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FLIGHT TESTS OF THE ERIE, PENNSYLVANIA VOR

FOR LIMITED DISTRIBUTION

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INTRODUCTION

This report presents the results of the flight tests conducted on the Erie, Pennsylvania VOR. This facility has a counterpoise 10 feet above ground in contrast to the 15- and 30-foot high counterpoises normally used at standard VOR facilities.

Fig. 1 is a photographic view of the Erie VOR installation. This type of installation provides a reduction in the cost of the counterpoise and transmitter house and also provides increased protection to the transmitter house from the effects of the elements. The purpose of these tests was to determine the effect of the low counterpoise height on general VOR performance.

FLIGHT TESTS

The item of primary importance during this flight testing was the measurement of the vertical plane field pattern produced by a standard 5-loop antenna array on a counterpoise ten feet above ground. This was followed by flight tests to measure the polarization error, heading effect, cone angle, and distance range. The results obtained during these tests are compared with results previously obtained when the same test was conducted on the north omnirange at the Technical Development and Evaluation Center at Indianapolis, which has a 15-foot high counterpoise.

Vertical Plane Field Pattern

The polar plot of the vertical field pattern measured on the Erie station with a 10-foot high counterpoise is shown in Fig. 2. A similar plot for the Technical Development and Evaluation Center omnirange, having a 15-foot high counterpoise, is given in Fig. 3. The principal difference between these diagrams is the relative increase of radio-frequency energy radiated at low angles from the Erie station.

Distance Range

The distance range of a VOR is defined as the distance in statute miles from the station, at which the course width in degrees becomes double the course width measured at ten miles. This test was conducted at an altitude of 1,000 feet above ground, 1,800 feet msl. The distance range of the Erie station was 73.9 miles, as compared to a distance range of 62.6 miles for the Indianapolis station.

Heading Effects

Recording the course deviation indicator current, the aircraft was flown on eight different headings, crossing a ground check point at every

45-degree heading. The recording was marked as the airplane crossed each check point, and the indicated bearing was then compared with the magnetic bearing. The zero reference point in each case was taken on the heading to the station. These results are shown in Table I.

TABLE I

ERIE VOR

Heading, Degs. (Check Point 20 Miles from Station)	Aircraft Heading Over Check Point (degs.)								Total Heading Effect (degs.)
	E	W	N	S	SE	SW	NE	NW	
90	-1/4	0	-1/4	-3/4	-1/2	-1/4	-1/2	+1/4	±1/2
180	+2 1/2	+3/4	0	0	+1 1/2	+1	+1	+1	±1 1/4
225	+1	+1 1/4	+1 3/4	+1/4	+1/4	+3/4	0	+2	±7/8
NORTH OMNIRANGE (Indianapolis)									
45	+3/4	+3/4	0	0	+1/2	0	+1/2	-3/4	±3/4
180	+3/4	-1	0	-1	0	-1/4	-1	+1/2	±7/8
270	0	-3/4	-1	+1/4	-1/2	-1/4	-1/4	-3/4	±5/8

30-Degree Wing Rock

Headed to the station, the aircraft was banked ±30 degrees. The nose of the airplane was held "on the point" during this maneuver. The course deviation indicator current was recorded, and then converted to degrees of course displacement. This polarization check was performed on two different radials of the station.

Bearing from Station (degs.)	Erie Error (degs.)	North Omnirange Indianapolis Error (degs.)
180	±5/8	±7/8
270	±3/8	±5/8

360-Degree Circle

Headed toward the station and starting from a ground check point, a 360-degree circle was flown at a constant 30-degree bank. The course deviation indicator current was recorded during this circle and converted into degrees of error from the azimuth course being flown at the beginning of the circle. Since the aircraft in the 360-degree circle was changing azimuth with respect to the station, this deviation was computed in degrees and subtracted from the course deviation indicated error, resulting in the numerical value of polarization error, following the removal of the receiver error. This polarization test was conducted at an altitude of 1,000 feet above ground and at a distance of approximately 20 miles from the station. These results are shown in Table II.

TABLE II

Bearing from Station (degs.)	Erie Error (degs.)	North Omnirange Indianapolis Error (degs.)
270	±1 3/4	±2 1/5
90	±2	-
45	-	±2

Cone Width Measurements

The final flight check conducted on the Erie VOR was the measurement of the cone width. Measurements were made by recording the course deviation indicator and the TO-FROM indicator. Results obtained using the course deviation indicator recordings are questionable, since it was impossible to obtain a straight-line recording when flying across the cone. This was probably due to improper phasing of the antenna array. The cone angle of elevation results obtained are listed in Table III.

TABLE III

Station	Cone Angle of Elevation (degs.)	
	Course Deviation Indicator Measurement	TO-FROM Indicator Measurement
Erie VOR	43 1/4*	49 7/10
Indianapolis North Omnirange	49 4/5	49 4/5

*Results on this measurement questionable.

CONCLUSIONS

The Erie, Pennsylvania VOR is located at a good site. A 6-mile radius circle flown about this omnirange facility revealed the maximum amount of scalloping to equal ±1/2 degree.

The counterpoise height of ten feet made no change in performance of the station with respect to polarization and cone width.

A considerable increase in low-angle radiation resulted, using the 10-foot counterpoise.

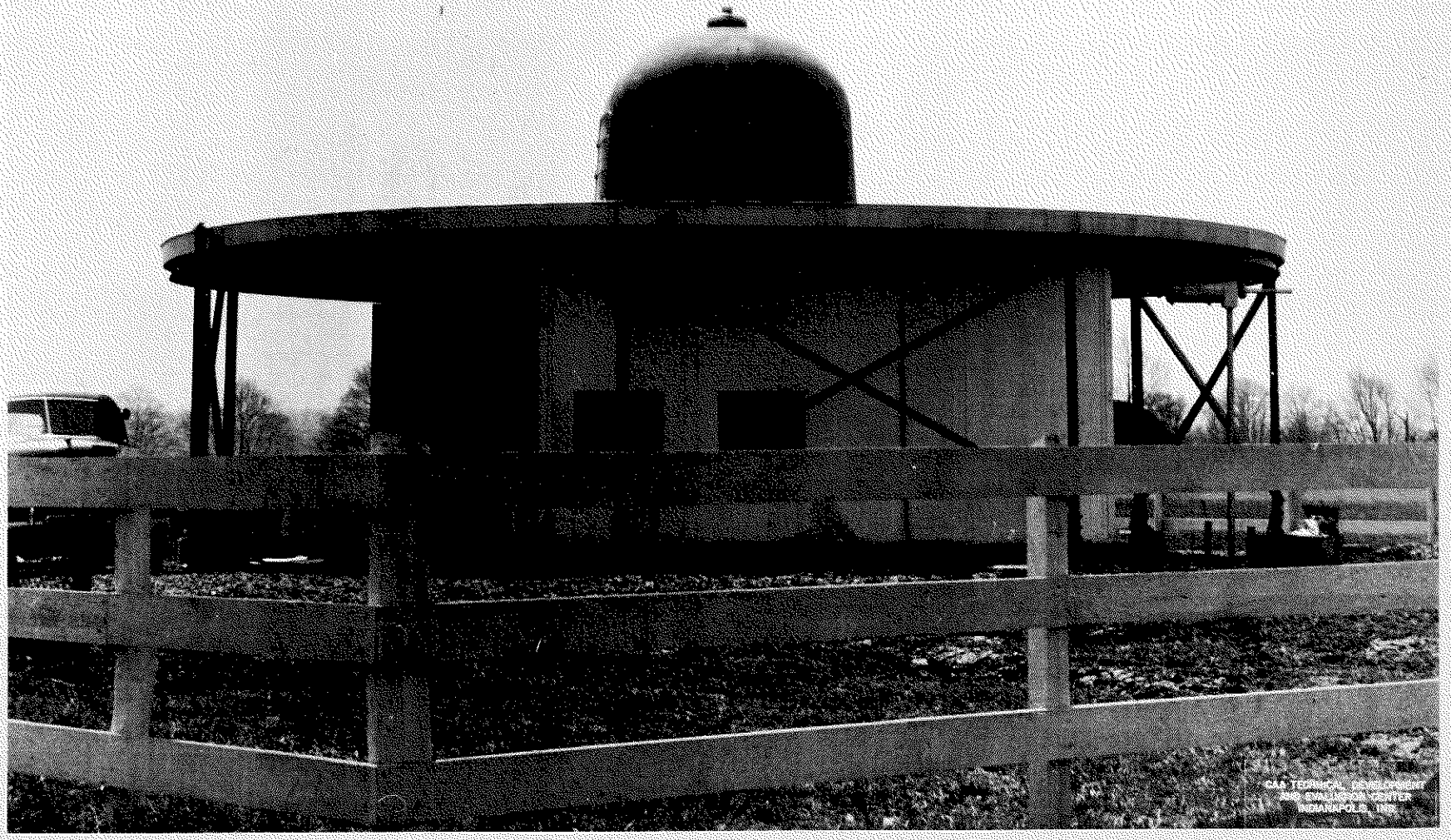

FIG. 1 ERIE, PA. VOR

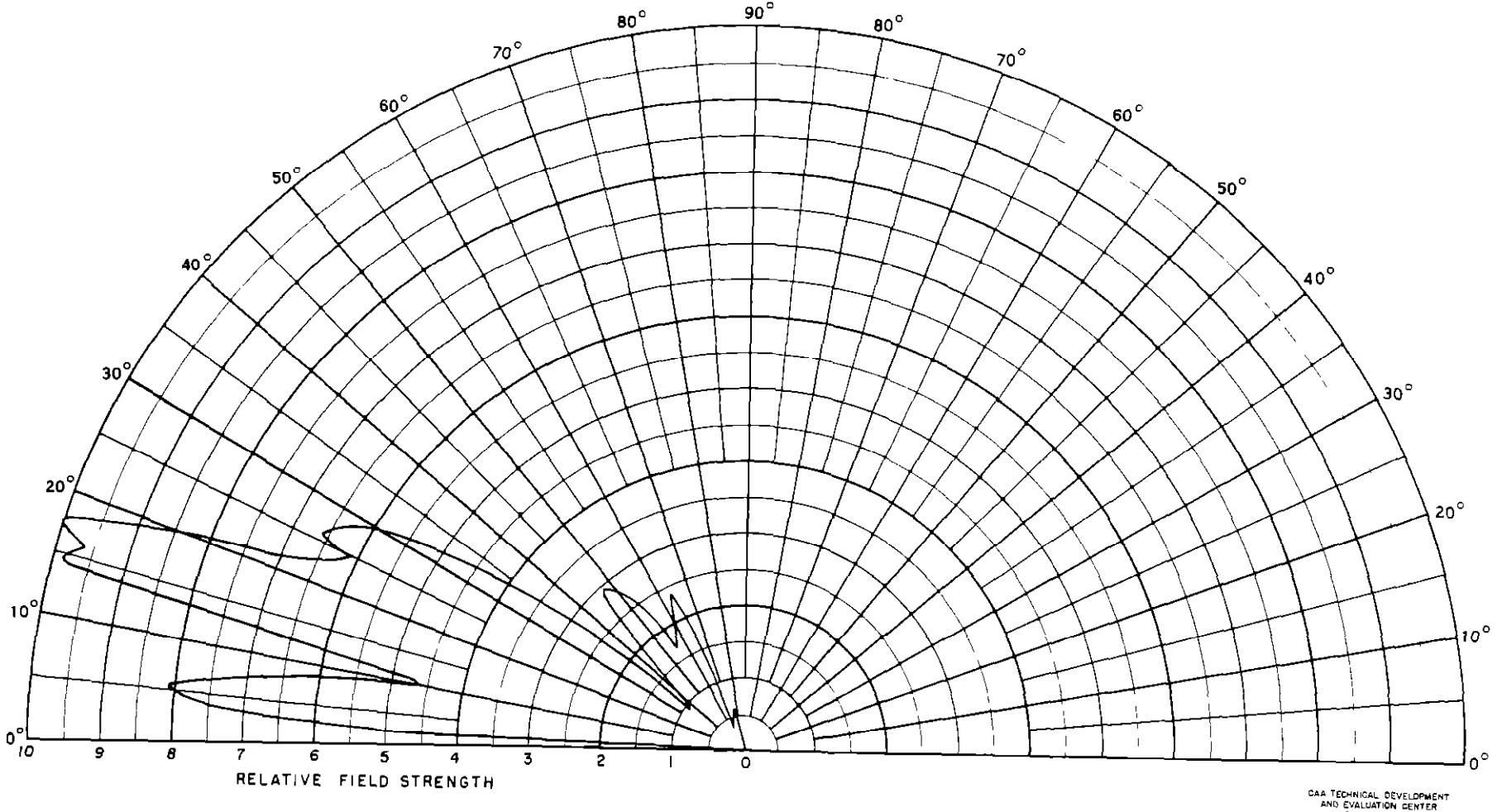

FIG 2 MEASURED VERTICAL FIELD PATTERN OF OMNIRANGE ANTENNA MOUNTED ON A COUNTERPOISE 10 FEET HIGH

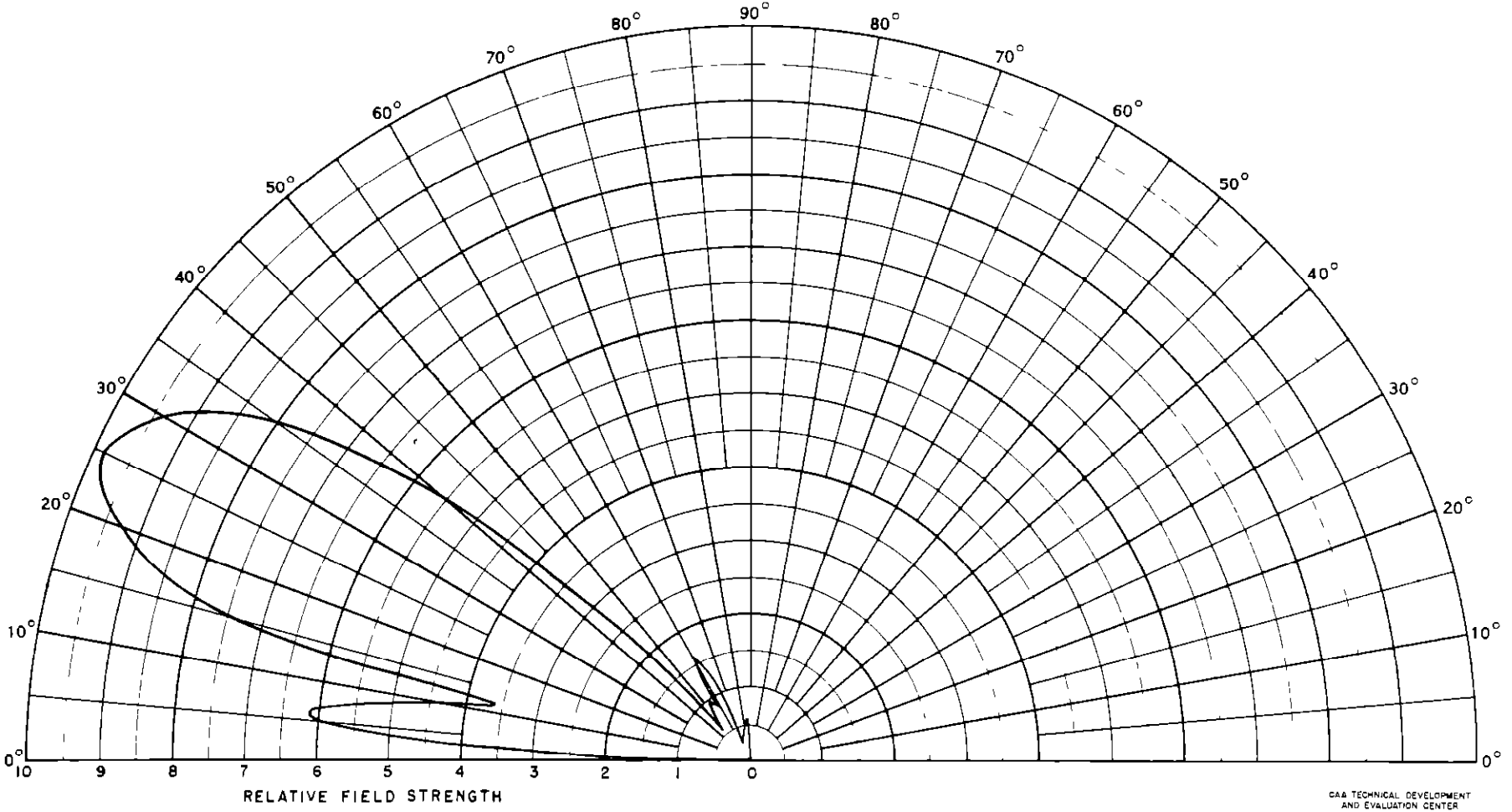

FIG 3 MEASURED VERTICAL PLANE FIELD PATTERN OF OMNIRANGE ANTENNA MOUNTED ON A COUNTERPOISE 15 FEET HIGH