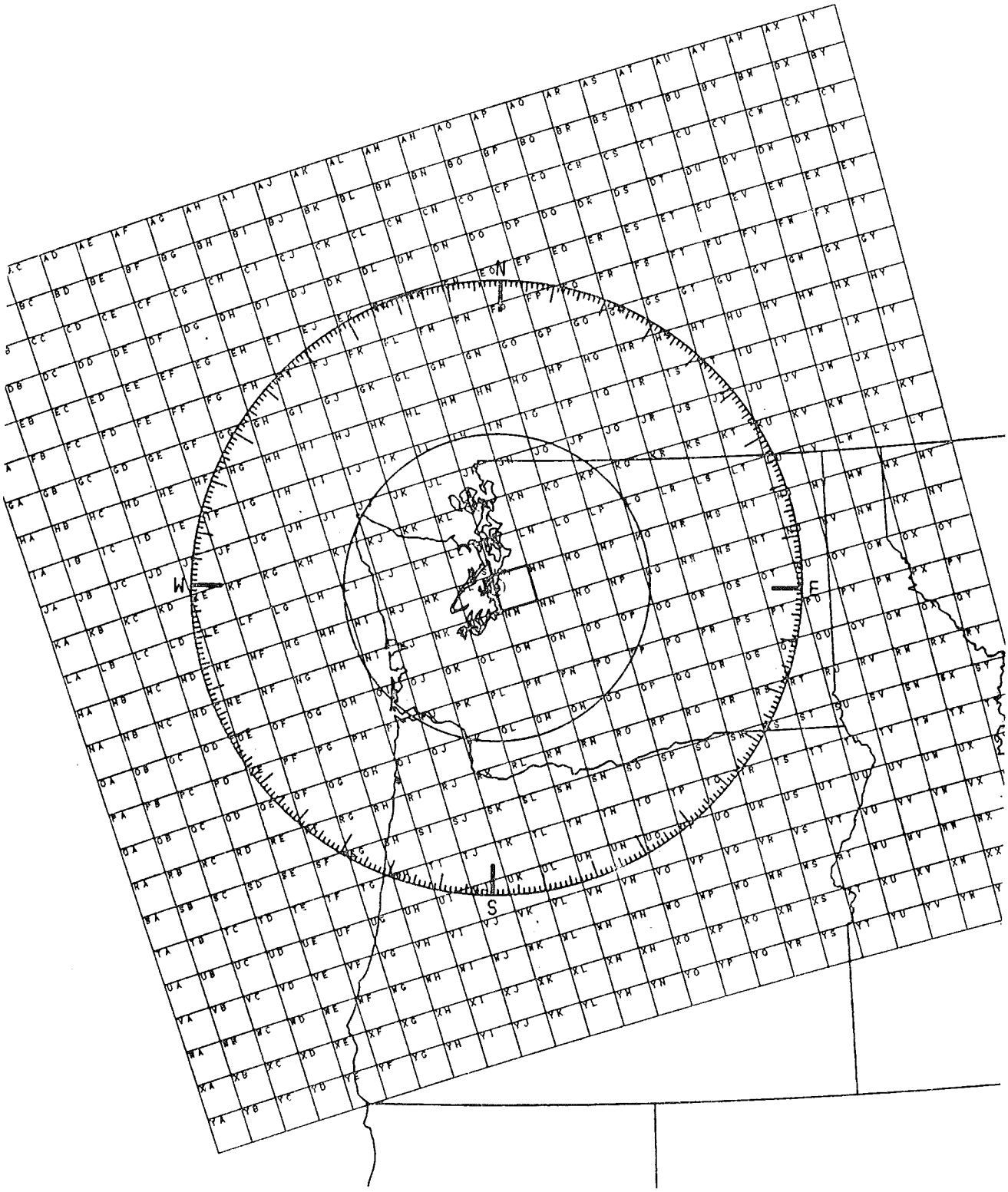

Figure 153.--200 nautical mile radar code grid for Seattle, Wash.

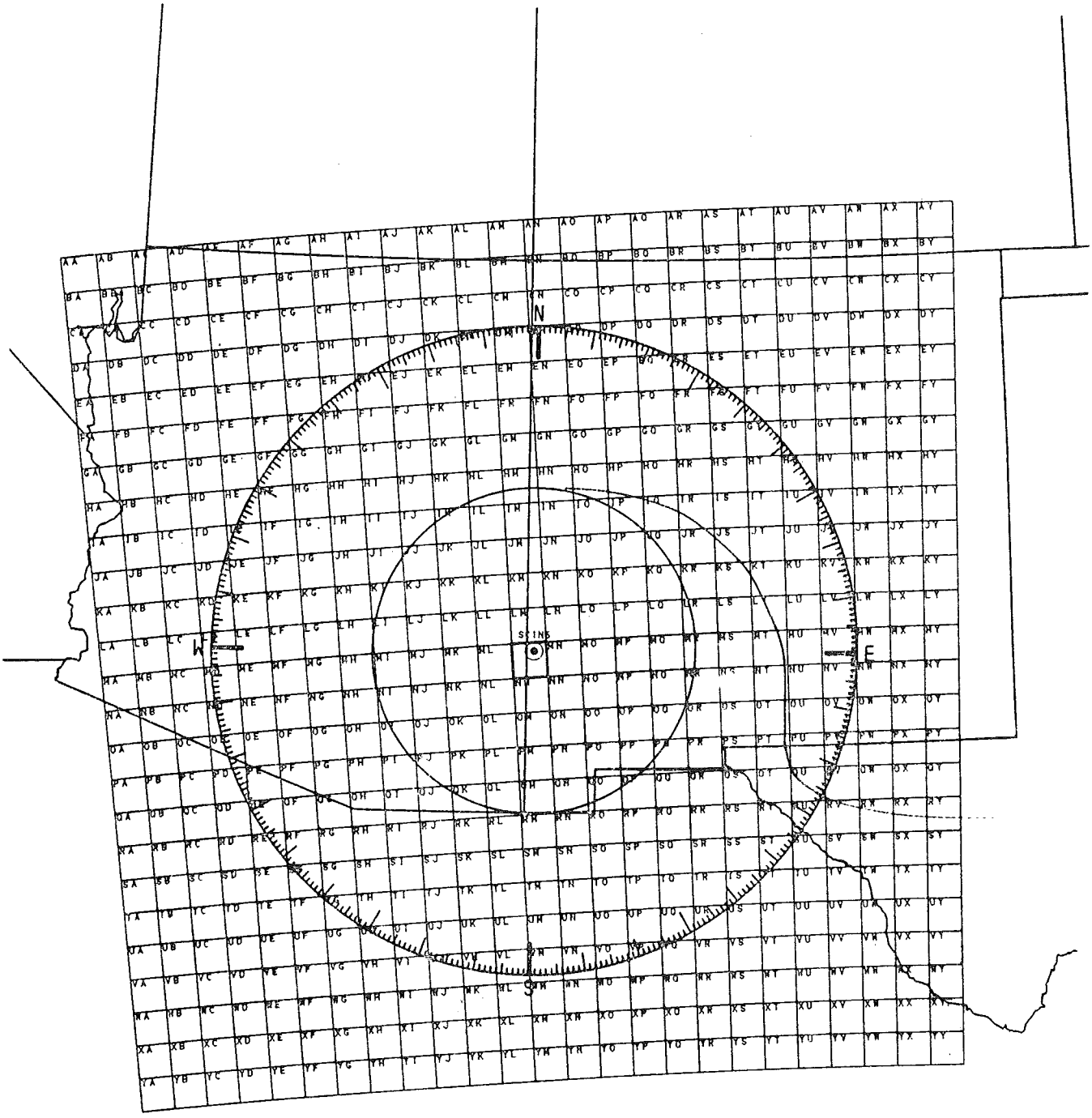

Figure 154.--200 nautical mile radar code grid for Silver City, N.Mex.

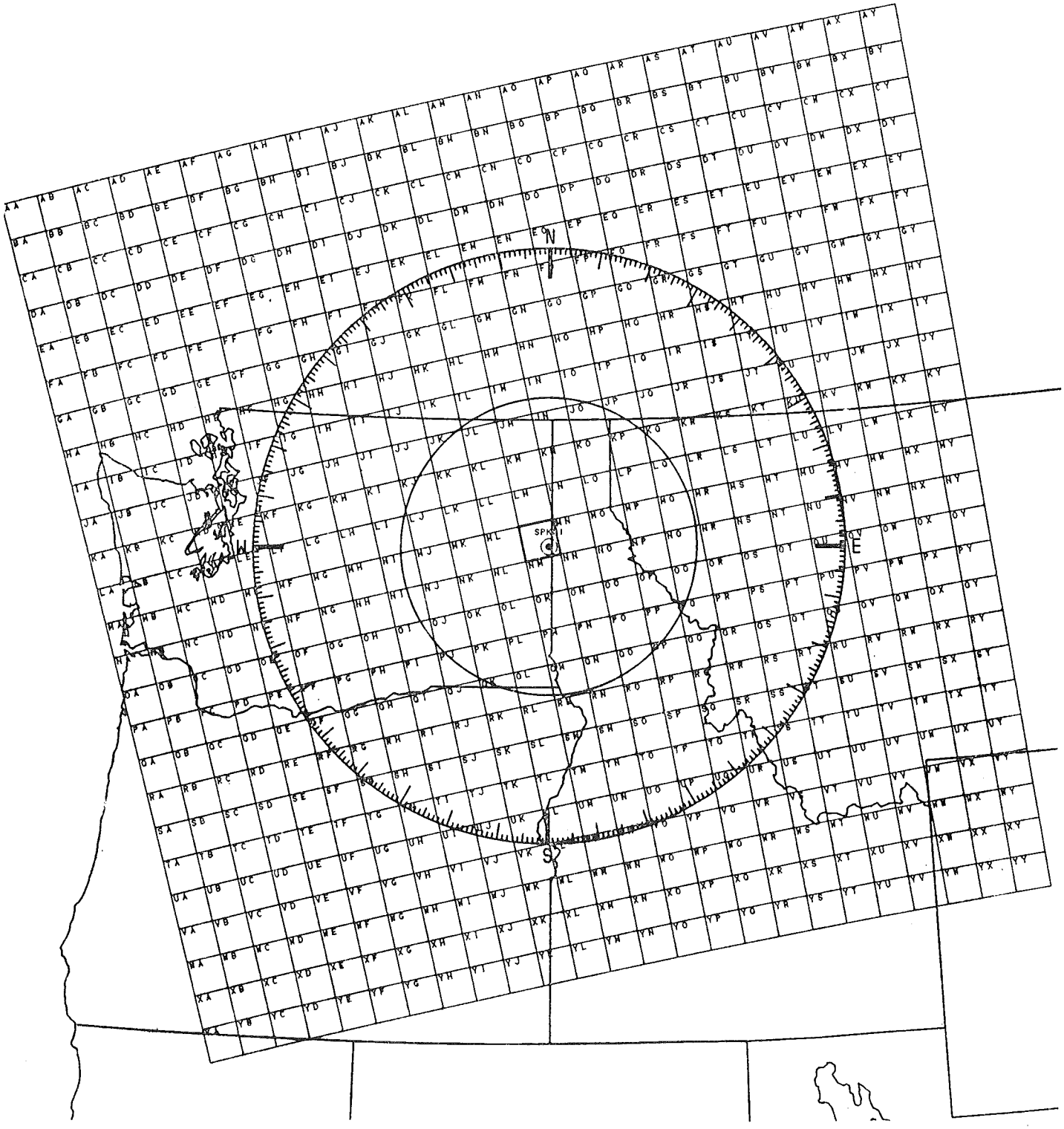

Figure 155.--200 nautical mile radar code grid for Spokane, Wash.

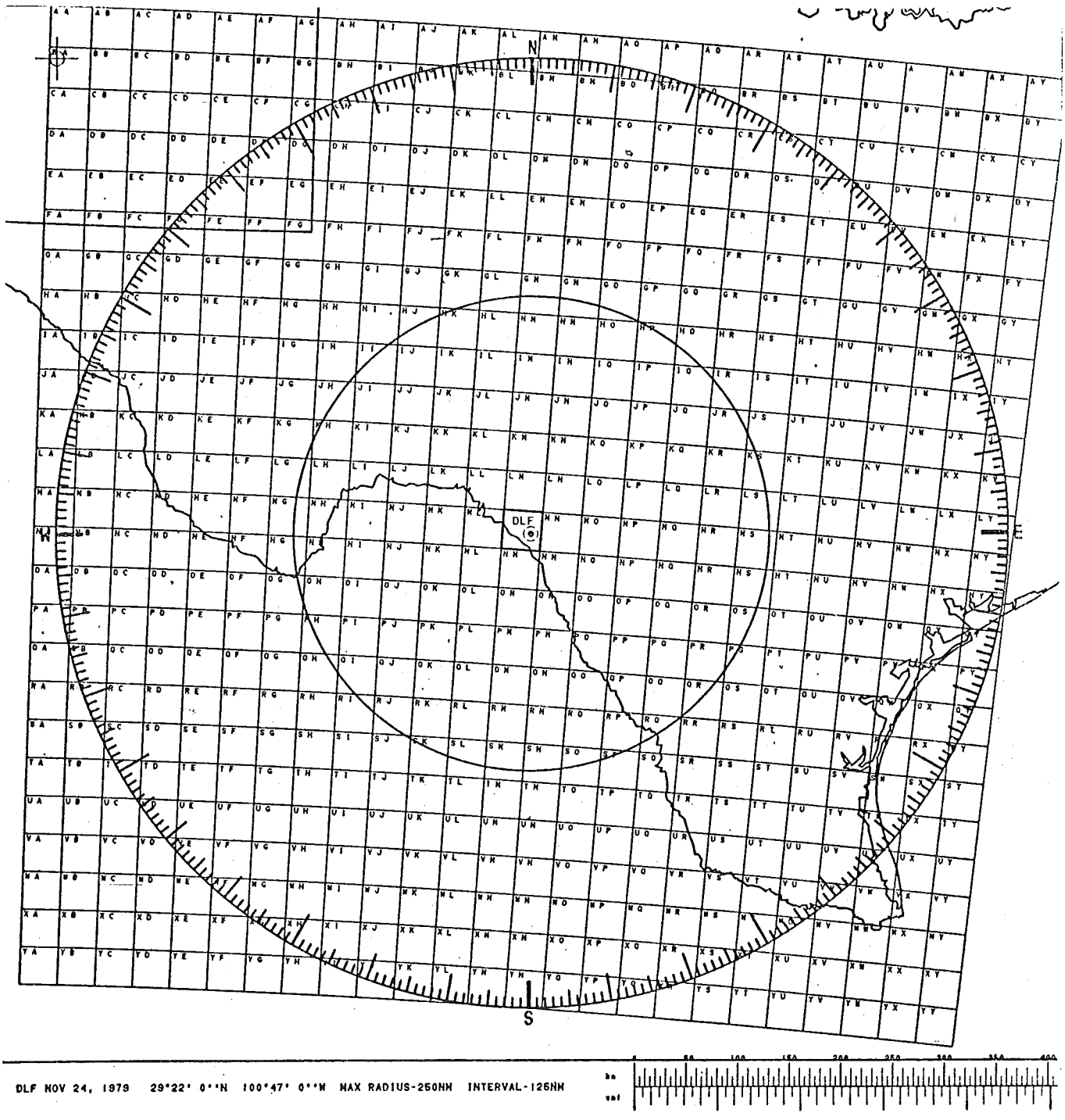

Figure 156.--250 nautical mile radar code grid for Laughlin AFB, Tex.

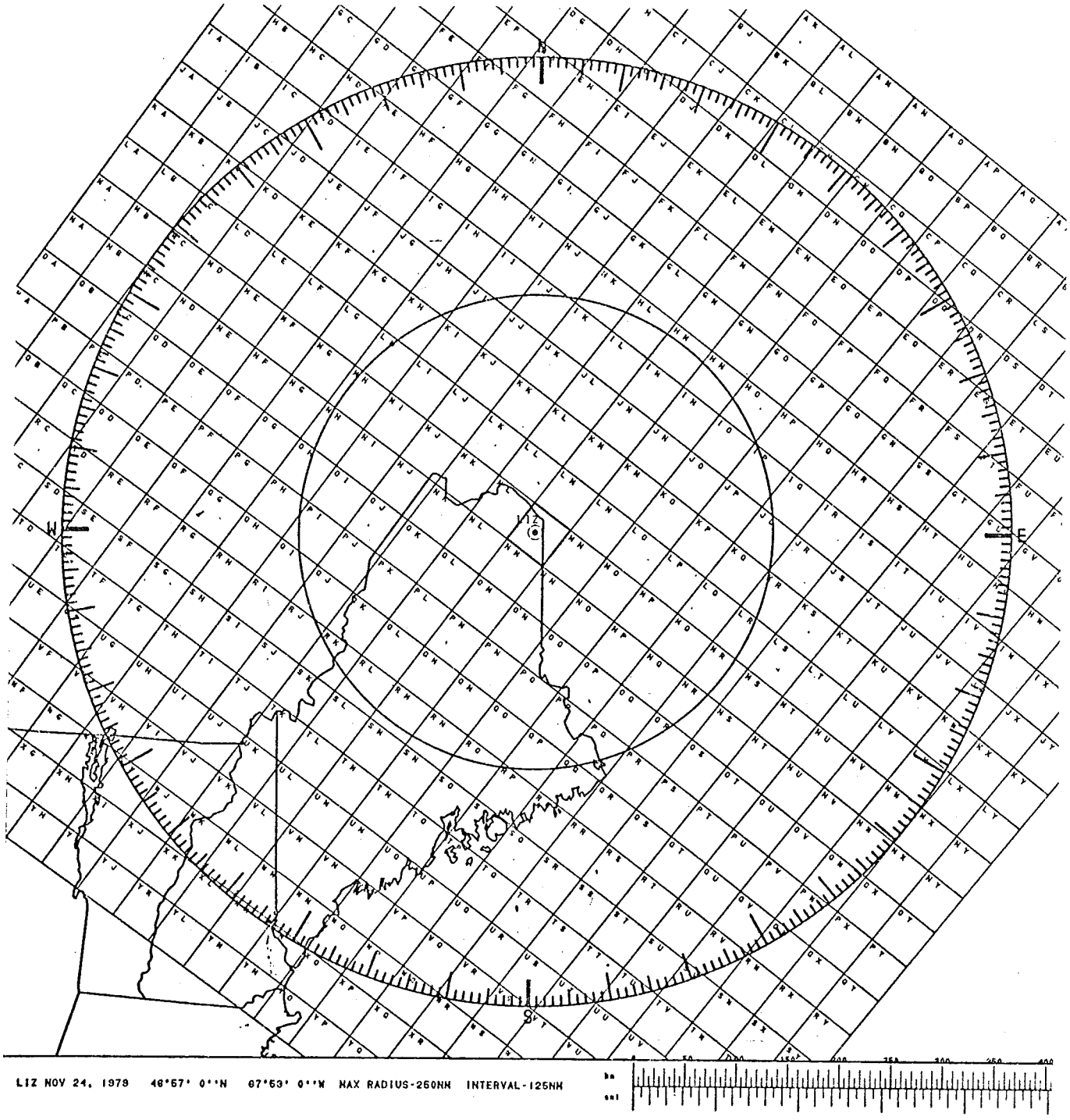

Figure 157.--250 nautical mile radar code grid for Loring AFB, Maine.

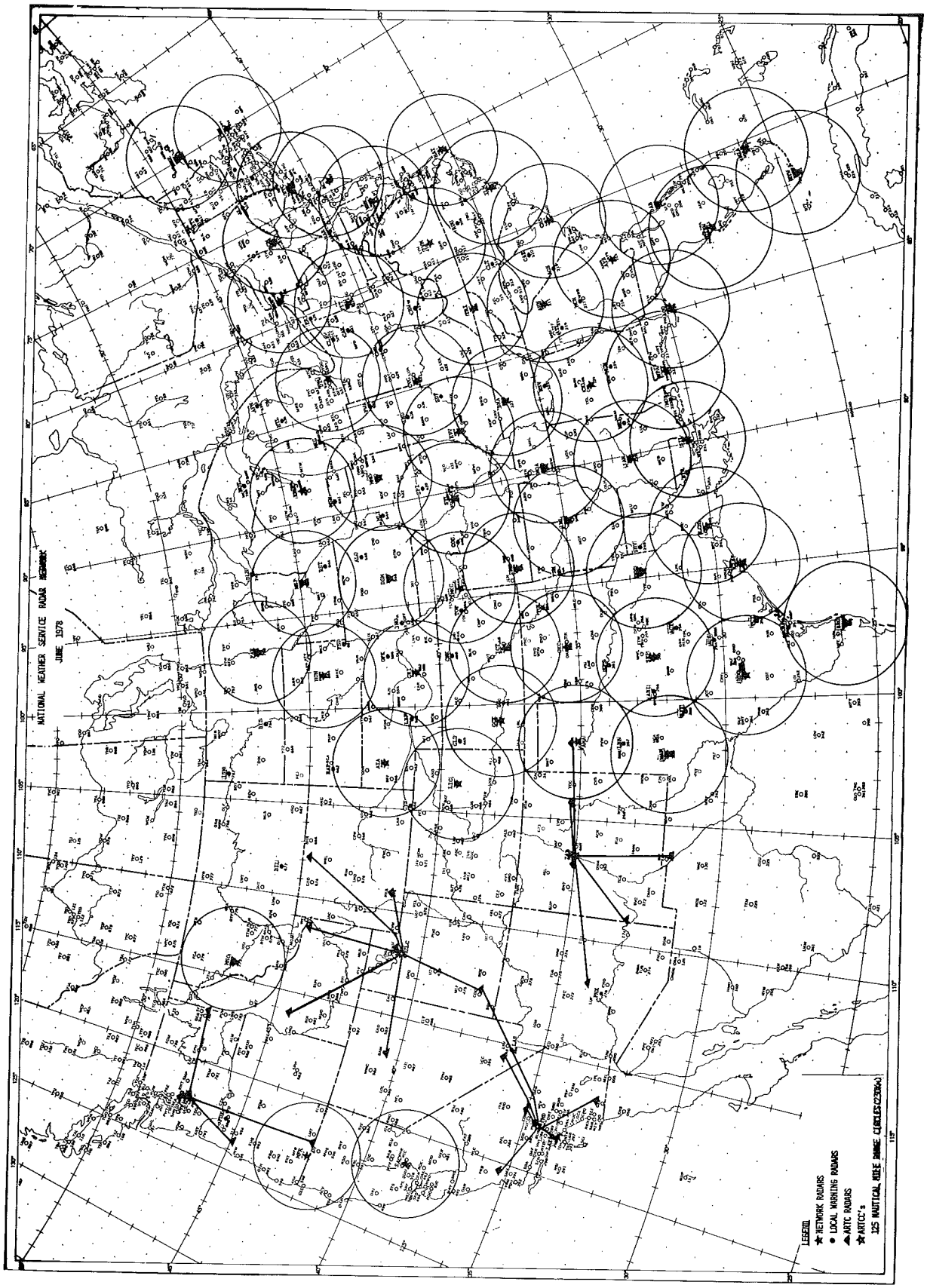

Figure 158.--Radar coverage by NWS Network Radars.