PAUL GODLEY CO.
CONSULTING RADIO ENGINEERS
MONTCLAIR, N. J.

ENGINEERING PROPOSAL

COVERING INCREASE OF POWER

KOMA 1520 Kc 50 Kw

OKLAHOMA CITY, OKLAHOMA.

September 1945

PAUL GODLEY CO.
CONSULTING RADIO ENGINEERS
MONTCLAIR, N. J.

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KOMA 1520 Kc. 50 Kw

OKLAHOMA CITY, OKLA.

SUMMARY:

KOMA, Oklahoma City, operates on 1520 Kc. with temporarily authorized 5000 watts, but subject to reduction of power to 500 watts at night lacking plans for night protection to co-channel stations.

This proposal contemplates increase of power to 50 Kw. day and night, change of site, and the use, at night, of a three element directive antenna designed to protect the secondary service areas of the Class I-B stations WKBW, Buffalo, N.Y. and TGW, Guatemala City.

The report includes (1) a discussion and mapping of the engineering and allocation factors involved, and (2) a mapping of areas and a tabulation of populations served by the present and proposed operations. It is shown in the report that, on the basis of FCC Standards, no interference will be caused to existing stations within their normally protected service areas.

Attached to, and a part of the report, are the following:

Figure 1: Map of channel geography showing the allocation problem.
2: Horizontal plane radiation pattern - night.
3: Vertical plane radiation patterns.
4: Plat of proposed antenna and ground system.
5: Map showing computed present and proposed night coverage.
6: Map showing computed present and proposed daytime coverage.
7: Map showing so-called blanket areas, present and proposed - night time, - with airports and radio stations also indicated.
8: Map showing so-called blanket areas, present and proposed, - daytime.
Appendix 1: Antenna design formulas and sample computation.

ALLOCATION PROBLEM:

There are two class I-B stations on the 1520 Kc. clear channel:

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WKBW, Buffalo, N.Y.	50 Kw. DA.
TGW , Guatemala City	10 Kw. Non-DA. 710 mv/m effective field assumed.

There are no other co-channel stations in North America.

Nearest adjacent channel station is KWWC (KVWC), Vernon, Texas, 1490 Kc., 250 watts, Class IV, 132 miles from the proposed transmitting site. On the basis of desired to undesired, ground-wave signal ratio of 1:50, soil conductivities as shown on the FCC Map of Conductivity, and basic radiation data, no interference will be caused to either the existing or the proposed station. Power in excess of 50 Kw. is developed by the KOMA directive antenna in the direction of three adjacent channel stations:

KSTP, St.Paul, Minn.	1500 Kc.	Class I-B	50 Kw.
KGA , Spokane, Wash.	1510 Kc.	Class I-B	10 Kw.
KFBK, Sacramento, Cal.	1530 Kc.	Class I-B	10 Kw.

On the basis of desired to undesired signal ratio of 1:5 for 10 Kc. separation, and 1:25 for 20 Kc. separation, and the FCC second hour after sunset 10%-of-time sky-wave curves, no interference will be caused to any of these stations by KOMA, nor will KOMA suffer interference from any of these.

Bearings and distances from Oklahoma City to the normally protected service areas of the two co-channel stations are shown in Figure 1. Pertinent nuisance field contours and service contours are also shown or indicated on the map. It is seen that no interference will be caused to the secondary service of WKBW within the boundaries of the United States, nor to the secondary service of TGW within the boundaries of Guatemala.

NIGHT LIMITATION - KOMA:

Sky-wave fields developed by TGW, Guatemala, (assuming 710 mv/m non-directive effective field) are such as to limit KOMA interference-free service to the 1.5 mv/m. Sky-wave fields of WKBW protect the 0.5 mv/m 50% sky-wave service area of KOMA.

DIRECTIVE ANTENNA SYSTEM:

The arrangement of the 3 element directive antenna system proposed for night operation is shown in Figure 2, with the horizontal plane radiation pattern. An enlarged detail of the computed minima and the expected tolerance of adjustment are also shown in Figure 2. Vertical plane patterns in the direction of the minima and the maximum are shown in Figure 3.

It is proposed to use the center one of the three towers by itself during the day, with a non-directional pattern of radiation.

Antenna design factors

Number of elements: 3 identical radiators.
Radiator type: Vertical guyed, uniform cross-section.
Overall height above grade level: 325 feet.
Height above insulators: approximately 320 feet.
Overall height above sea level: approximately 1600 feet.
Equivalent overall electrical height: 190°.
Orientation of towers: The 3 towers are in line bearing 113° true.
Tower spacing: 90° (162 feet)
Computed relative current and radiated field magnitudes:

Northwest tower	(1)	0.51
Center tower	(2)	1.0
Southeast tower	(3)	0.51

Relative current phasing:

#1	117.0° lagging
2	2.5° leading
3	117.0° leading

Current distribution: Sinusoidal.
Ground system: Each radiator is to be supplied with 120 radial wires, each 0.4 wavelength long (259 feet) except where individual systems overlap. (See Figure 4). Wires are to be plowed into the soil to a depth of 4" to 6". Individual radiator ground systems are to be bonded to bus at points of intersection.
Effective field: Day and night - 1700 mv/m.

Towers #1 and #3 will be effectively disconnected during daytime operation. Operation of the proposed system in accordance with the above specifications will produce radiation patterns as shown in Figures 2 and 3. A plat of the arrangement of antenna towers and ground system is shown in Figure 4.

Radiation formulas used in the antenna design, together with sample calculations are appended to the report.

SERVICE CONTOURS:

The maps of Figures 5, 6, 7 and 8 show estimated day and night field intensity contours for both the authorized present and the proposed operation. Location of these contours is based on (1) the proposed basic pattern of radiation as shown in Figure 2, (2) conductivity of 15×10^{-14} emu, as shown in the FCC Map of Conductivity, and (3) non-directive effective fields as follows:

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Present day	5 Kw.	435 mv/m eff.field
Present night	500 W.	135 mv/m eff.field
Proposed day	50 Kw.	1700 mv/m eff.field

Present night coverage is estimated on the basis of the FCC decision of September 5, 1945, covering the use of 500 watts at night. Night coverage prior to this time would be the same as shown for the present daytime operation.

The normally protected contour for the proposed class of station is 0.5 mv/m, day and night, and 2.5 mv/m for the present operation. The actual interference-free contour for the proposed operation is 1.5 mv/m. These contours are mapped in Figures 5 and 6.

TRANSMITTER SITE:

The site proposed for the transmitter is located about 9 miles south of Oklahoma City, in Moore Township, near US Highway 77. It is indicated on the attached maps at geographical coordinates approximately as follows:

North latitude: 35° 21' 40"
West longitude: 97° 30' 00"

The transmitting site has been selected in accordance with the Standards of Good Engineering Practice, and sufficient space has been made available to accommodate the required transmitting and radiating system as shown in Figure 4.

Distances from the proposed site to airports within 10 miles are listed as follows:

Wheatley Airport	3/4 mile southeast of site
Will Rogers Airport	7 miles northwest of site
Tinker Airport	7 miles northeast of site
Norman Field (Navy)	9 miles south of site

There are also emergency fields listed as follows:

South of site	4 miles
South of site	8 miles
Southeast of site	7.5 miles
Southeast of site	5 miles

The proposed site is not located within any regular airway marked on aeronautical charts; but it is located within the "Local Flying Area" associated with the Amber 4 Airway. Site is 3 miles south of the center line of Amber 4 airway to Tulsa, and 7 miles east of Amber 4 Airway to Fort Worth.

Radio stations and airports within 10 mile radius of the proposed site are indicated on the map of Figure 7.

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AREAS AND POPULATION:

The area covered, and population served within the various contours have been determined, and are tabulated below:

Day time operation

Contour	Area (sq.mi.) Present	Area (sq.mi.) Proposed	Population Present	Population Proposed
500 mv/m	2.12	23.75	115	1 153
250	7.06	72.4	534	3 131
25	266	1 194	224 200	260 793
5	1 523	4 900	287 950	422 458
2	3 280	10 520	357 000	610 125
0.5	10 950	32 350	554 400	1 092 672

Night time operation

Contour	Area (sq.mi.) Present	Area (sq.mi.) Proposed	Population Present	Population Proposed
500 mv/m	0.21	20.0	14	885
250	0.85	57.6	42	3 077
25	50.4	818	3 143	232 259
5	459	3 456	233 114	337 731
2.5	960	-	246 416	-
2.0	1 195	7 500	255 840	429 959
1.5	1 592	9 790	264 965	470 211
0.5	-	22 870	-	682 784

Areas were computed where circular, or measured with the polar planimeter, and populations have been determined in accordance with FCC stipulations in Form 304, with reference to 1940 Census figures.

CONCLUSION:

It is believed that the proposal conforms with the requirements of good allocation; and that it involves an important gain in the efficiency of use of the 1520 Kc. channel in North America.

This report consists of 5 typewritten pages, 8 Figures and 1 appendix.

Paul F. Godley
for PAUL GODLEY CO.
Consulting Radio Engineers
Montclair New Jersey

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CONSULTING RADIO ENGINEERS
MONTCLAIR, N. J.

STATE OF NEW JERSEY:
COUNTY OF ESSEX: SS:

PAUL F. GODLEY, who is known to me, deposes and says: That he is a Consulting Radio Engineer; that he resides in Montclair, N.J.; that he is a member of the firm of Paul Godley Co.; that the foregoing report was prepared by him, or under his immediate supervision, and that the statements therein contained are true, to the best of his knowledge and belief.

Paul F. Godley

SUBSCRIBED and SWORN to before me this 29th day of September 1945

[signature]
My Commission expires Oct. 19, 1949.

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APPENDIX 1

Assuming equal height radiators, sinusoidal current distribution, and perfect ground reflection, and referring all current magnitudes and phases to the center tower (#2), the formula for the proposed three element array becomes:

$$e = k V \left[(1 + n_1 \cos A_1 + n_3 \cos A_3)^2 + (n_1 \sin A_1 + n_3 \sin A_3)^2 \right]^{1/2}$$

where

subscripts refer to tower numbers.

$k = 1566$ for an effective field of 1700 mv/m.

$V = \dfrac{\cos H - \cos (H \sin \theta)}{\cos \theta (\cos H - 1)}$

H = equivalent electrical height of antenna.

θ = vertical plane angle above the horizon.

n = (with subscript) current magnitude relative to center tower.

$A_1 = S_1 \cos (\phi - 180) \cos \theta + \psi_1$

$A_3 = S_3 \cos \phi \cos \theta + \psi_3$

S = (with subscript) spacing in degrees.

ϕ = azimuthal angle, measured counter-clockwise from line of towers.

ψ = (with subscript) current phase relative to center tower.

SAMPLE COMPUTATION:

Az = 168° ϕ = 55° θ = 20°

$A_1 = 90° \cos (55-180) \cos 20 + (-117 - 2.5) = -168.0°$

$A_3 = 90° \cos 55 \cos 20 + (117 - 2.5) = 163.0°$

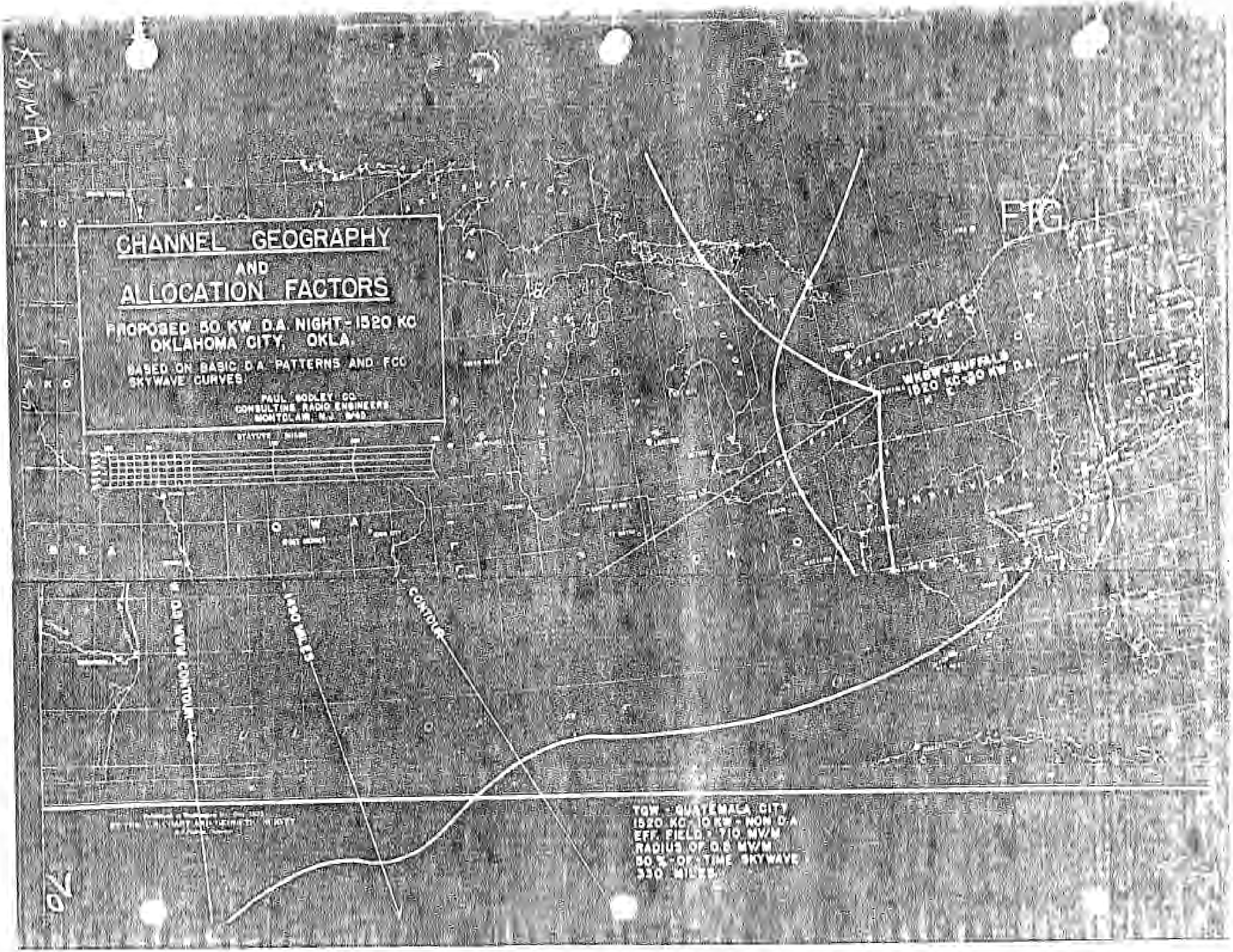
$n_1 \cos A_1 = -0.499$ $n_1 \sin A_1 = -.1060$

$n_3 \cos A_3 = -0.488$ $n_3 \sin A_3 = .1490$

$V = \dfrac{\cos 190 - \cos (190 \sin 20)}{\cos 20 (\cos 190 - 1)} = 0.754$

$e = 1566 \times 0.754 \left[(1 - .499 - .488)^2 + (.1490 - .1060)^2 \right]^{1/2}$

$= 53.1$ mv/m


KOMA
FIG
CHANNEL GEOGRAPHY
AND
ALLOCATION FACTORS
PROPOSED 50 KW. D.A. NIGHT - 1520 KC
OKLAHOMA CITY, OKLA.
BASED ON BASIC D.A. PATTERNS AND FCC
SKYWAVE CURVES
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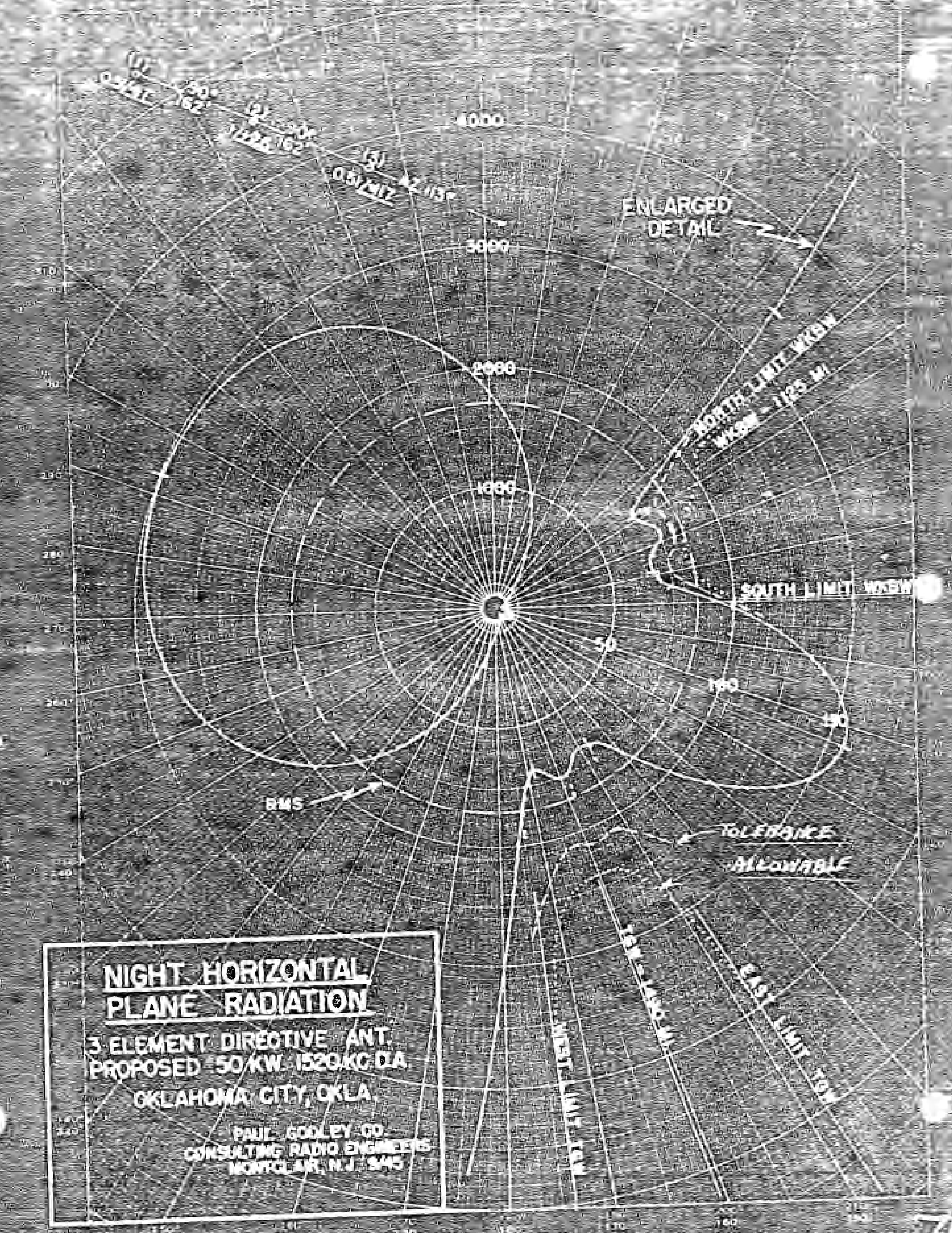
WKBW BUFFALO
1520 KC - 50 KW D.A.
CONTOUR
1490 MILES
0.5 MV/M CONTOUR
TGW - GUATEMALA CITY
1520 KC. 10 KW - NON D.A.
EFF. FIELD 710 MV/M
RADIUS OF 0.5 MV/M
50% OF TIME SKYWAVE
330 MILES
70

FIG. 2



NIGHT HORIZONTAL PLANE RADIATION
3 ELEMENT DIRECTIVE ANT.
PROPOSED 50 KW. 1520 KC D.A.
OKLAHOMA CITY, OKLA.
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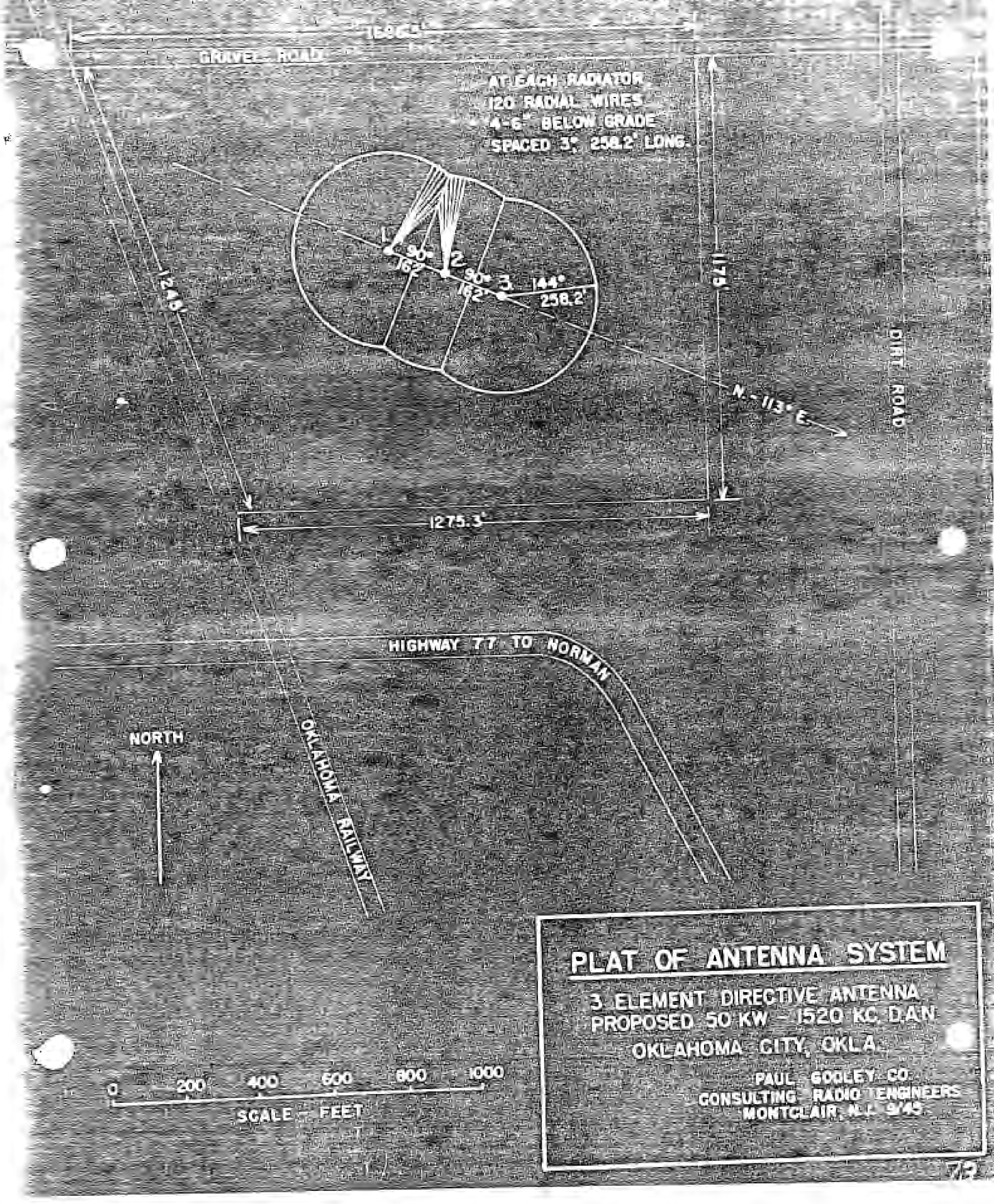
ENLARGED DETAIL
NORTH LIMIT WKBW
WKBW - 1125 MI.
SOUTH LIMIT WKBW
TOLERANCE
ALLOWABLE
EAST LIMIT TSW
WEST LIMIT TSW
RMS
4000
3000
2000
1000
50
100
150

FIG. 4


GRAVEL ROAD
AT EACH RADIATOR
120 RADIAL WIRES
4-6" BELOW GRADE
SPACED 3°, 258.2' LONG.
1
2
3
90°
162'
90°
162'
144°
258.2'
1248'
1175'
N. 113° E.
DIRT ROAD
1275.3'
HIGHWAY 77 TO NORMAN
OKLAHOMA RAILWAY
NORTH
0
200
400
600
800
1000
SCALE - FEET
PLAT OF ANTENNA SYSTEM
3 ELEMENT DIRECTIVE ANTENNA
PROPOSED 50 KW - 1520 KC. DA-N
OKLAHOMA CITY, OKLA.
PAUL GODLEY CO.
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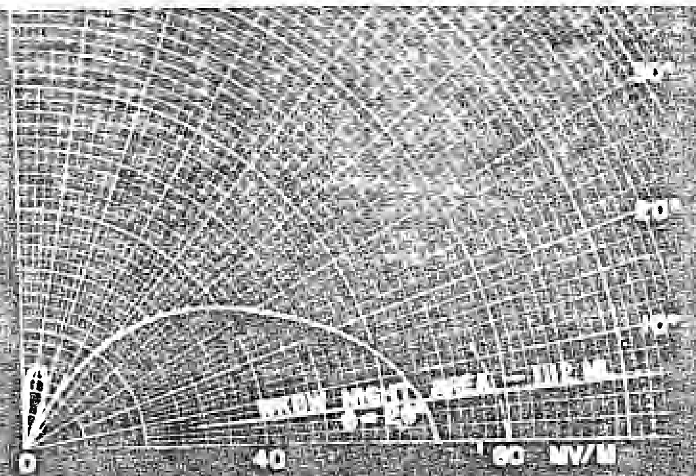
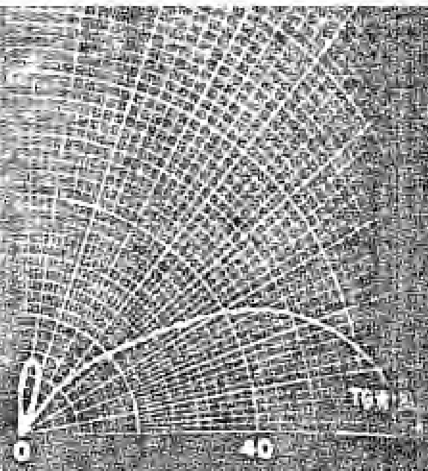


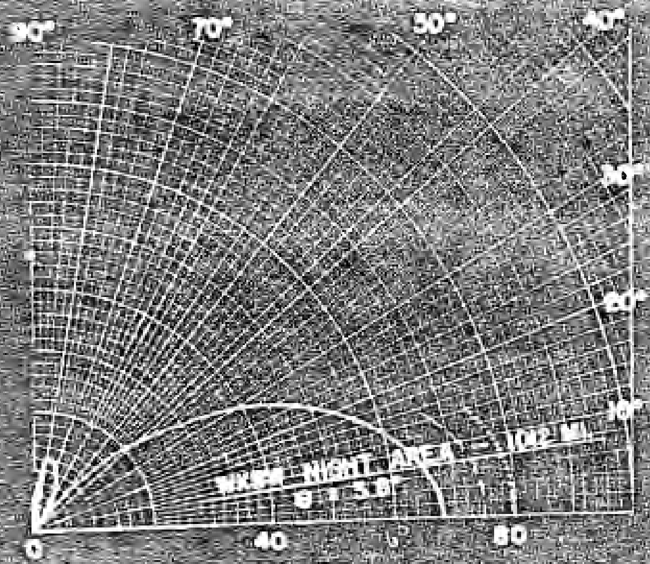
30°
20°
10°
NIGHT AREA
0
40
80 MV/M



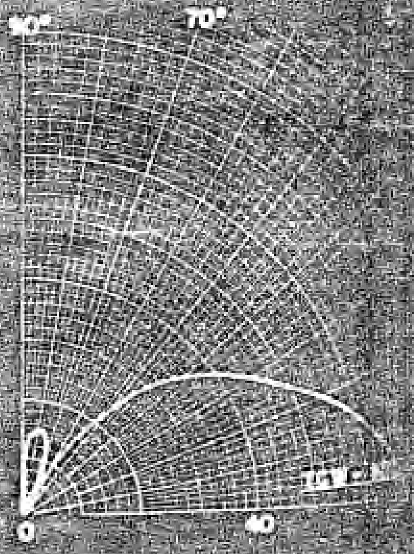
0
40

AZ. = 79°

AZ. = 16



90°
70°
50°
40°
30°
20°
10°
NIGHT AREA
0
40
80



90°
70°
0
40

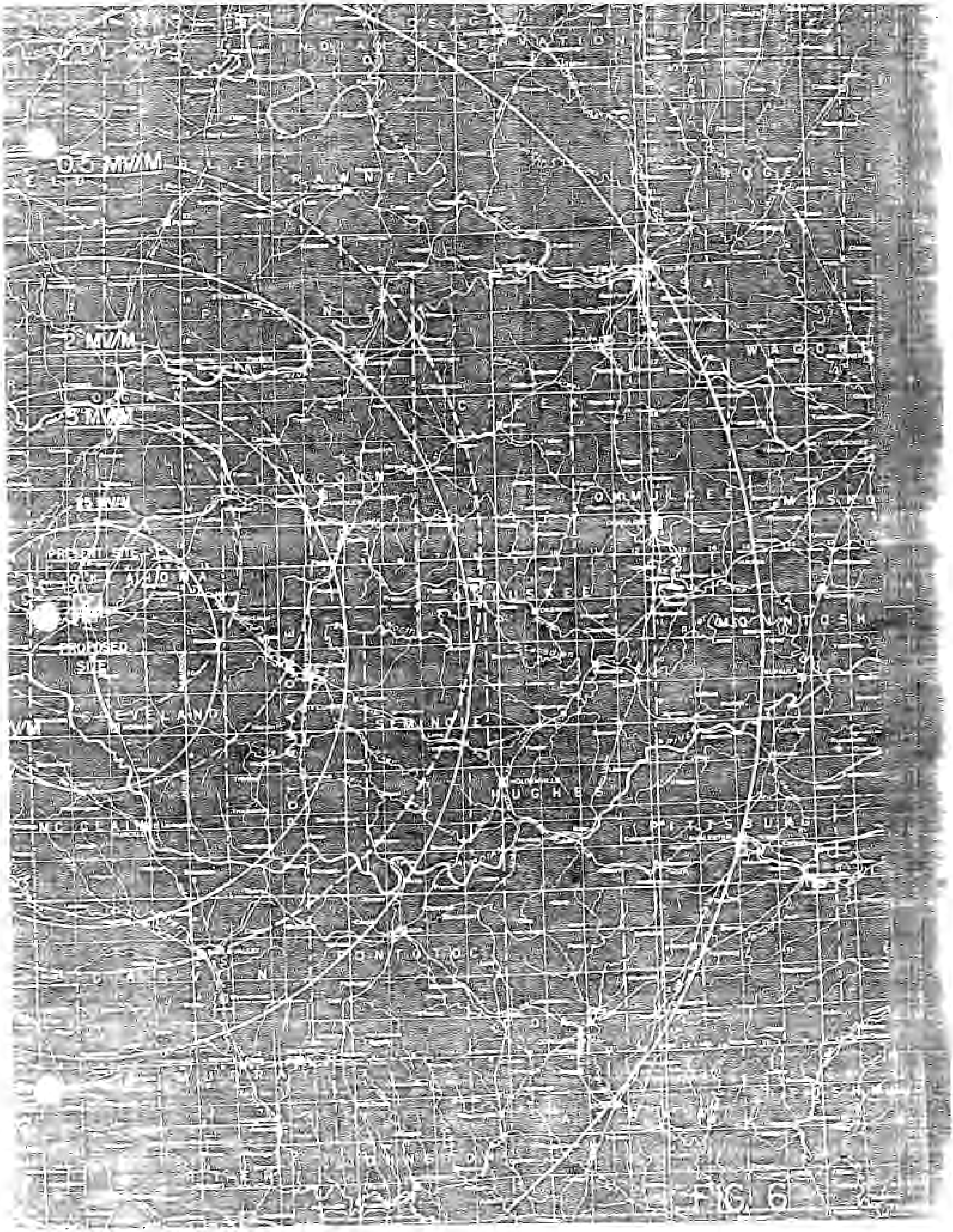

0.5 MV/M
2 MV/M
5 MV/M
PRESENT SITE
PROPOSED SITE
INDIAN RESERVATION
CREEK
OKMULGEE
MCINTOSH
CLEVELAND
SEMINOLE
HUGHES
PITTSBURG
PONTOTOC

FIG. 6

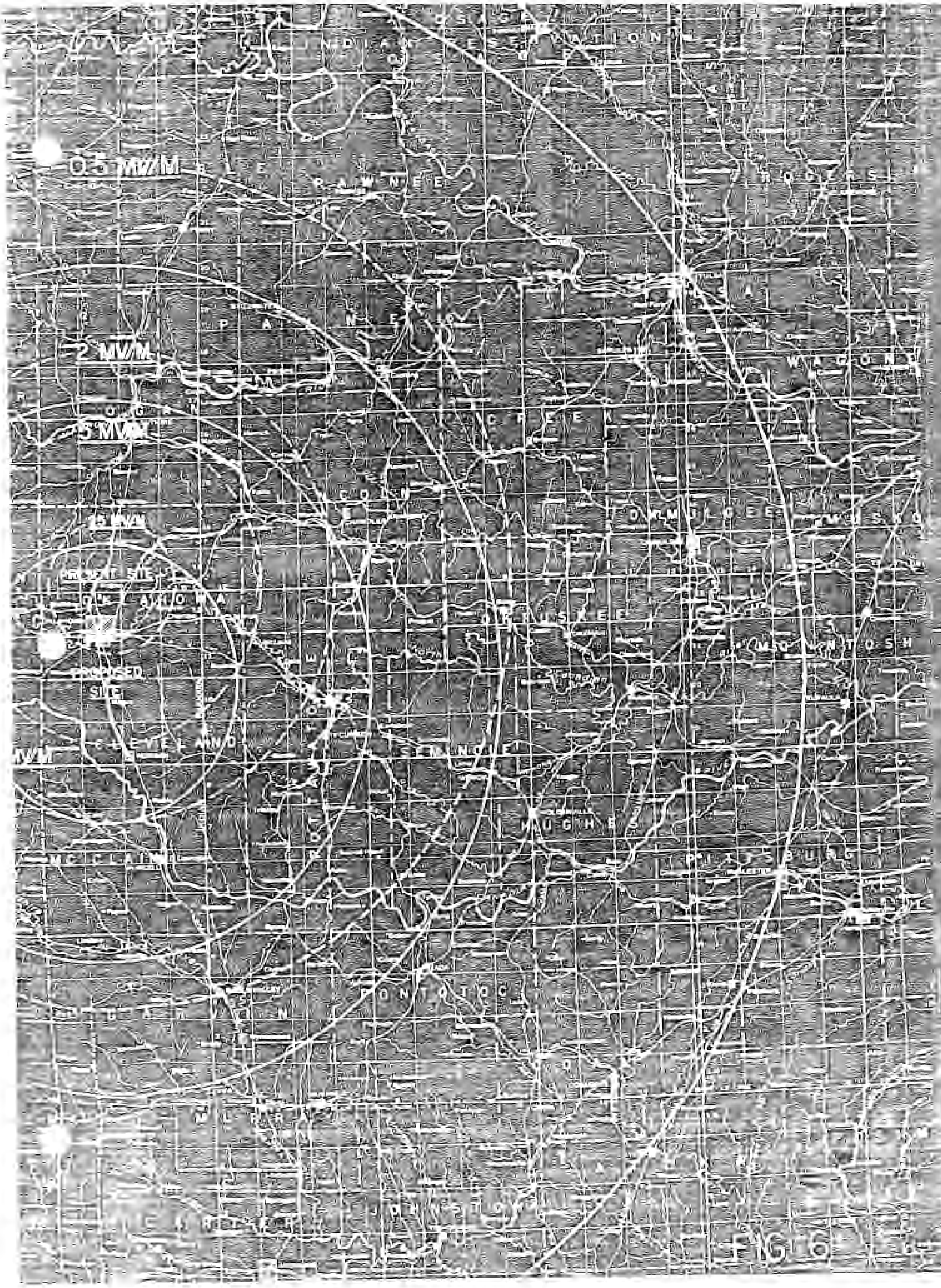
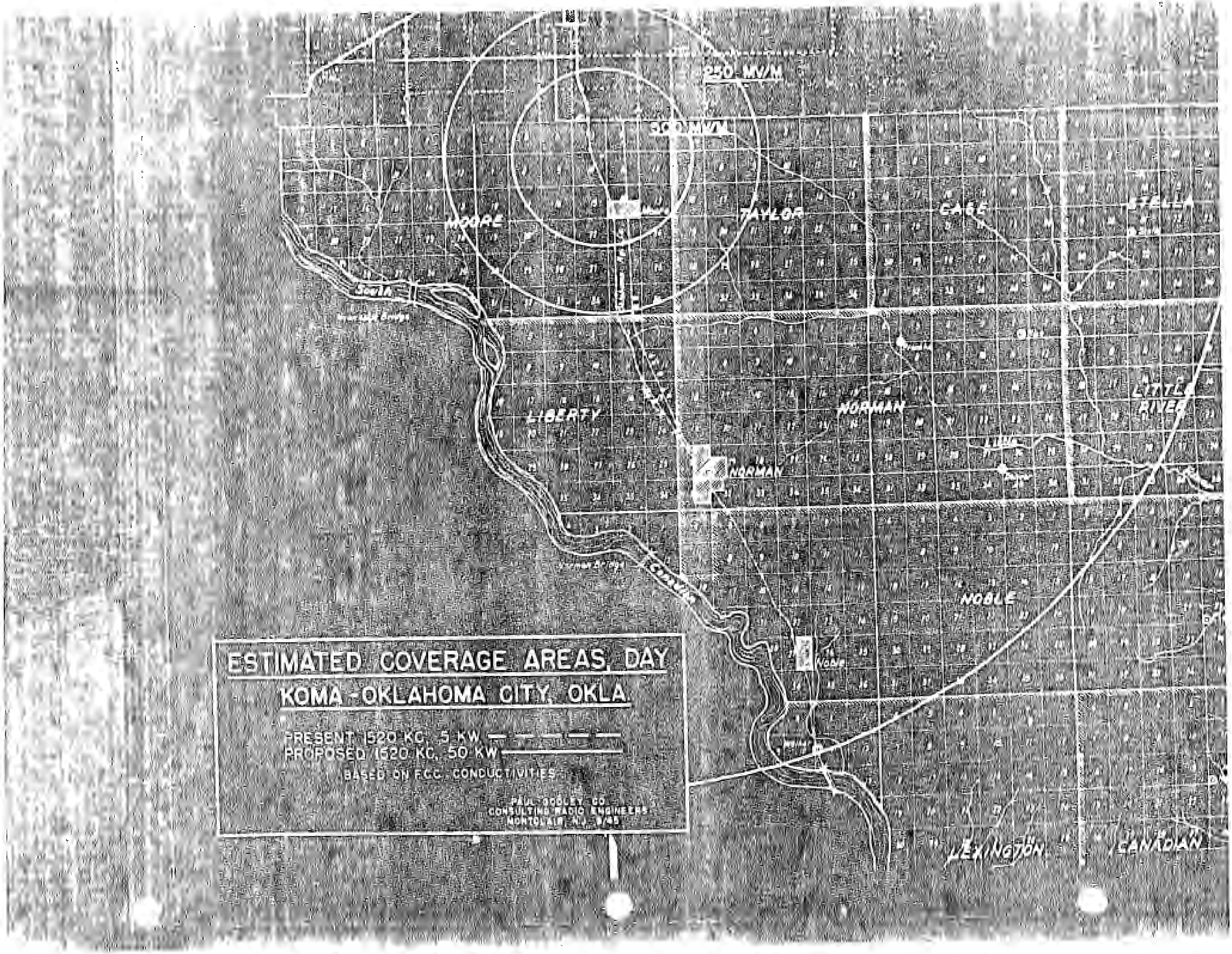

0.5 MV/M
2 MV/M
5 MV/M
25 MV/M
PRESENT SITE
PROPOSED SITE
OKLAHOMA
PAWNEE
CREEK
OKMULGEE
OKFUSKEE
McINTOSH
WAGONER
SEMINOLE
HUGHES
PITTSBURG
PONTOTOC
CLEVELAND
McCLAIN

FIG 6


250 MV/M
500 MV/M
MOORE
TAYLOR
CAGE
STELLA
LIBERTY
NORMAN
NORMAN
LITTLE RIVER
NOBLE
LEXINGTON
CANADIAN
ESTIMATED COVERAGE AREAS, DAY
KOMA - OKLAHOMA CITY, OKLA.
PRESENT 1520 KC. 5 KW
PROPOSED 1520 KC. 50 KW
BASED ON F.C.C. CONDUCTIVITIES
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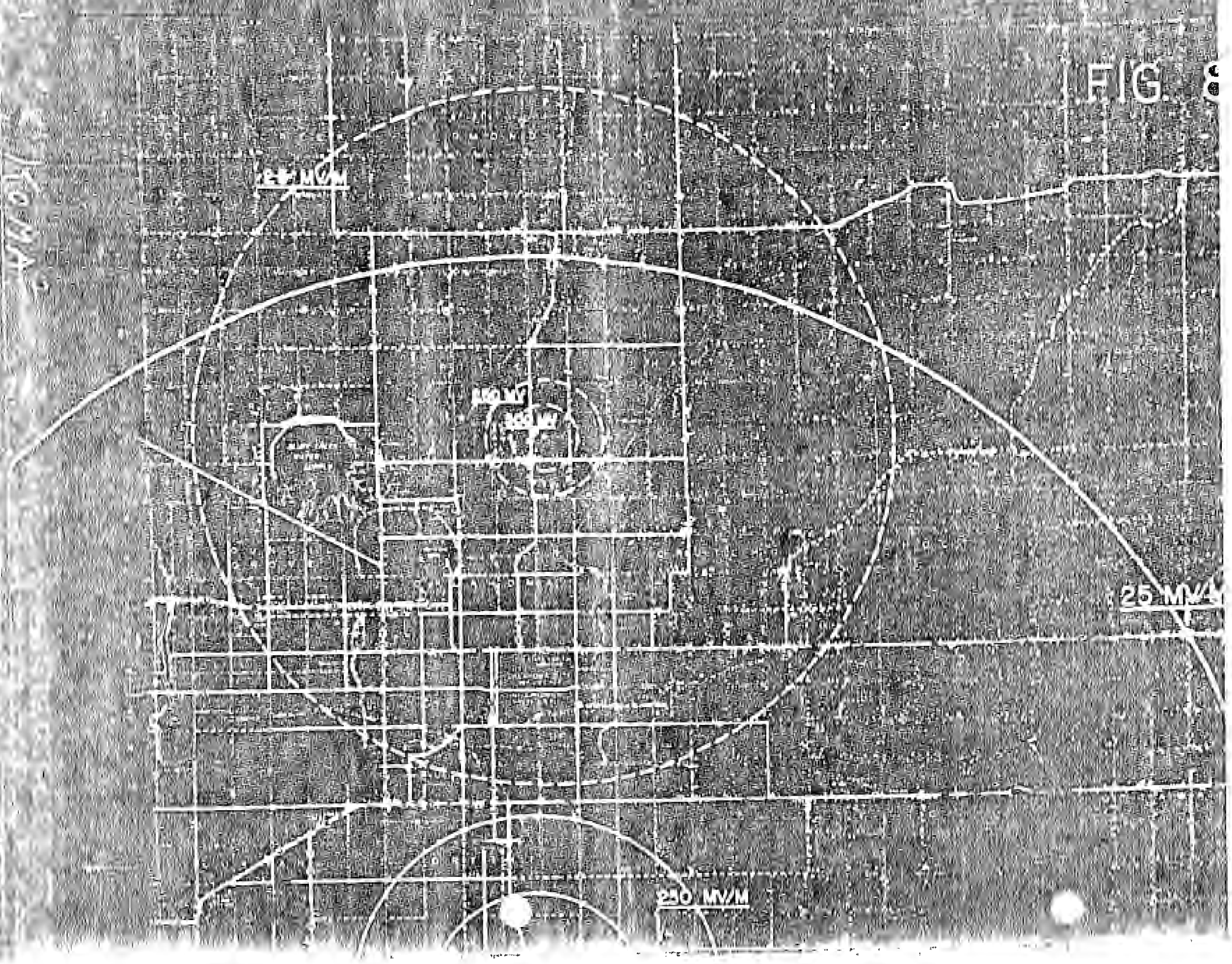
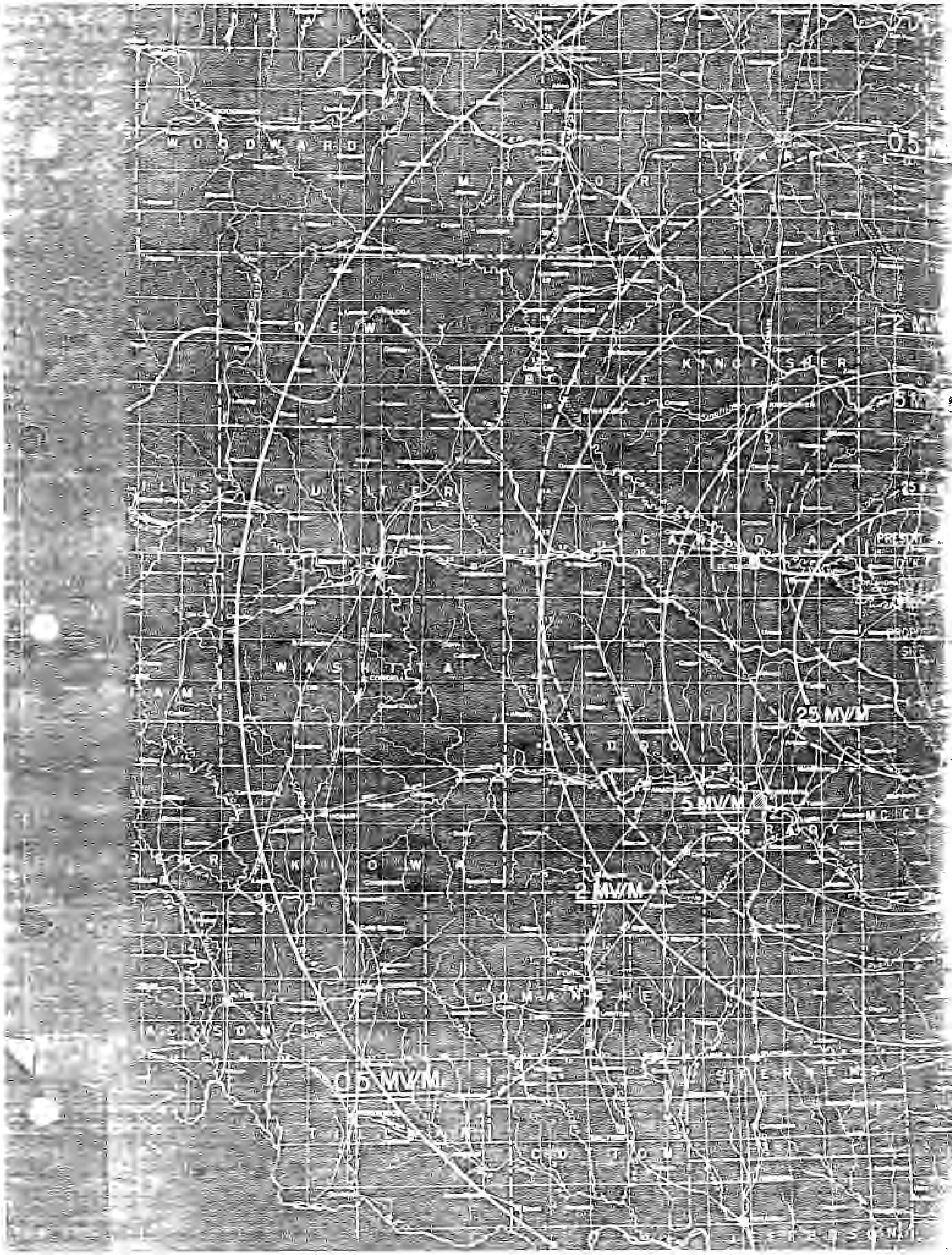
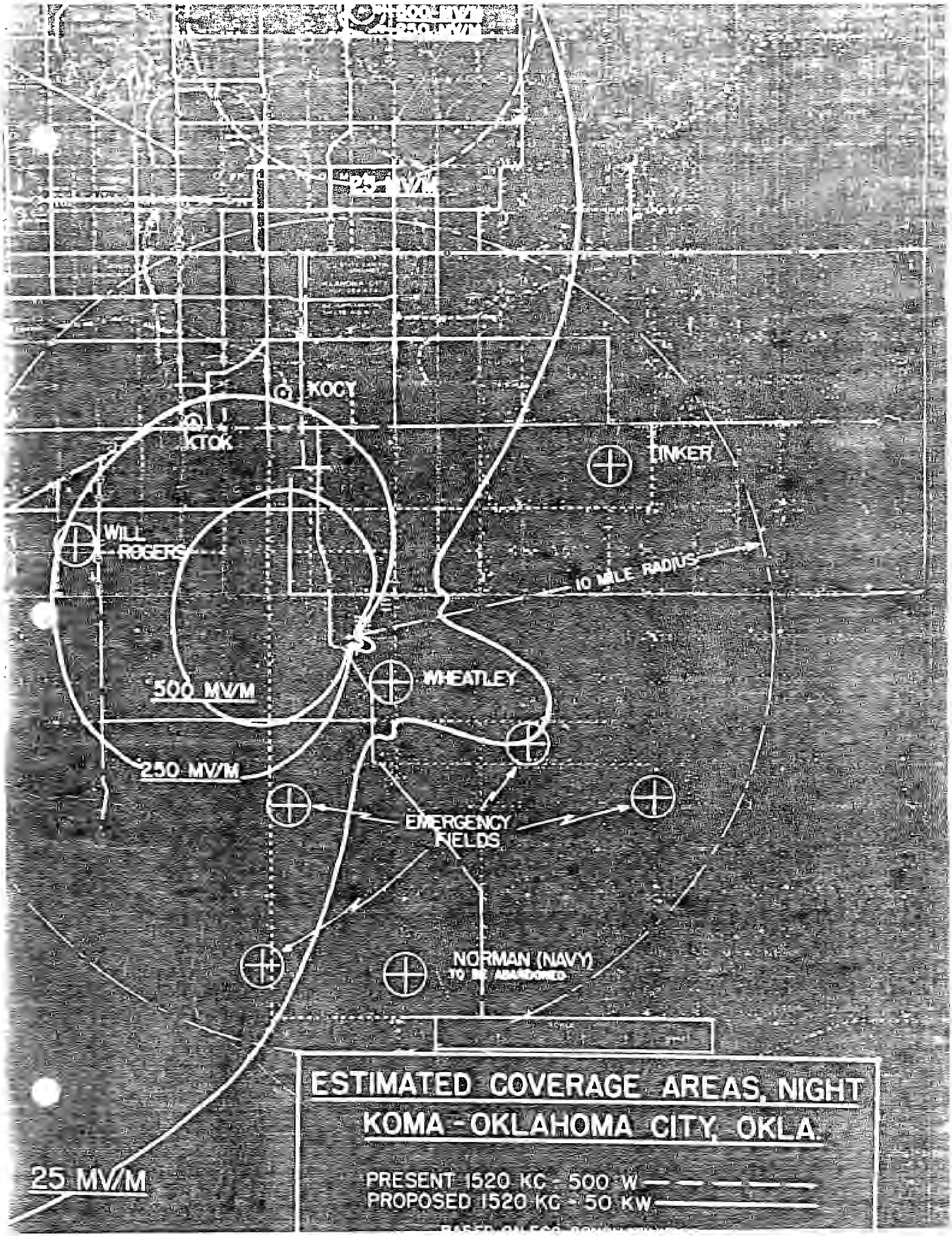
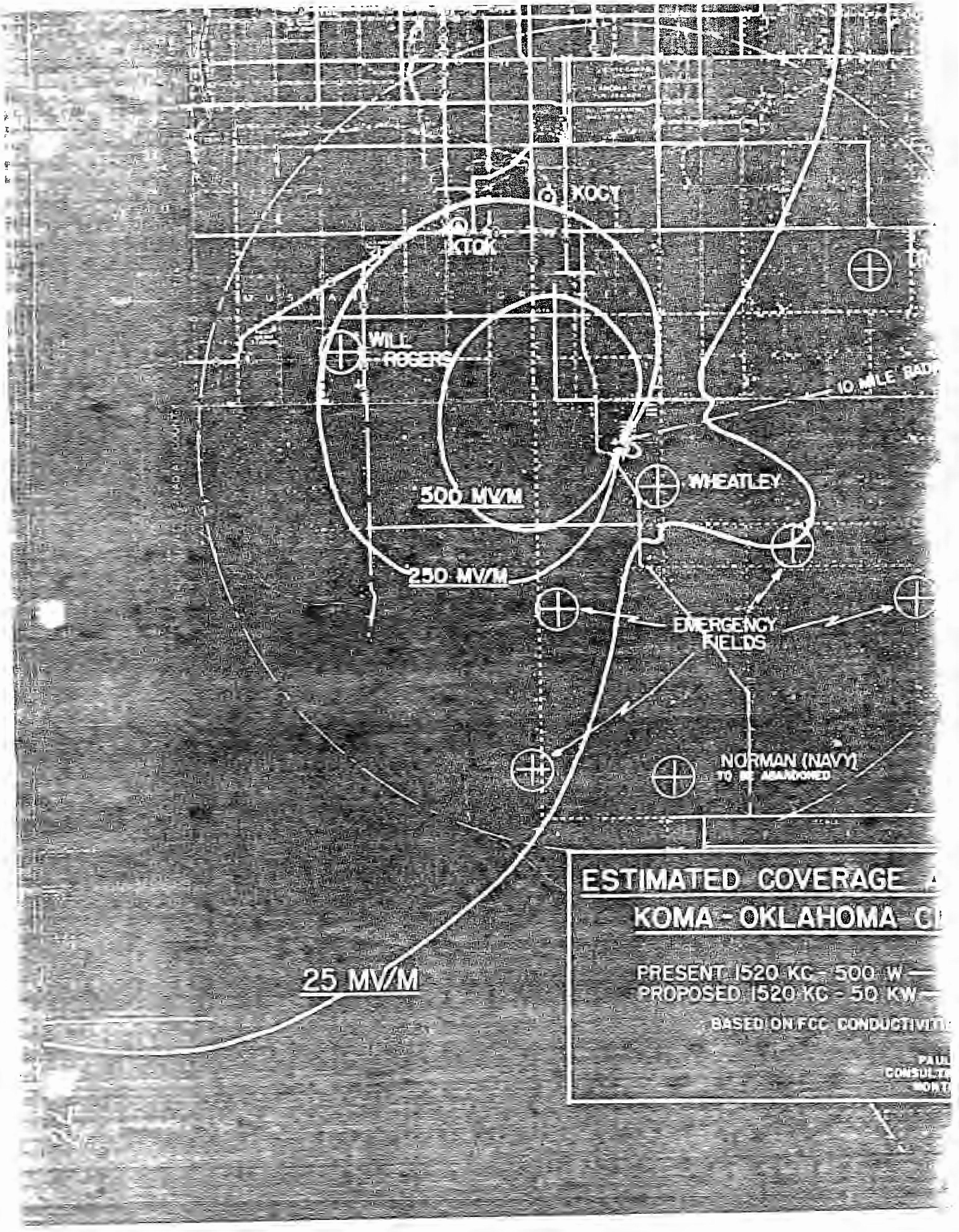

25 MV/M
250 MV/M
FIG. 8

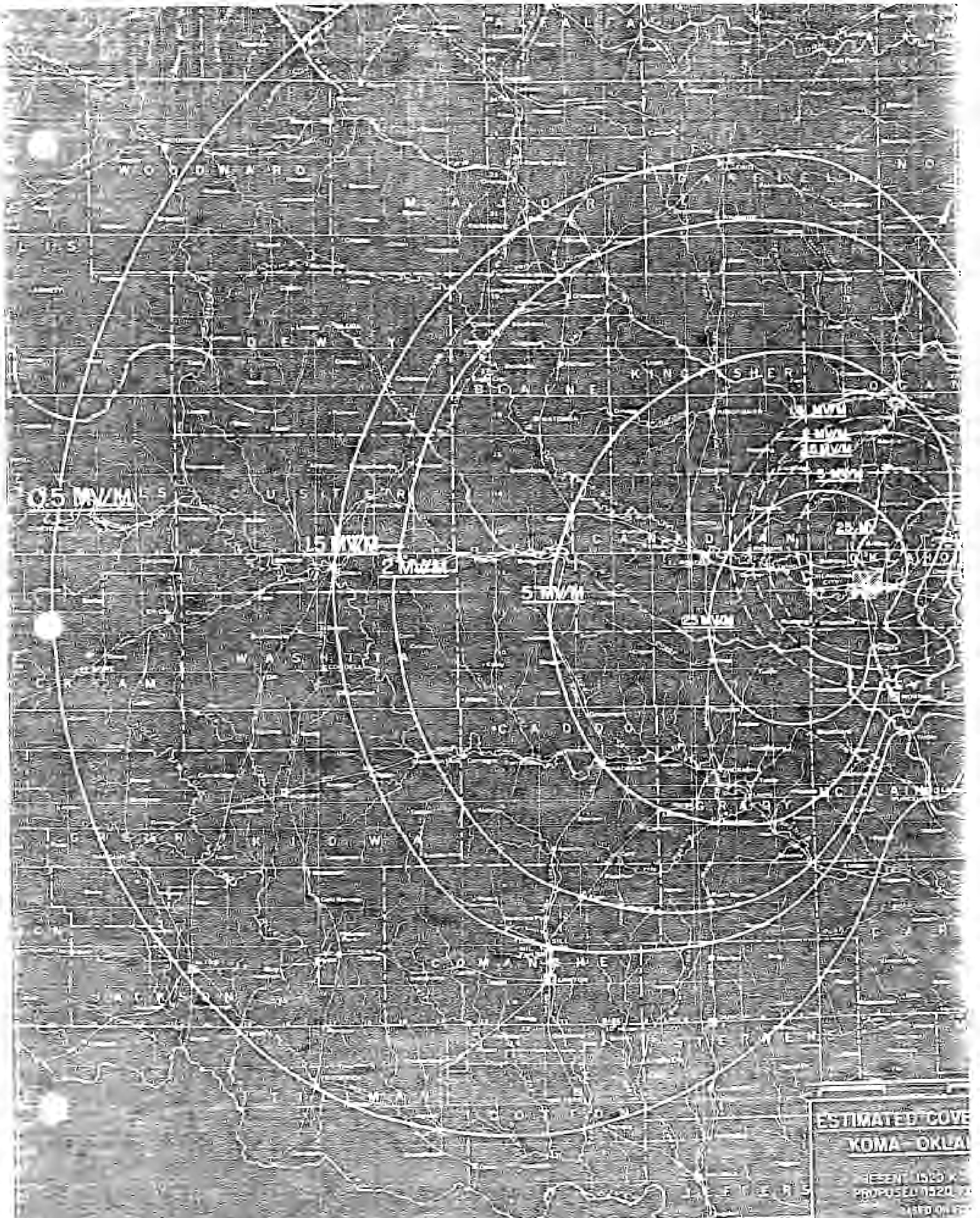


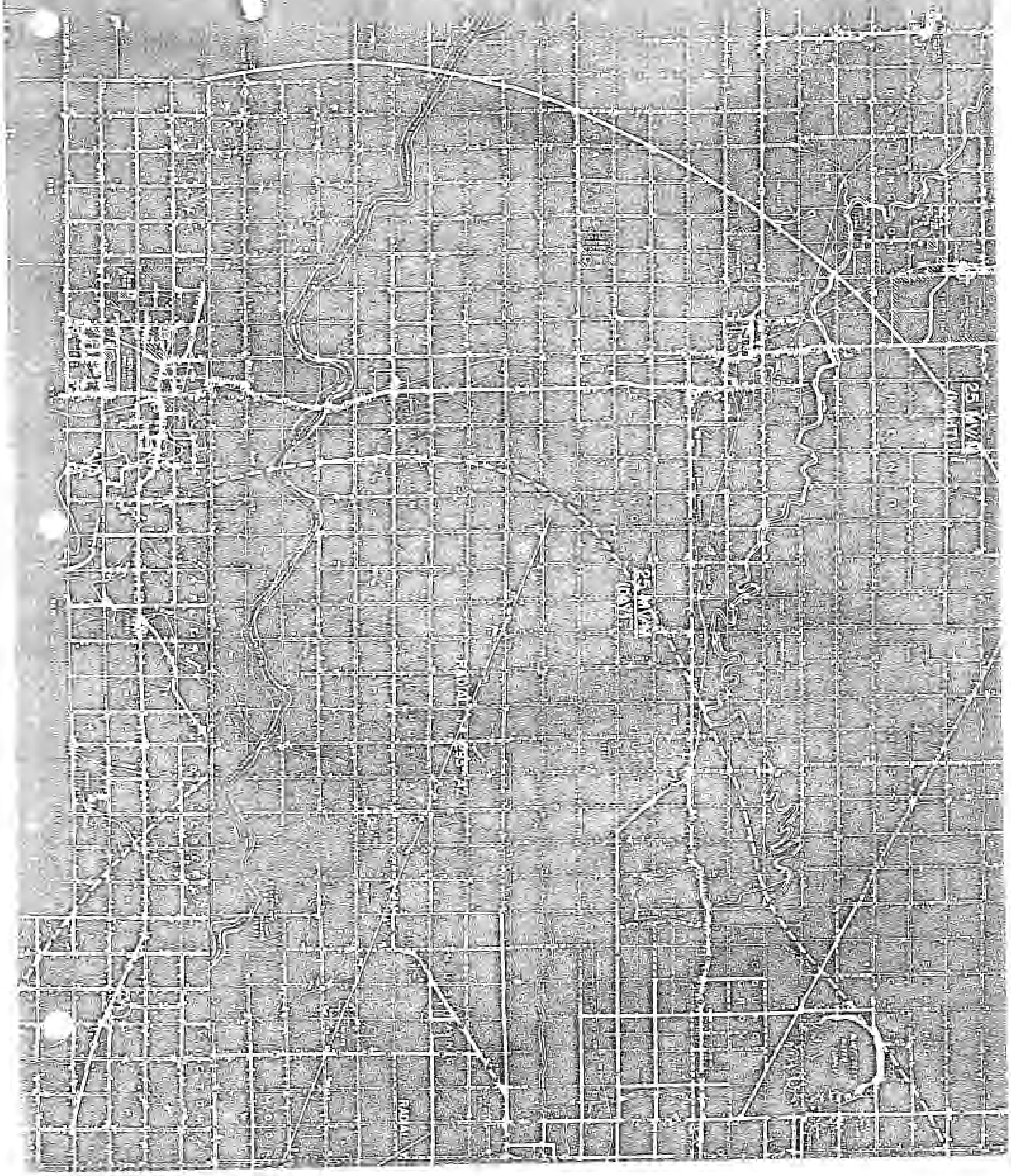
WOODWARD
MAJOR
DEWEY
KINGFISHER
CUSTER
CANADIAN
WASHITA
CADDO
KIOWA
COMANCHE
25 MV/M
5 MV/M
2 MV/M
0.5 MV/M

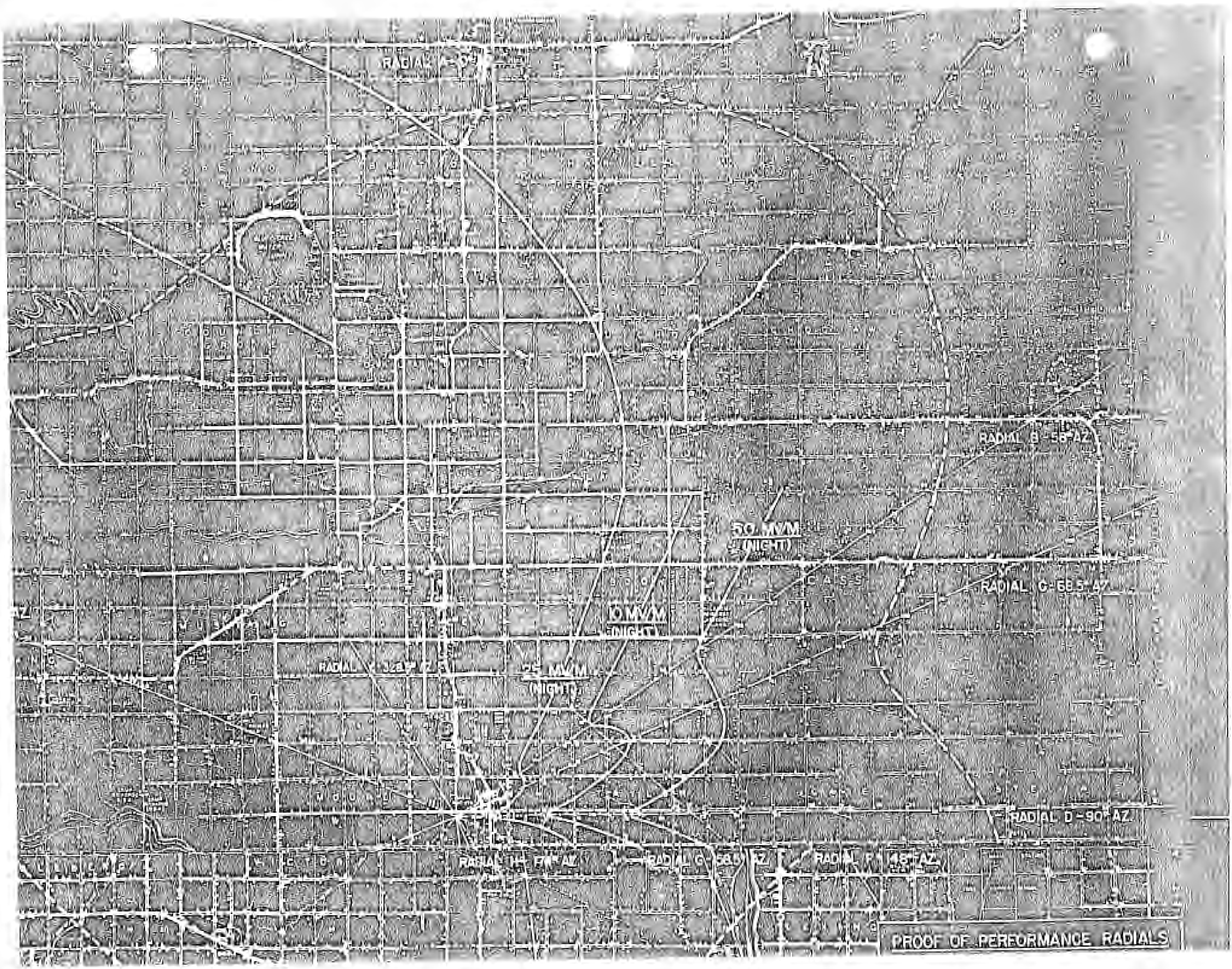

KOCY
KTOK
TINKER
WILL ROGERS
10 MILE RADIUS
WHEATLEY
500 MV/M
250 MV/M
EMERGENCY FIELDS
NORMAN (NAVY)
TO BE ABANDONED
25 MV/M
ESTIMATED COVERAGE AREAS, NIGHT
KOMA - OKLAHOMA CITY, OKLA.
PRESENT 1520 KC - 500 W
PROPOSED 1520 KC - 50 KW

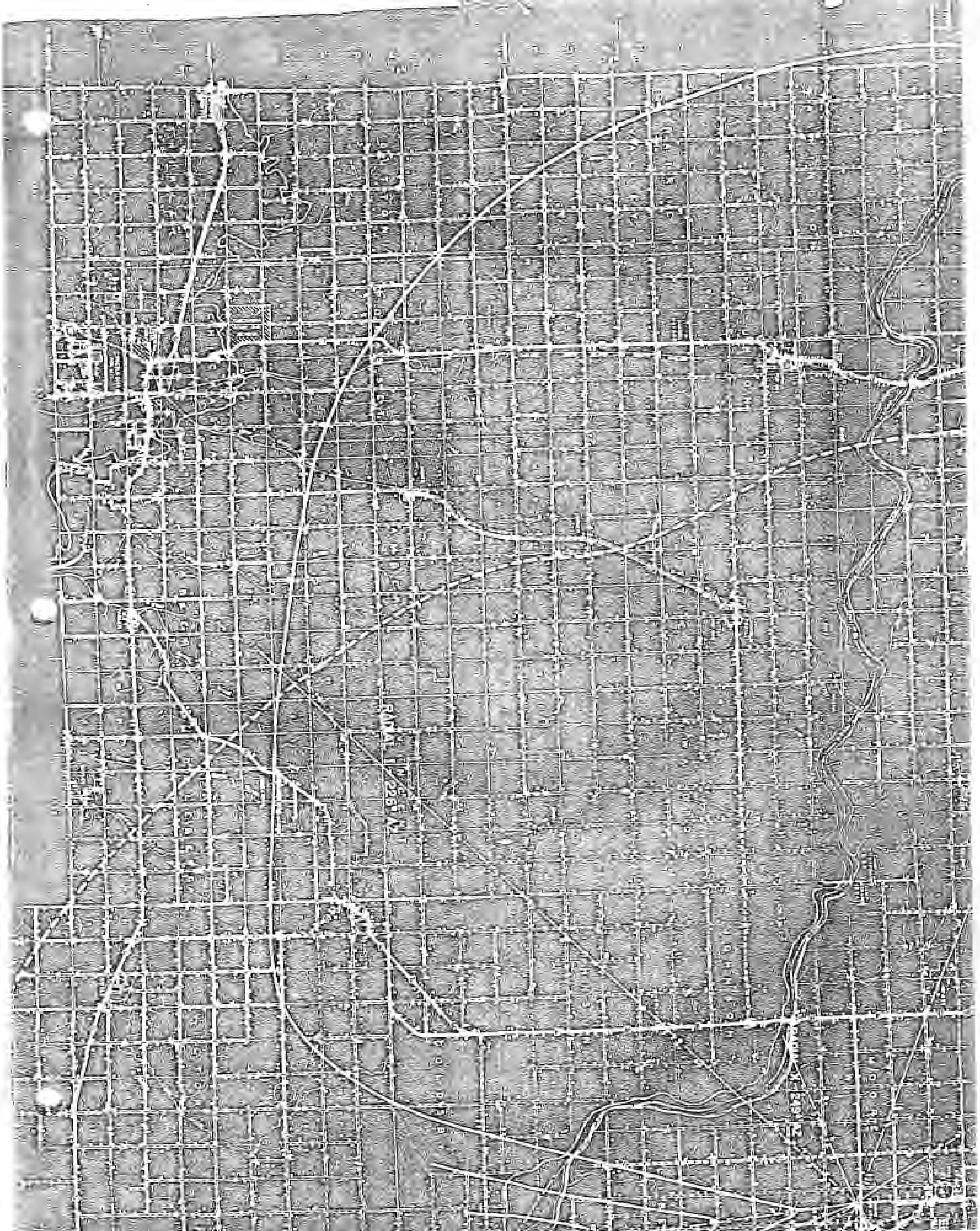


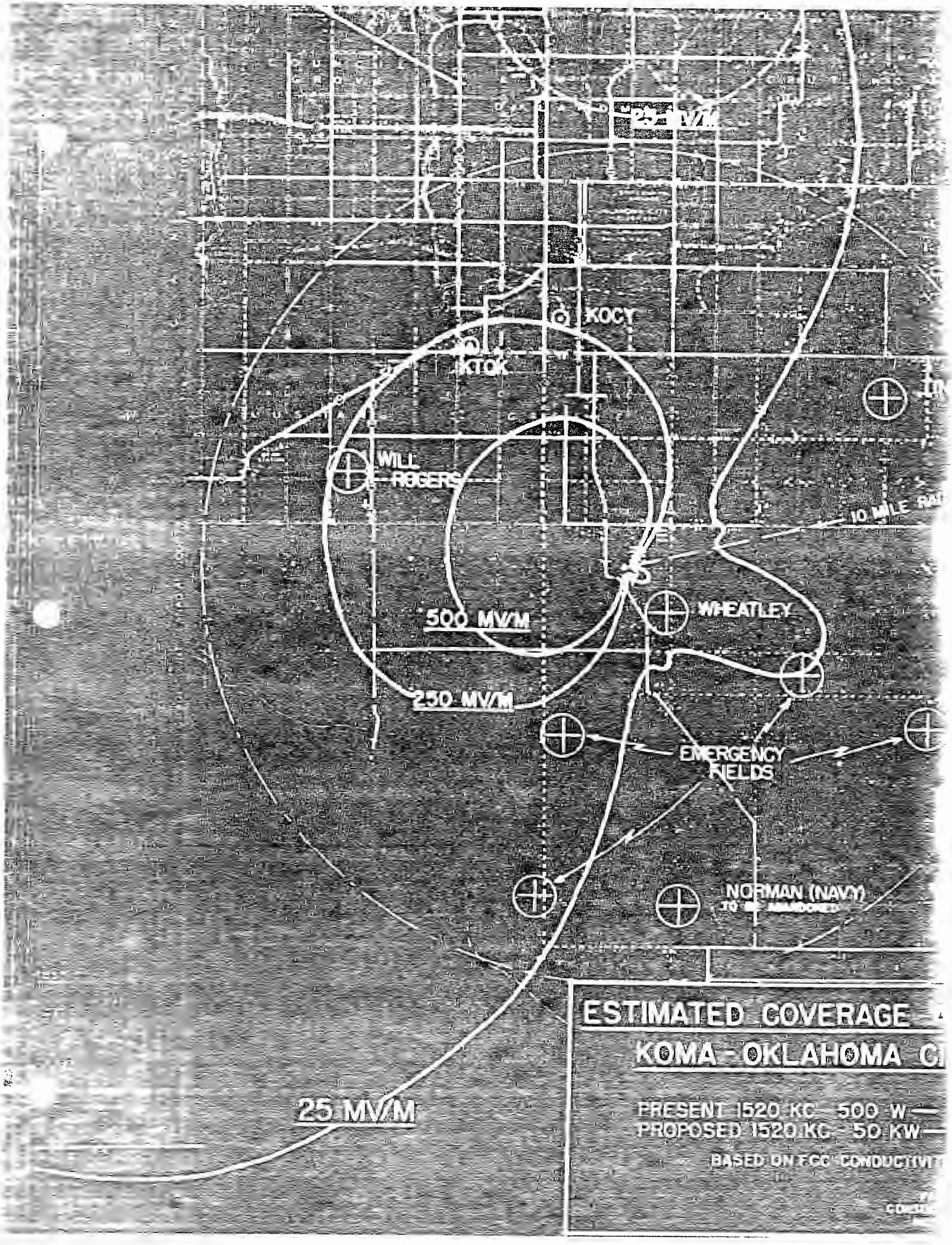
KOCY
KTOK
WILL ROGERS
10 MILE
WHEATLEY
500 MV/M
250 MV/M
EMERGENCY FIELDS
NORMAN (NAVY)
TO BE ABANDONED
25 MV/M
ESTIMATED COVERAGE
KOMA - OKLAHOMA
PRESENT 1520 KC - 500 W
PROPOSED 1520 KC - 50 KW
BASED ON FCC


WOODWARD
MAJOR
DEWEY
BLAINE
CUSTER
CANADIAN
WASHITA
CADDO
GRADY
KIOWA
COMANCHE
STEPHENS
JACKSON
TILLMAN
COTTON
0.5 MV/M
1.5 MV/M
2 MV/M
5 MV/M
25 MV/M
ESTIMATED COVE
KOMA - OKLA
PROPOSED 1520

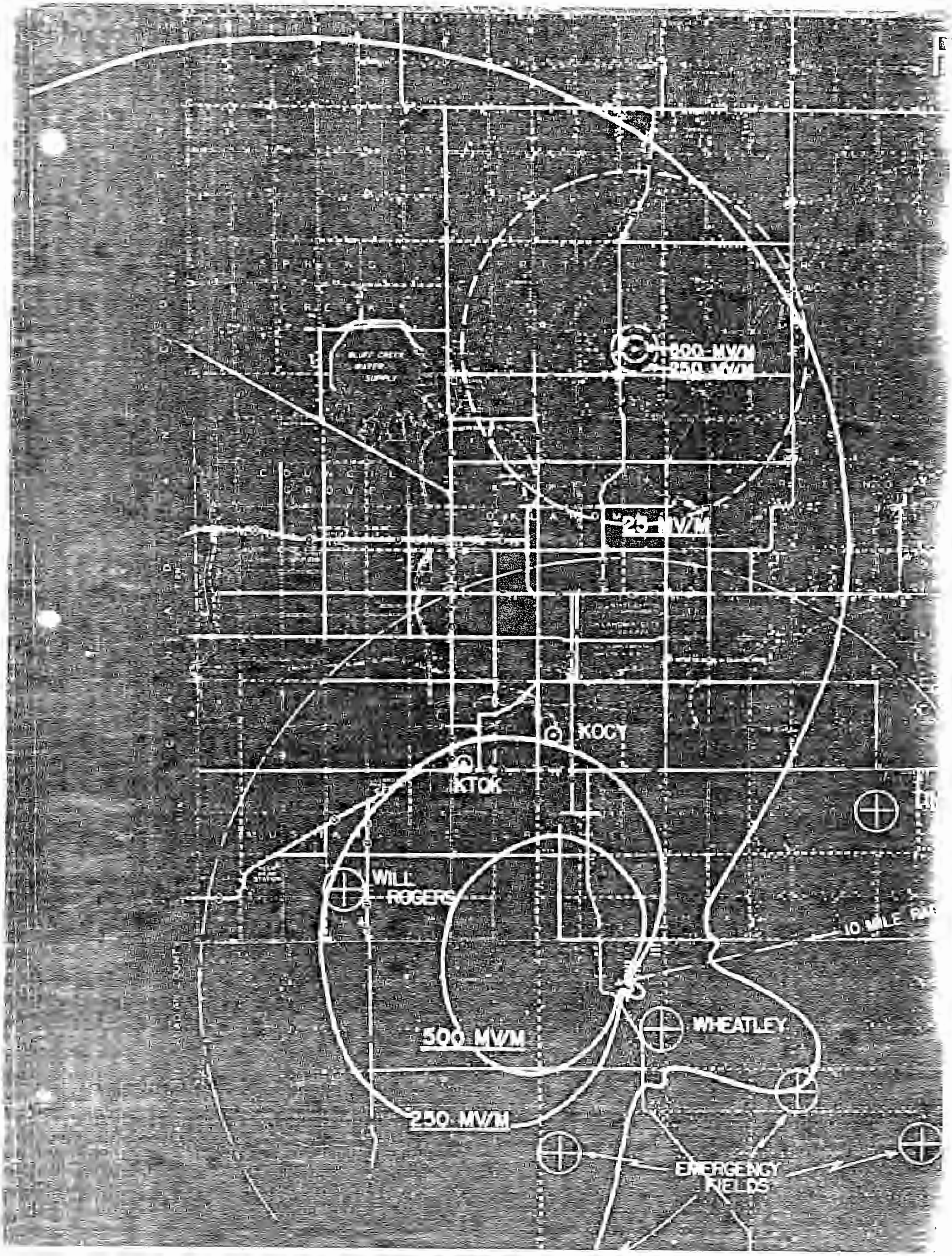

25 MVA
25 MVA


RADIAL B-58°AZ.
50 MV/M
(NIGHT)
RADIAL C-68.5°AZ.
10 MV/M
(NIGHT)
25 MV/M
(NIGHT)
RADIAL D-90°AZ.
RADIAL F-148°AZ.
PROOF OF PERFORMANCE RADIALS

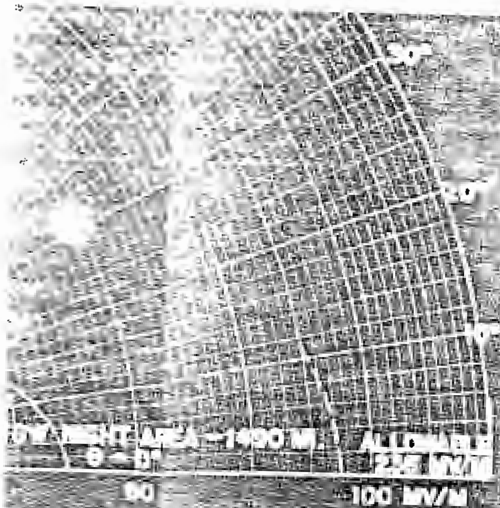


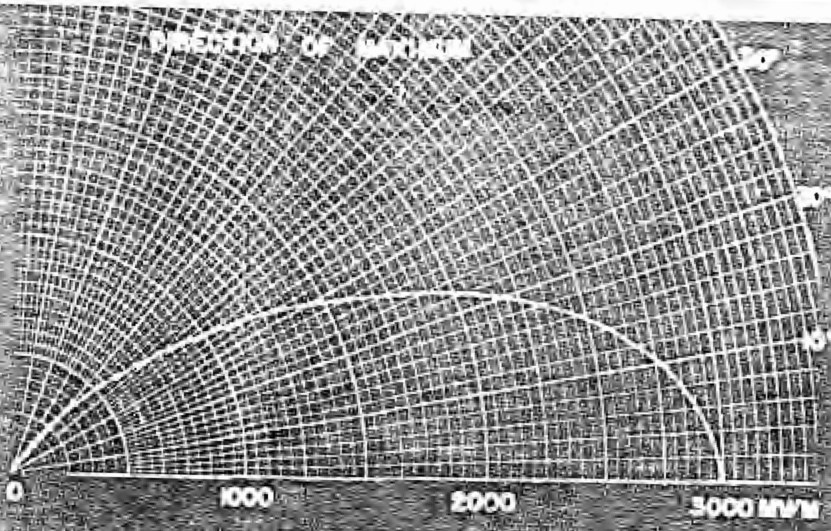


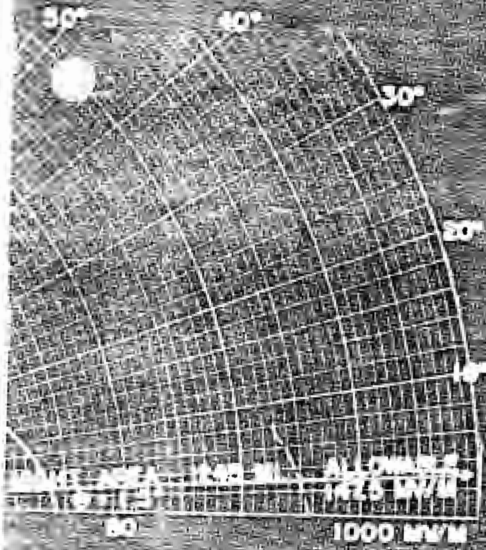
KOCY
KTOK
WILL ROGERS
10 MILE RA
WHEATLEY
500 MV/M
250 MV/M
EMERGENCY FIELDS
NORMAN (NAVY)
25 MV/M
ESTIMATED COVERAGE
KOMA - OKLAHOMA C
PRESENT 1520 KC - 500 W
PROPOSED 1520 KC - 50 KW
BASED ON FCC CONDUCTIVIT



500 MV/M
250 MV/M
25 MV/M
KOCY
KTOK
WILL ROGERS
10 MILE RA
WHEATLEY
500 MV/M
250 MV/M
EMERGENCY FIELDS







VERTICAL PLANE RADIATION

3 ELEMENT DIRECTIVE ANTENNA
PROPOSED 50 KW. 1520 KC. D.A.N.
OKLAHOMA CITY, OKLA.

SHOWING ESTIMATED TOLERANCE ------
& MAXIMUM ALLOWABLE FIELD ....

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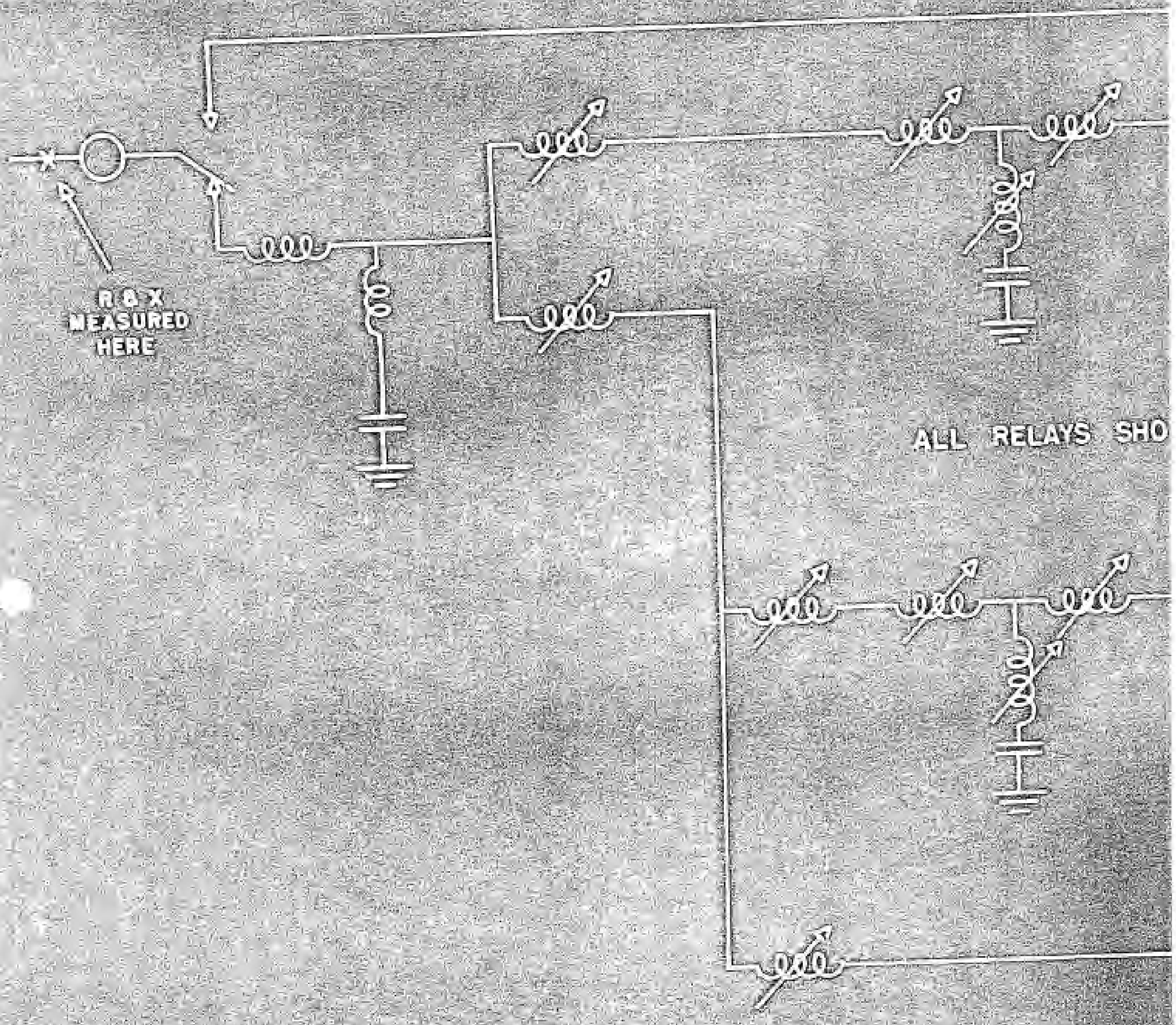
FIG. 3



SCHEMATIC CIRCU
KOMA 50 KW. D.A.N. I
OKLAHOMA CITY, O

2504- 13Z 7323

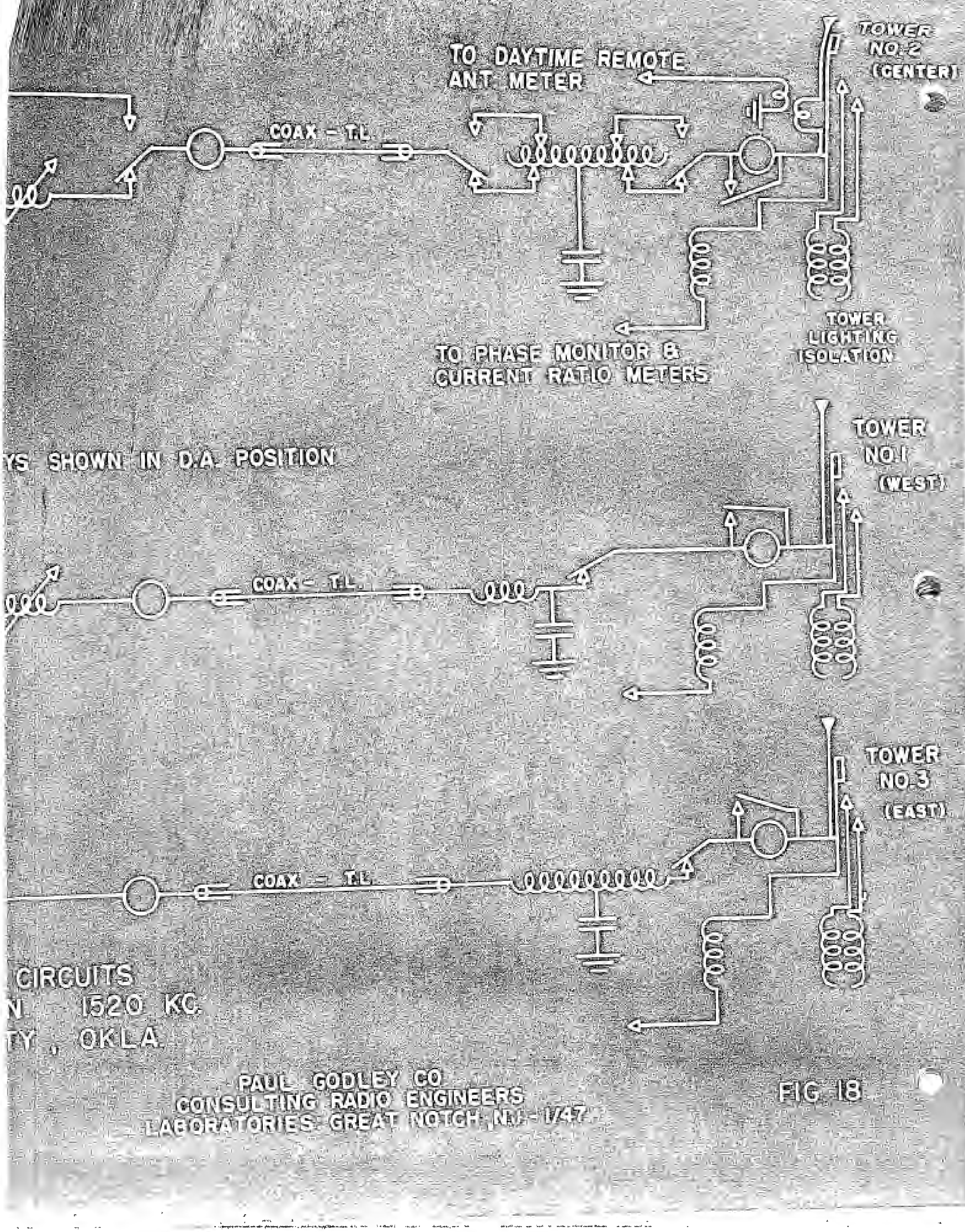

TO DAYTIME REMOTE
ANT. METER
COAX - T.L.
TOWER
NO. 2
(CENTER)
TOWER
LIGHTING
ISOLATION
TO PHASE MONITOR &
CURRENT RATIO METERS
YS SHOWN IN D.A. POSITION
TOWER
NO. 1
(WEST)
COAX - T.L.
TOWER
NO. 3
(EAST)
COAX - T.L.
CIRCUITS
N 1520 KC.
TY, OKLA.
PAUL GODLEY CO.
CONSULTING RADIO ENGINEERS
LABORATORIES GREAT NOTCH, N.J. - 1/47

FIG 18

May 18, 1950

Federal Communications Commission
P. O. Box 5238
Dallas 2, Texas

Attention: Mr. C. R. Williams

Dear Sir:

Reference to official notice dated April 22, 1950, regarding antenna currents in the elements not being maintained within 5% in compliance with Section 11 of Standards of Good Engineering Practice. We submit the attached data taken from field readings May 17th after final adjustments were made.

Sincerely,

M. W. Thomas
Chief Engineer

MWT/mh

Base Current	Amp.	Current Ratio	Current ratio Specified in License	% Deviation ~~Direction~~
I_1	15	1.22	1.2	plus 2%
I_2	12.3	1.0	1.0	0
I_3	1.74	1.414	1.36	plus 4%

Readings in MV/M at monitoring points

Point	MV/M	MV/M (License spec.)
1	32.0	33.0
2	3.5	15.0
3	3.2	10.0
4	13.0	23.0
5	7.2	7.2
6	6.6	14.0
7	7.7	10.

F.C.C. File No. ________ License File No. 469

LICENSE SPECS. FOR DIRECTIONAL OPERATION OF KOMA, Oklahoma City, Okla.

Freq. 1520 kc, Power 50 kw U DA-N, Date 10-20-50

No. and Type of Elements: Three uniform cross-section, guyed, series fed, vertical radiators

Height above Insulators: 326'

Overall Height: 327'

Spacing and Orientation: Spacing is 162' (90°) between adjacent towers on a line bearing 113° true.

Non-Directional Antenna: Center tower with end towers floating.

Ground system consists of 120 - 259' buried copper radials equally spaced about each tower.

Tower	Northwest (1)	Center (2)	Southeast (3)	
Theoretical Phasing:	-117°	2.5°	117°	
Phase Indication:*	-116°	0°	-246.5°	
Theoretical Field Ratio:	0.51	1.0	0.51	
Antenna Base Current Ratio:	1.185	1.0	0.136	
Phase Monitor Sample / ~~Remote Antenna Base~~ Current Ratio:	0.522	1.0	0.517	

* As indicated by W E 2A phase monitor.

Phase indications and antenna base currents shall be read and entered in the operating log at least once each hour. Phase monitor sample currents may be read and logged in lieu of base currents provided base currents are read and logged at least once daily (~~for each pattern~~).

The field intensity in mv/m (at night) of KOMA measured at the monitoring points described on the attached sheets is not to exceed the following values:

No. 1(58 °) 34.

No. 2(68.5 °) 45.

No. 3(90 °) 10.

No. 4(113 °) 23.

No. 5(148 °) 18.

No. 6(158.5 °) 11.

No. 7(174 °) 16.

No. 8(____ °)

No. 9(____ °)

(Special Requirements)

KOMA 1522 kc Projection of contours by equivalent-distance method

Az	Eo*	0.5	Eo	0.5	Equal
0	1670	102	1910	107	5.5° and
30	✓	102	600	67	216°
60	"	102	67	26.6	
90	"	96	30	18.4	
120	"	90.5	120	34.3	
150	"	85	68	27	
180	"	104.5	110	33	
210	"	105	1280	94	
240	"	105.5	2620	124.5	
270	"	105.5	3330	135.5	
300	"	104	3580	138	
330	"	103	2910	127	
		15°	1270	92	
		45	170	39.5	
		140	61	25.5	
		158	95	31	
		173	45	22	
		195	530	64	

* ht = 325'

6 = .5 λ

√50 × 236

KTOK - 212 510304 DBP

KOMA, 1520 KC, 50 KW, DA-N

Site 35° 20' 00" N h = 325'
97° 30' 02" W G = 0.5λ

F.C.C. Ground Conductivity Map

Az	Distance & Conductivity
0	15 (0 - 102 mi), 20 (102 -
30	15
60	15 (0 - 117 mi), 6 (117 - 140), -)
90	15 (0 - 77 mi), 6 (77 - 95 mi), 4 (95 →
120	15 (0 - 63 mi), 6 (63 - 102)
150	15 (0 - 48 mi), 6 (48 →
180	15 (0 - 81 mi), 20 (81 →
210	15 (0 - 66 mi), 20 (66 →
240	15 (0 - 62 mi), 20 (62 →
270	15 (0 - 62 mi), 20 (62 →
300	15 (0 - 72 mi), 20 (72 →
330	15 (0 - 88 mi), 20 (88

Appendix V, attached hereto, is the Horizontal Plane Radiation Pattern of the KOMA Directional Antenna. This was obtained by plotting the results of Appendix III in graphic form.

Appendix VI-A and VI-B, attached, show the various Vertical Plane Radiation Patterns of the KOMA Directional Antenna. This was obtained by plotting the results of Appendix IV in graphic form.

Appendix VII, attached hereto, is a map of the United States, showing the Canadian border, on which have been drawn the estimated location of the 25 microvolt-per-meter 10% second-hour interference signal.

The North American Regional Broadcasting Agreement provides that in the use of 690 kc, in the United States, it is "Permissible to increase the field intensity above 25 uv/m (10% skywave) west of Minnesota on Canadian border." This Agreement provides that (with the above exception) the United States station shall not deliver in excess of 25 uv/m across the Canadian border. Examination of Appendix VII shows that these conditions are met by the proposed operation of KOMA.

Appendix VIII, attached hereto, is a portion of an airways map showing the location of the proposed transmitter for KOMA, 50 kw, 690 kc operation, with relation to airways and airports. The nearest airport (Curtis-Wright, 10 miles away) is not used by transport airlines.

Appendix IX, attached hereto, is a portion of a United States Topographic Map, showing the site of the proposed operation of KOMA, and also showing the estimated location of the 250 mv/m contours (day and night) resulting from the proposed operation.

Appendix X, attached hereto, is a map of Oklahoma City and surrounding area, showing the estimated location of the 25 and 5 mv/m contours. Signals in excess of 25 mv/m are provided over all the city of Oklahoma City.

The population with the various contours has been estimated by applying these contours to Census Bureau maps, and referring to the Report of the Fifteenth Census (1930). These estimates are as follows:

Contour	Day	Night
250 mv/m	4,024	1,254
25	315,204	297,904
5 mv/m	995,616	799,931

Affiant states that the foregoing is true of his own knowledge except as to such portions of the foregoing as are on information and belief, and that he believes such portions to be true.

Joseph A. Chambers
Joseph A. Chambers

Sworn to before me this 9th day of March, 1940.

[illegible]
Notary Public, D. C.

My Commission Expires [illegible].

APPENDIX I

DESCRIPTION OF DIRECTIONAL ANTENNA PROPOSED FOR

KOMA, OKLAHOMA CITY, OKLA., 50 KW., 690 KC.

The proposed Directional Antenna is described as follows:

a. Number of elements: Three

b. Type of elements: Vertical radiators, insulated. The center element will be guyed, uniform cross-section. The two end elements will be self-supporting, tapered cross-section. Other details to be determined.

c. Top loading: None

d. Height above insulators: Center element: 750 feet, (0.525 λ, 190°) Each end element: 200 feet (0.14 λ, 51°)

e. Overall height above ground level: Center element, approximately 755 feet; each end element, approximately 205 feet.

f. Overall height above mean sea level: Center element, approximately 1845 feet, each end element, approximately 1295 feet.

g. Orientation: Three towers on a line bearing 29° true. Towers spaced 110°, 436 feet apart on this line. The phase of the field from the north-east element is 74° ahead of the field of the center element, while the phase to the field of the south-west element lags to the field of the center element by 74°.

h. Ground system: A 40 x 40 foot ground screen will be placed under each tower. Not less than 120 buried radial ground wires will extend from each ground screen to a distance of 450 feet, except that where the ground systems of the separate towers would overlap they are joined.

i. Ratio of fields from elements: Relative units;
Center element = 2.04
Each end element = 1.0

j. The design includes the usual assumption that the current distribution in the elements is essentially sinosodial. It is also assumed that the effective field in the horizontal plane from the center element along (750 foot tower) is 240 mv/m/kw, or 1700 mv/m for 50 kw, and that the RMS value of the effective field from the array is 1500 mv/m for 50 kw.

APPENDIX II

FORMULAE FOR DETERMINATION OF PERFORMANCE OF KOMA DIRECTIONAL ANTENNA

The basic formula used for determination of performance of a three-element antenna, as here proposed is:

$$E = \frac{K}{\sin\theta}\sqrt{\begin{array}{l}\{f_1(\cos h_1 - \cos[h_1\cos\theta]) + f_2(\cos h_2 - \cos[h_2\cos\theta]) \\ \cos[S_2\cos(\phi_2 - \phi)\sin\theta + \psi_2] + f_3(\cos h_3 - \cos[h_3\cos\theta]) \\ \cos[S_3\cos(\phi_3 - \phi)\sin\theta + \psi_3]\}^2 + \{f_2(\cos h_2 - \cos[h_2\cos\theta]) \\ \sin[S_2\cos(\phi_2 - \phi)\sin\theta + \psi_2] + f_3(\cos h_3 - \cos[h_3\cos\theta]) \\ \sin[S_3\cos(\phi_3 - \phi)\sin\theta + \psi_3]\}^2\end{array}}$$

Where

f_1 = relative radiation from element No. 1

f_2 = relative radiation from element No. 2

f_3 = relative radiation from element No. 3

h_1 = height of element No. 1, degrees

h_2 = height of element No. 2, degrees

h_3 = height of element No. 3, degrees

ϕ = azimuth angle

ϕ_2 = bearing No. 2 element from No. 1 (used as reference)

ϕ_3 = bearing No. 3 element from No. 1

S_2 = spacing, degrees, No. 2 element from No. 1

S_3 = spacing, degrees, No. 3 element from No. 1

θ = zenith angle

ψ_2 = phasing No. 2 element referred to No. 1

ψ_3 = phasing No. 2 element referred to No. 1

K = pattern constant, including RMS value

For the array proposed, the No. 1 element has a height of

190°, and for the horizontal plane pattern, where $\theta = 90°$,

$$f_1 (\cos h_1 - \cos [h_1 \cos \theta]) = f_1 (-.985 - 1) = 1.985 f_1$$

Elements No. 2 and No. 3 each have a height of 51°, and for the horizontal plane pattern, where $\theta = 90°$,

$$f_2 (\cos h_2 - \cos [h_2 \cos \theta]) = f_2 (.629 - 1) = .371 f_2$$

The horizontal field of element No. 1 is 2.04 relative units, Therefore, $f_1 = \frac{2.04}{1.985} = 1.028$

The horizontal fields of elements No. 2 and No. 3 are each 1 relative unit. Therefore, f_2 and $f_3 = \frac{1.0}{.371} = 2.695$

Let f_2 and $f_3 = 1$, then $f_1 = .381$

Substituting these and other values for antenna proposed, and letting $\phi_0 = 0$, the formula becomes:

$$E = \frac{K}{\sin \theta} \sqrt{\begin{aligned} &\{.381 (\cos 190 - \cos [190 \cos \theta]) + (\cos 51 - \cos [51 \cos \theta]) \\ &\cos [110 \cos \phi \sin \theta + 74] + (\cos 51 - \cos [51 \cos \theta]) \\ &\cos [110 \cos (180 - \phi) \sin \theta + 74]\}^2 + \{(\cos 51 - \cos [51 \cos \theta]) \\ &\sin [110 \cos \phi \sin \theta + 74] + (\cos 51 - \cos [51 \cos \theta]) \\ &\sin [110 \cos (180 - \phi) \sin \theta - 74]\}^2 \end{aligned}}$$

$$= \frac{K}{\sin \theta} \begin{aligned} &\{.381 (\cos 190 - \cos [190 \cos \theta]) \\ &+ 2 \cos [110 \cos \phi \sin \theta + 74] (\cos 51 - \cos [51 \cos \theta])\} \end{aligned}$$

For the horizontal plane pattern, $\theta = 90°$,

$$E_r = K \{.381 (1.985) + .742 \cos [110 \cos \phi \sin \theta + 74]\}$$

$$= K \{.7565 + .742 \cos [110 \cos \phi \sin \theta + 74]\}$$

$$= K \{1.02 + \cos [110 \cos \phi \sin \theta + 74]\}$$

A P P E N D I X   III

CALCULATION OF HORIZONTAL PLANE RADIATION PATTERN

KOMA DIRECTIONAL ANTENNA

For determination of radiation pattern in the horizontal plane, where θ = 90°, the formula becomes:

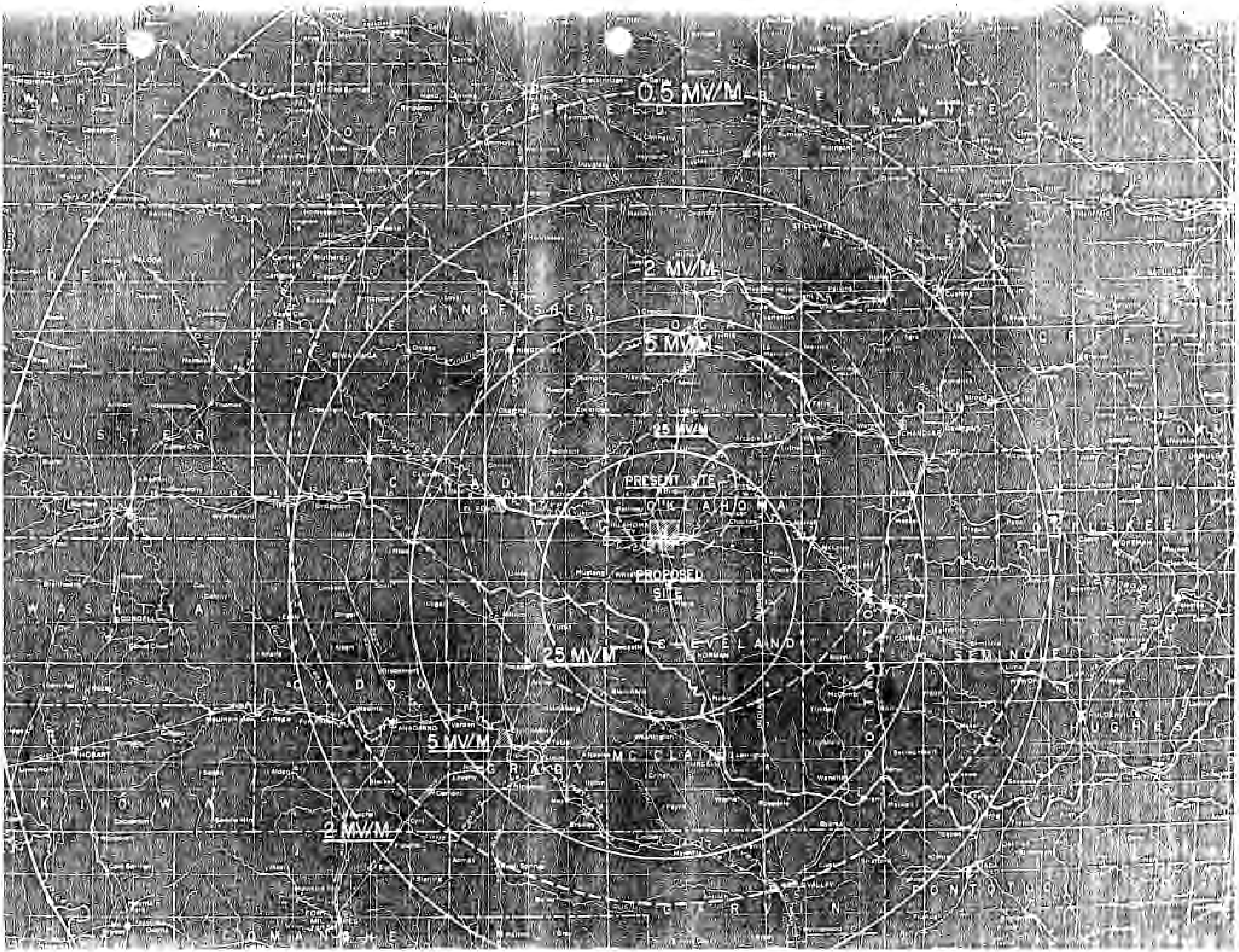
$$E_{\phi} = K(1.02 + \cos [110 \cos \phi + 74])$$

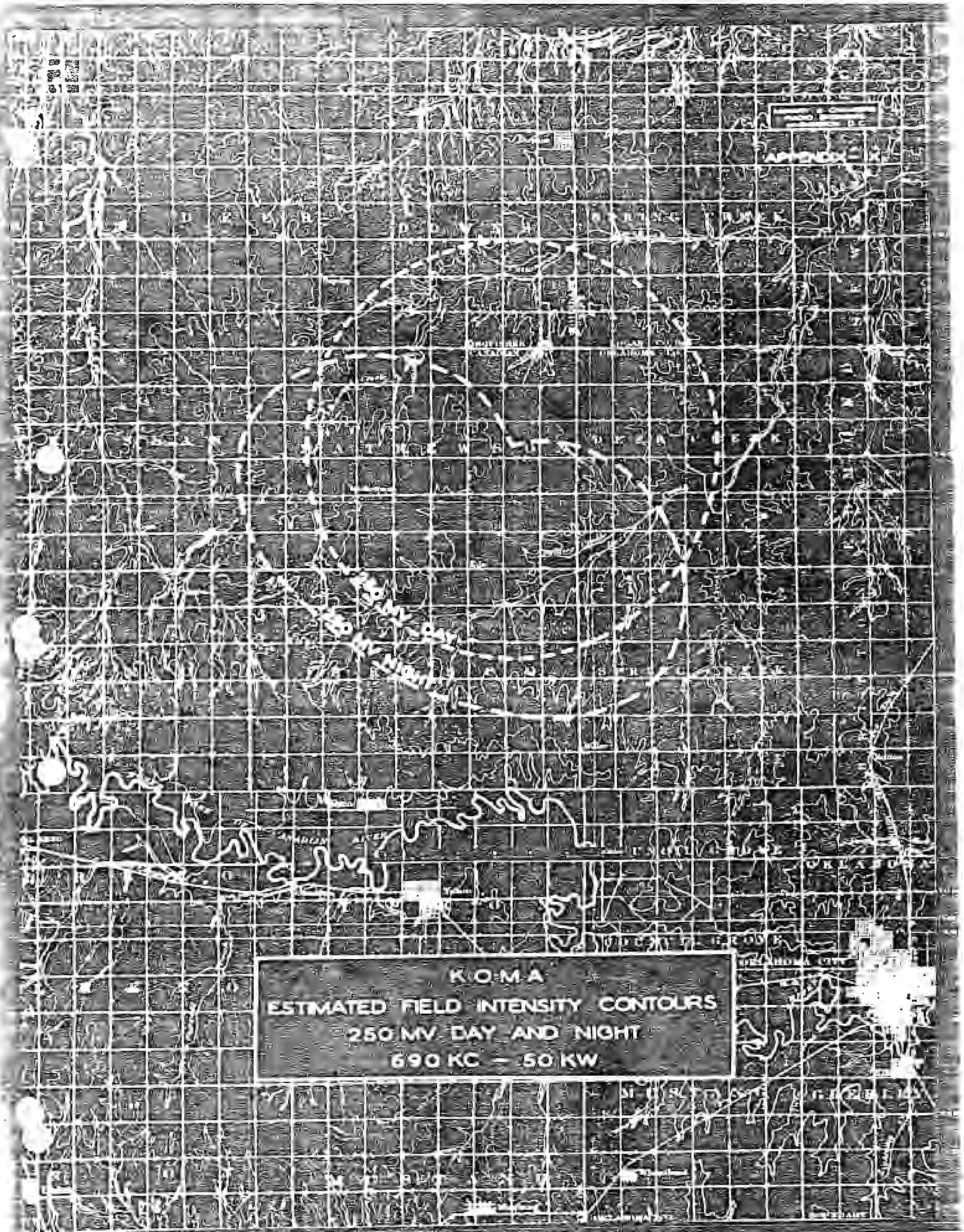
Bearing	ø	A 110 cosø	B A +74	C cos B	D C +1.02	D^2	E 1100 xD
29	0	110.00	184.00	-.998	.023	.0005	24.2
24 – 34	5	109.55	183.55	-.998	.022		24.0
19 – 39	10	108.20	182.20	-.999	.021	.0004	23.1
14 – 44	15	106.20	180.20	-1.00	.020		22.0
9 – 49	20	103.25	177.25	-.998	.022	.0005	24.2
4 – 54	25	99.70	173.70	-.992	.028		30.8
359 – 59	30	95.25	169.25	-.984	.036	.0013	39.6
354 – 64	35	90.15	164.15	-.963	.057		63.0
349 – 69	40	84.30	158.30	-.930	.090	.0081	99.0
339 – 79	50	70.70	144.70	-.816	.204	.0415	225.0
329 – 89	60	55.00	129.00	-.630	.390	.1515	430.0
319 – 99	70	37.65	111.65	-.361	.651	.4220	718.0
309 – 109	80	19.11	93.11	-.054	.976	.9590	1075.0
299 – 119	90	0	74.00	.276	1.296	1.6700	1425.0
289 – 129	100	-19.11	54.89	.576	1.596	2.5350	1760.0
279 – 139	110	-37.65	36.35	.806	1.826	3.3200	2020.0
269 – 149	120	-55.00	19.00	.946	1.966	3.8500	2160.0
259 – 159	130	-70.70	3.30	.999	2.019	4.0600	2220.0
249 – 169	140	-84.30	-10.30	.984	2.004	4.0000	2200.0
239 – 179	150	-95.25	-21.25	.931	1.951	3.8000	2150.0
229 – 189	160	-103.25	-29.25	.873	1.893	3.5700	2080.0
219 – 199	170	-108.20	-34.20	.828	1.848	3.4000	2030.0
209	180	-110.00	-36.00	.810	1.830	3.3300	2010.0

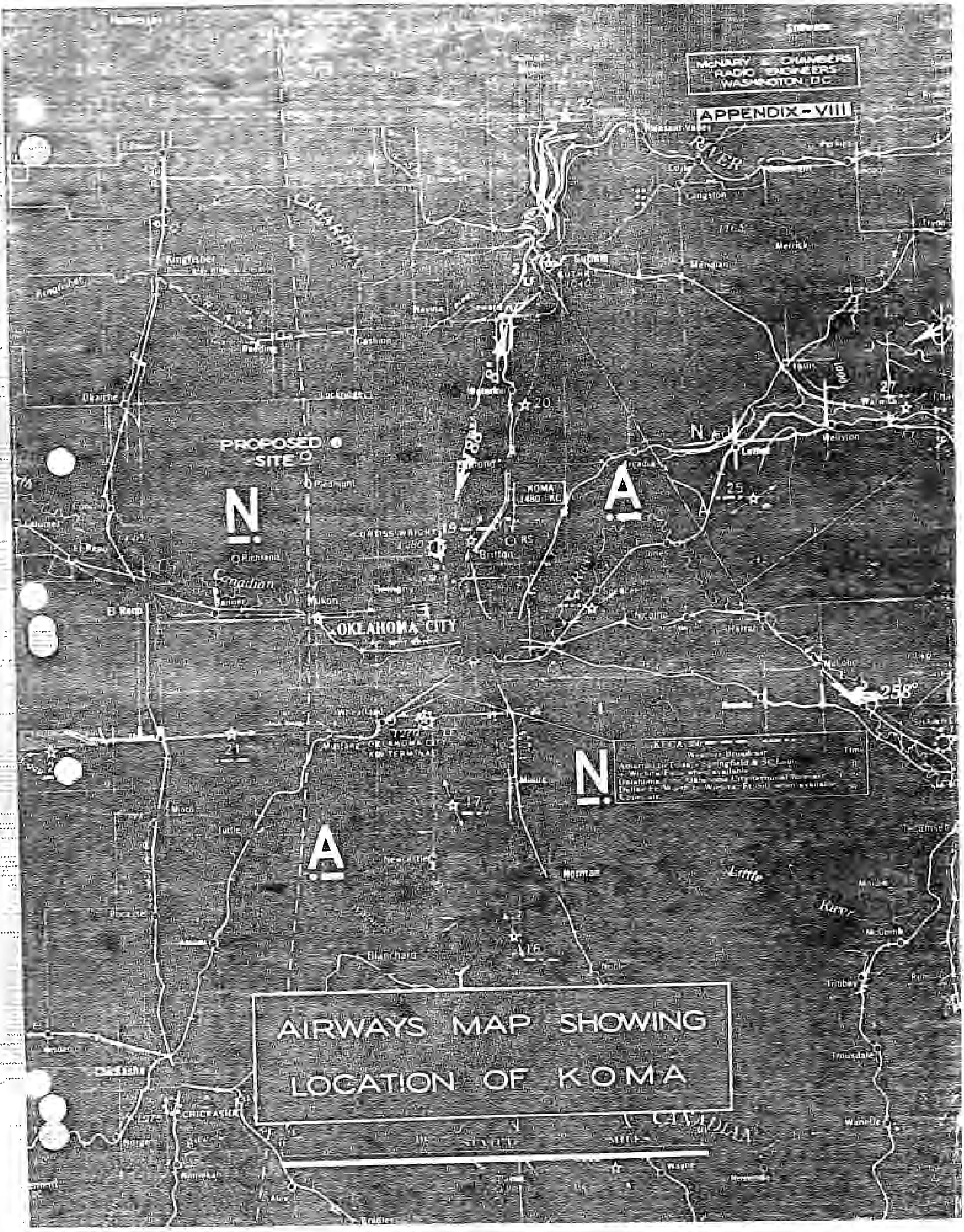
```
  35.11
   x  2
  70.22
 -  3.33
36) 66.89
    1.857
```

$\sqrt{1.857} = 1.364$

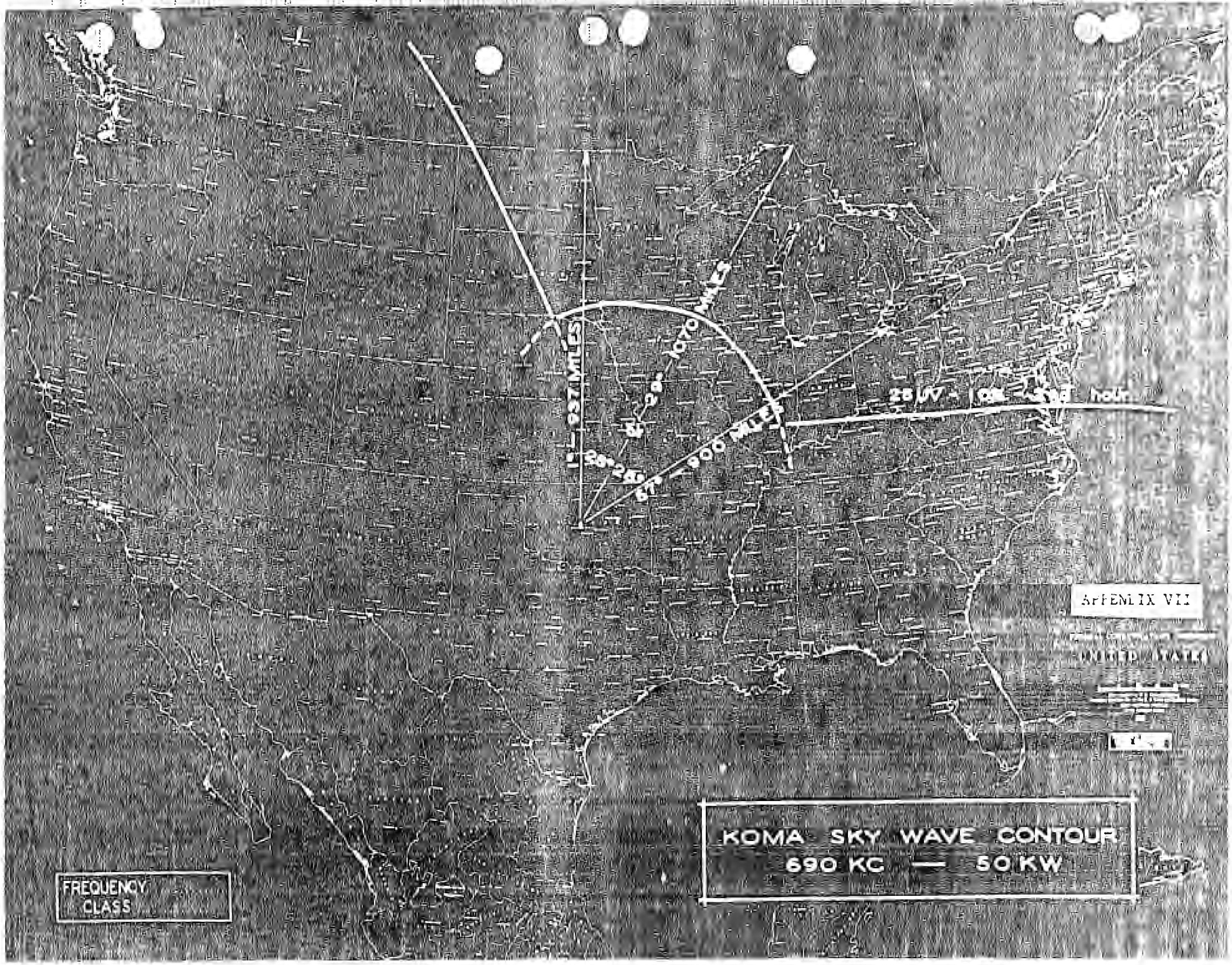
$\frac{1500}{1.364} = 1100 = K$


0.5 MV/M
2 MV/M
5 MV/M
25 MV/M
PRESENT SITE
PROPOSED SITE
OKLAHOMA
CLEVELAND
MC CLAIN
GRADY
CADDO
CANADIAN
KINGFISHER
LOGAN
LINCOLN
POTTAWATOMIE
SEMINOLE
HUGHES
CUSTER
WASHITA
KIOWA
COMANCHE
BLAINE
MAJOR
GARFIELD
PAWNEE
PAYNE
CREEK
DEWEY
WOODWARD
PONTOTOC
GARVIN


K·O·M·A
ESTIMATED FIELD INTENSITY CONTOURS
250 MV. DAY AND NIGHT
690 KC — 50 KW.


McNARY & CHAMBERS
RADIO ENGINEERS
WASHINGTON, D.C.
APPENDIX - VIII
CIMARRON
RIVER
Kingfisher
Okarche
PROPOSED SITE
Piedmont
N
A
KOMA
1480 KC
CURTISS WRIGHT
Britton
Canadian
El Reno
Yukon
OKLAHOMA CITY
Wellston
258°
Moore
Newcastle
Norman
Little
River
Blanchard
Chickasha
Tribbey
Trousdale
Wanette
AIRWAYS MAP SHOWING
LOCATION OF KOMA

APPENDIX VII

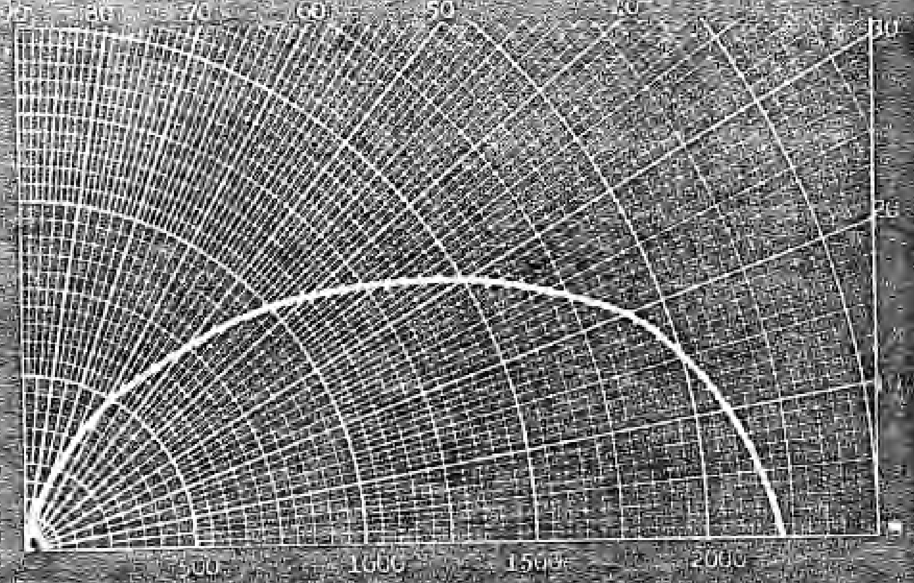


KOMA SKY WAVE CONTOUR
690 KC — 50 KW

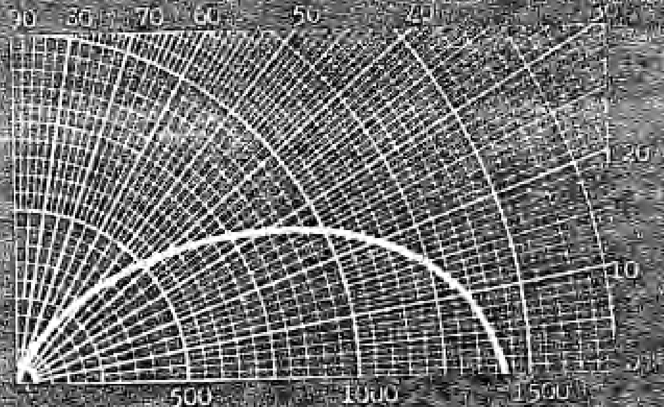
— KOMA —

VERTICAL PLANE PATTERNS

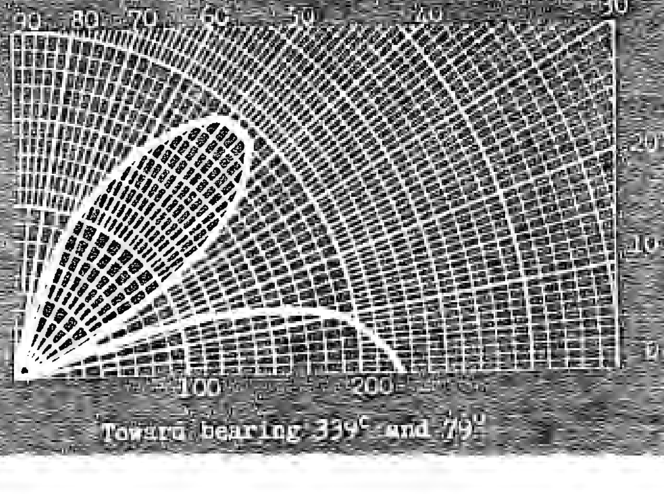
690 KC — 50 KW



Toward maximum - bearing 160° and 258°



Toward bearing 299° and 119°

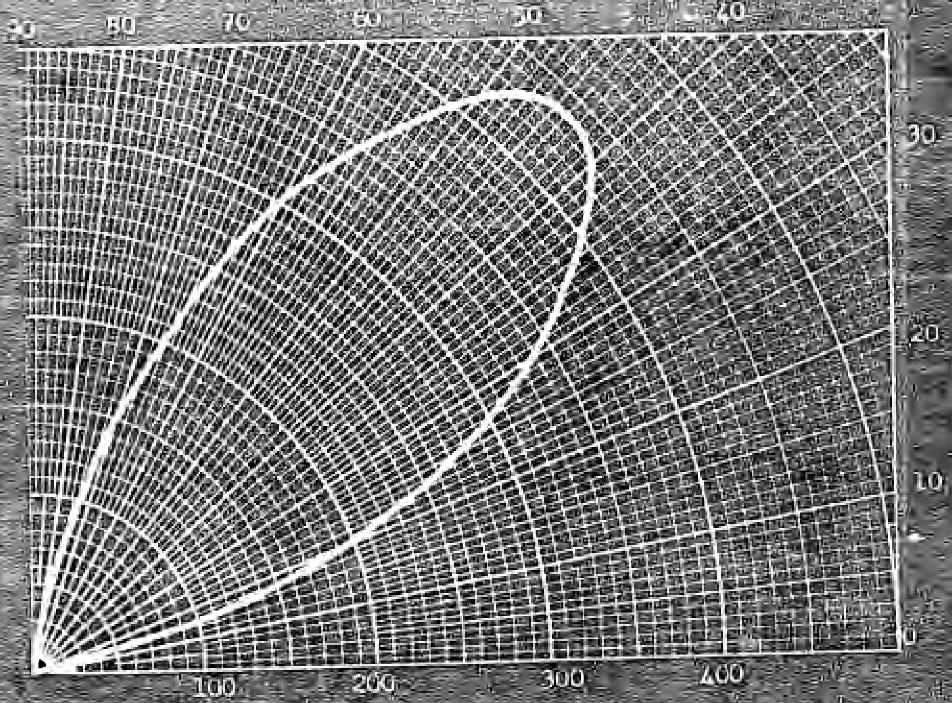


Toward bearing 339° and 79°

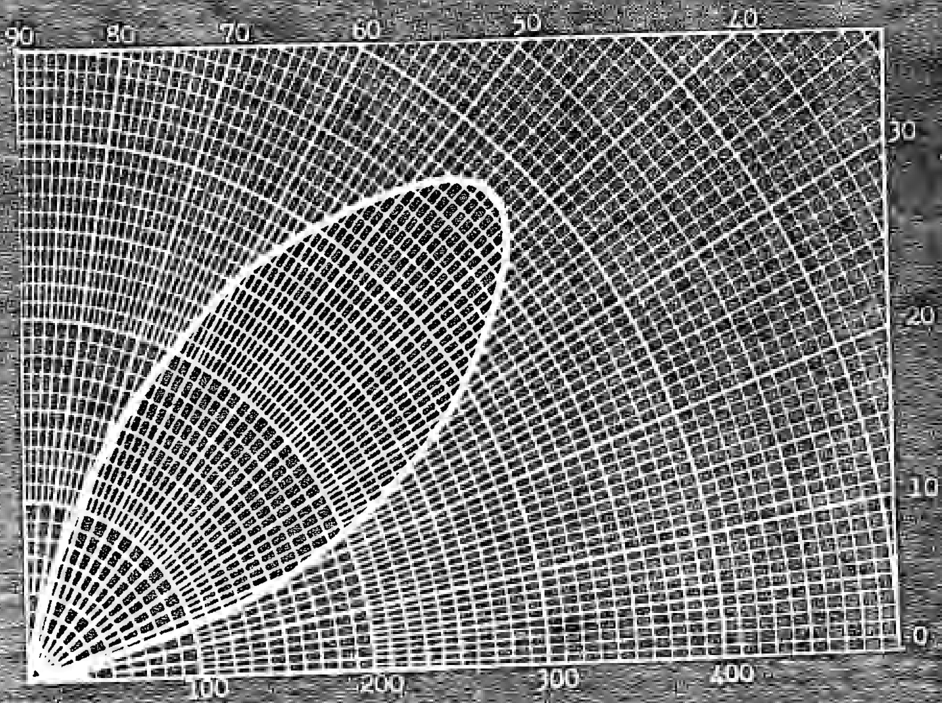
APPENDIX VI-8

— K O M A —

VERTICAL PLANE PATTERNS
690 KC — 50 KW

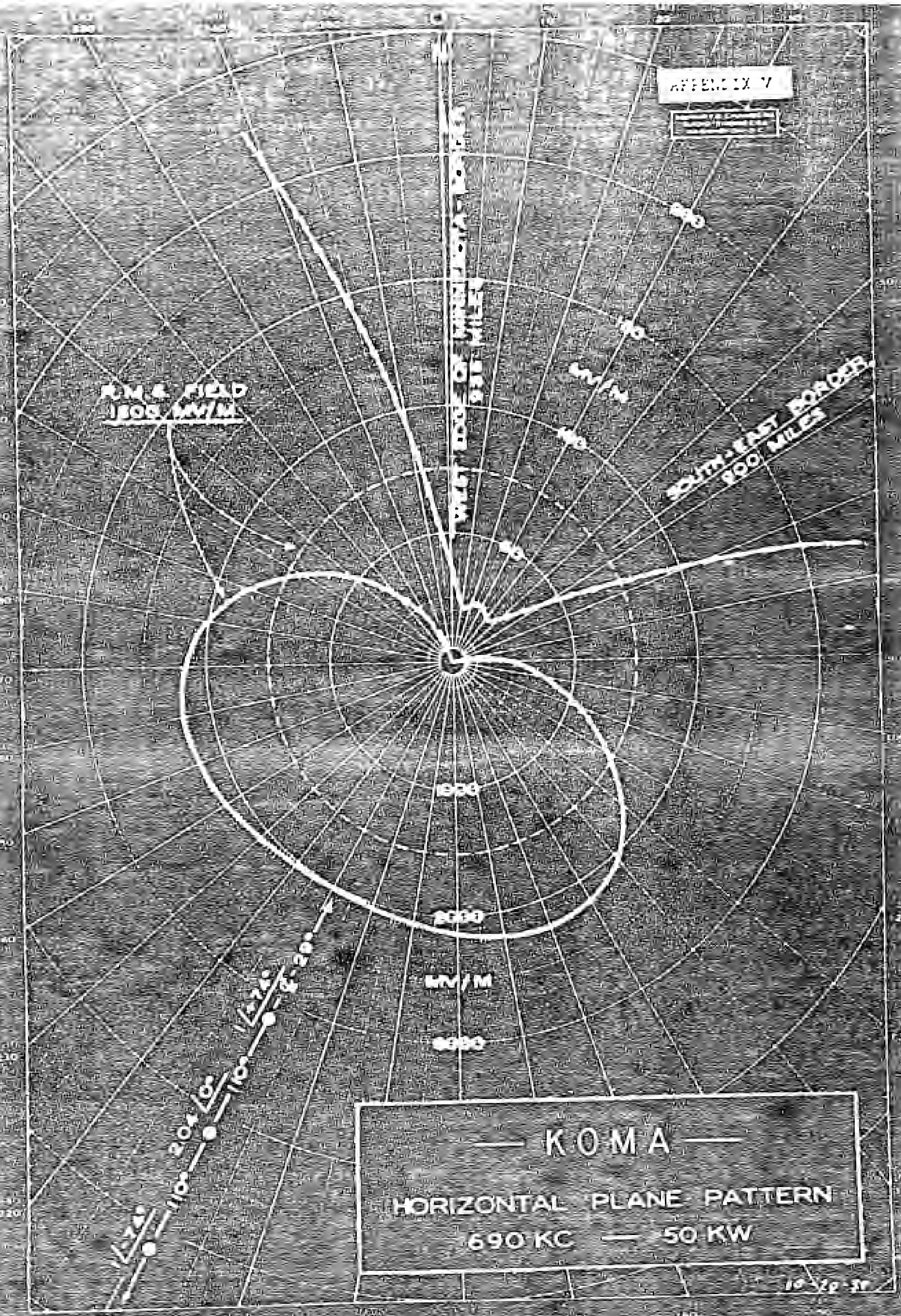


Center Line of Towers - Bearing 29°



Toward Bearing 57°

APPENDIX VI-A



APPENDIX V
A.M. & FIELD
1500 MV/M
WEST EDGE OF MINNESOTA BORDER
SOUTH-EAST BORDER
900 MILES
MV/M
1000
2000
MV/M
— KOMA —
HORIZONTAL PLANE PATTERN
690 KC — 50 KW

Toward Bearing 29° and 359°, ϕ = 50°

$$E = \frac{K}{\sin \theta}\left\{.381\,(.985 - \cos[190 \cos \theta]) + 2 \cos[70.7 \sin \theta + 74](.629 - \cos[51 \cos \theta])\right\}$$

θ	D .381 C	J .629 - H	L 70.7 sin θ	M L + 74	N 2 cos M	P N x J	O P + D
0	0	0	0	74	.551	0	0
10	.002	-.011	12.26	86.26	.129	-.001420	.00058
20	.005	-.041	24.15	98.15	-0.2825	.01158	.01658
30	-0.008	-.089	35.3	109.3	-0.661	.05875	.05075
40	-0.061	-.147	45.5	119.5	-0.984	.1446	.0836
50	-0.172	-.212	54.15	128.15	-1.225	.2620	.0900
60	-0.342	-.274	61.15	135.15	-1.420	.3890	.0480
70	-0.536	-.331	66.4	140.4	-1.540	.5250	-.0110
80	-0.695	-.351	69.6	143.6	-1.610	.5650	-.130
90	-0.756	-.371	70.7	144.7	-1.630	.6075	-.1525

θ	R O/sin θ	E 1486 R
0	0	0
10	.003345	4.96
20	.04850	71.8
30	.1015	151.0
40	.1300	193.0
50	.1175	174.20
60	.05425	80.2
70	.0117	17.3
80	-.132	-190.0
90	-.1525	-225.0

Toward Bearing 99° and 119°, ϕ = 90°

$$E = \frac{V}{\sin \theta}\left\{.381\,(.985 - \cos[190 \cos \theta]) + .552\,(.629 - \cos[51 \cos \theta])\right\}$$

θ	D .381 C	J .629 - H	P .552 J	C P + D	L O/sin θ	E 1486 L
0	0	0	0	0	0	0
10	.002	-.011	-.00606	-.00706	-.022350	-37.7
20	.005	-.041	-.02370	-.0177	-.05175	-76.8
30	.008	-.089	-.04900	-.0570	-.1140	-169.0
40	-.061	-.147	-.0810	-.142	-.2210	-327.0
50	-.172	-.212	-.1165	-.285	-.3770	-557.0
60	-.342	-.274	-.1510	-.4930	-.5700	-845.0
70	-.536	-.331	-.1825	-.7185	-.7650	-1133.0
80	-.695	-.351	-.1930	-.8880	-.9020	-1335.0
90	-.756	-.371	-.2040	-.9600	-.9600	-1425.0

θ	[illegible]	.2042 [illegible]	27.1 sin θ	L 474	[illegible]
0	[illegible]	0	0	[illegible]	.541
10	[illegible]	.011	16.9	89.9	[illegible]
20	.005	[illegible]	[illegible]	107.2	[illegible]
30	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40	[illegible]	[illegible]	[illegible]	136.2	[illegible]
50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
60	[illegible]	[illegible]	24.00	158.0	[illegible]
70	[illegible]	[illegible]	25.50	[illegible]	[illegible]
80	[illegible]	[illegible]	26.60	169.6	[illegible]
90	[illegible]	[illegible]	26.29	[illegible]	[illegible]

θ	P [illegible] J	Q P+I	R Q/sin θ	F 1486 F
0	0	0	0	0
10	.00755	[illegible]	.01560	[illegible]
20	.01170	.0267	.078	115.[illegible]
30	.02570	.0877	.1759	260.0
40	.188	[illegible]	[illegible]	[illegible]
50	.1600	[illegible]	[illegible]	362.0
60	.2270	[illegible]	.2020	357.5
70	.040	.1070	.1204	163.8
80	.060	.005	.00605	7.7
90	[illegible]	-.027	-.024	35.[illegible]

Second Heading FP Tube ψ = 0°

$R = \frac{1}{\sin\theta}\{\ldots\}$ [illegible]

θ	D .384 C	J .429 - H	L 110 sin θ	L 474	M cos [illegible]	N [illegible] J	P+[illegible]
0	0	0	0	74	1	0	0
10	.102	-.011	19.1	93.1	-.1021	.001190	.0019
20	.005	-.021	37.6	111.6	[illegible]	[illegible]	.035
30	-.008	-.029	55.0	129.0	[illegible]	.0118	.109
40	-.061	-.147	70.6	144.6	-1.69	.395	.279
50	.172	-.17	84.2	158.2	-1.86	[illegible]	[illegible]
60	.242	-.274	95.1	169.1	-1.96	[illegible]	.1990
70	-.336	-.330	103.3	177.3	-1.993	.6590	[illegible]
80	[illegible]	-.351	108.4	182.4	-1.997	[illegible]	.007
90	-.356	-.371	110.0	184.0	-1.99	.7420	-.014

θ	R Q/sin θ	F 1486 F
0	0	0
10	.01840	27.3
20	.1030	153.0
30	.2075	307.5
40	.277	412.0
50	.2905	432.0
60	.2250	334.0
70	.1308	194.0
80	.00711	10.55
90	-.014	20.75