SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION LINE

PATTERN CERTIFICATION

DIRECTIONAL FM ANTENNA

KRNR

March 13, 2019

Call Sign	:	KRNR
Location	:	Goldthwaite, TX
Frequency	:	100.5 MHz
Channel	:	263A
Antenna Model	:	FMEC/6-PLUS-0.75WS-DA
Maximum Antenna Gain		
Horizontal	:	**5.71 / 7.57 dB**
Vertical	:	**5.71 / 7.57 dB**

ANTENNA DESCRIPTION

A custom designed FMEC/6-PLUS-0.75WS-DA antenna was fabricated to conform to the prescribed directional azimuth pattern. The antenna consists of six (6) circularly polarized, cross-V dipole radiating elements 0.75 wave spaced mounted to a Rohn 65G tower. The antenna points 310 degrees true North.

DESCRIPTION OF TEST PROCEDURE

The test antenna consisted of a single third-scale bay. The antenna was mounted to a third-scale pipe, which was mounted to a third-scale pole by use of third-scale brackets identical to those shipped with the final, full-scale antenna. For testing, the entire third-scale model was then mounted atop a 20' (foot) high platform, and all feed cables were properly grounded. Horizontal and vertical readings were taken. The desired directional pattern was obtained by adjusting the distance between the tower and the antenna, and modifying the direction of the azimuth heading.

DESCRIPTION OF TEST PARAMETERS AND EQUIPMENT

Horizontal and vertical pattern readings were taken by mounting a source antenna - a vertical/horizontal dipole, Cavity Back Resonator (CBR) antenna bay - approximately 100' (feet) from the third-scale antenna model. The source antenna's height was adjusted to achieve a uniform field at the third-scale test antenna location. The CBR antenna was operated in receive mode, at frequency 301.5 MHz. The third-scale test antenna was then rotated clockwise in order to achieve 360° (degree) pattern readings. A gain reference was taken using a dipole tuned to 301.5 MHz. Nowhere did the received signal, or resultant documentation, exceed a maximum to minimum ratio of 15dB (decibels).

619 Industrial Park Road, Ebensburg, PA 15931 Tel. 800 762 7743 / 814 472 5436 ♦ Fax 814 472 5552

TEST RESULTS

The attached calculations verify that the **RMS** value of this antenna is ***86.1%*** of the **RMS** value of the pattern authorized in the related FCC file **BPH-20180413AAR.** The vertical component **RMS** value is **0.614**. The horizontal component **RMS** value is **0.767**. The circular polarized component **RMS** value is **0.833.**

Azimuth and elevation plots and associated tabulations of this antenna are included with this package.

Measured vertical polarized directivity:	**2.649 / 4.23 dB**
Measured horizontal polarized directivity:	**1.700 / 2.30 dB**
Measured circular polarized pattern directivity:	**1.441 / 1.59 dB**

Gain in each polarization was calculated using the following relation:

GAIN = *Azimuth Directivity x Power Ratio Between Polarizations x Elevation Directivity*

Using this relationship along with ratio measured at our testing facilities:

V-Pol. Gain = (2.649)(.391)(5.513) **= 5.71 / 7.57 dB**
H-Pol. Gain = (1.700)(.609)(5.513) **= 5.71 / 7.57 dB**

INSTALLATION AND MOUNTING

The antenna is to be mounted in accordance with the supplied drawings. The antenna center of radiation is to be **45.0** ***meters (147.65 ft.)*** above ground level. The antenna aperture is **36.7 feet**. No other antennas are to be mounted within ***10 feet*** of the antenna. No other obstructions other than those specified by original drawings supplied are to be mounted at the same level as the antenna. The antenna is to be oriented ***310 degrees*** from true North.

The system's orientation and the mounting details are described in the following drawings:

DRAWING NO.	**TITLE**
1982D03	ELEVATION
1982D04	ANTENNA ORIENTATION
2105A10	TEST RANGE SCHEMATIC

The antenna elevation is shown on **DWG. 1982D03**.The antenna elements shall be aligned at the same heading as in **DWG. 1982D04**.This will ensure that the antenna is oriented properly at **310** degrees from true North**.** The test range schematic **DWG. 2105A10** shows the mounting configuration of the antenna setup on our range.

DOCUMENT EXHIBITS

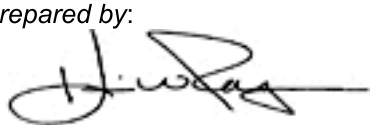
The following exhibits are included as part of this Certificate of Compliance:

Exhibit 1	Circular Polarized Azimuth Pattern Field Strength Tabulations (Composite)
Exhibit 2	Measured Horizontal Polarized Azimuth Pattern Measured Field Strength Tabulations (Horizontal)
Exhibit 3	Measured Vertical Polarized Azimuth Pattern Measured Field Strength Tabulations (Vertical)
Exhibit 4	Elevation Pattern Elevation Tabulations
Exhibit 5	Antenna Data Sheet
Exhibit 6	RMS Calculations
Exhibit 7	Drawings

TEST EQUIPMENT

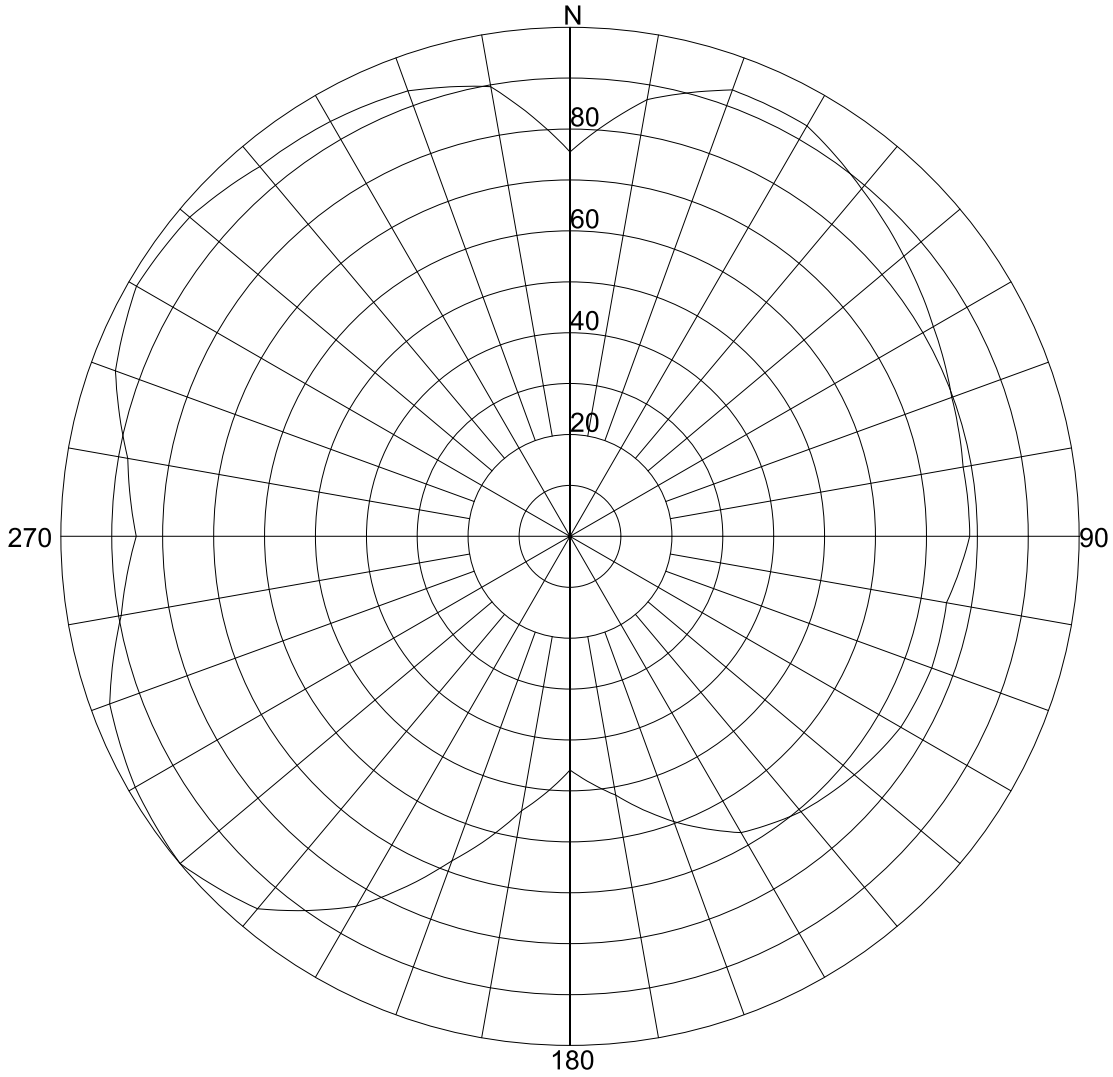
Network Analyzer	:	Hewlett Packard Model # 8753C Serial Number: 08753 – 69138
Computer	:	Pentium 3, 450 MHz, SAMS Range Program
Printer	:	Hewlett-Packard Laser Jet 6L
Positioner	:	Orbit Positioner
		All equipment is calibrated to ANSI/NCSL Z540-1-1994 specs

Prepared by:



Kevin W. Rager
Antenna Engineer
Systems With Reliability, LP

Exhibit 1: Circular Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability

CLIENT: *KRNR*

Date: 2/28/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Circular

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.44118 / 1.59dB

PATTERN RMS: *0.833*

Micro-Tek Eng. Ver. 2.6

Exhibit 1 (cont'd): Circular Polarized Azimuth Pattern Tabulations

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.7550 (-2.44)	180	.4590 (-6.76)
5	.8130 (-1.8)	185	.5030 (-5.97)
10	.8710 (-1.2)	190	.5470 (-5.24)
15	.9020 (-0.9)	195	.6125 (-4.26)
20	.9330 (-0.6)	200	.6780 (-3.38)
25	.9320 (-0.61)	205	.7585 (-2.4)
30	.9310 (-0.62)	210	.8390 (-1.52)
35	.9110 (-0.81)	215	.8970 (-0.94)
40	.8910 (-1)	220	.9550 (-0.4)
45	.8735 (-1.17)	225	.9775 (-0.2)
50	.8560 (-1.35)	230	1.0000 (0)
55	.8400 (-1.51)	235	.9930 (-0.06)
60	.8240 (-1.68)	240	.9860 (-0.12)
65	.8110 (-1.82)	245	.9740 (-0.23)
70	.7980 (-1.96)	250	.9620 (-0.34)
75	.7910 (-2.04)	255	.9285 (-0.64)
80	.7840 (-2.11)	260	.8950 (-0.96)
85	.7845 (-2.11)	265	.8735 (-1.17)
90	.7850 (-2.1)	270	.8520 (-1.39)
95	.7680 (-2.29)	275	.8670 (-1.24)
100	.7510 (-2.49)	280	.8820 (-1.09)
105	.7535 (-2.46)	285	.9160 (-0.76)
110	.7560 (-2.43)	290	.9500 (-0.45)
115	.7530 (-2.46)	295	.9665 (-0.3)
120	.7500 (-2.5)	300	.9830 (-0.15)
125	.7395 (-2.62)	305	.9790 (-0.18)
130	.7290 (-2.75)	310	.9750 (-0.22)
135	.7175 (-2.88)	315	.9615 (-0.34)
140	.7060 (-3.02)	320	.9480 (-0.46)
145	.6890 (-3.24)	325	.9445 (-0.5)
150	.6720 (-3.45)	330	.9410 (-0.53)
155	.6340 (-3.96)	335	.9360 (-0.57)
160	.5960 (-4.5)	340	.9310 (-0.62)
165	.5560 (-5.1)	345	.9140 (-0.78)
170	.5160 (-5.75)	350	.8970 (-0.94)
175	.4875 (-6.24)	355	.8260 (-1.66)

Systems With Reliability

CLIENT: *KRNR* Date: 2/28/2019

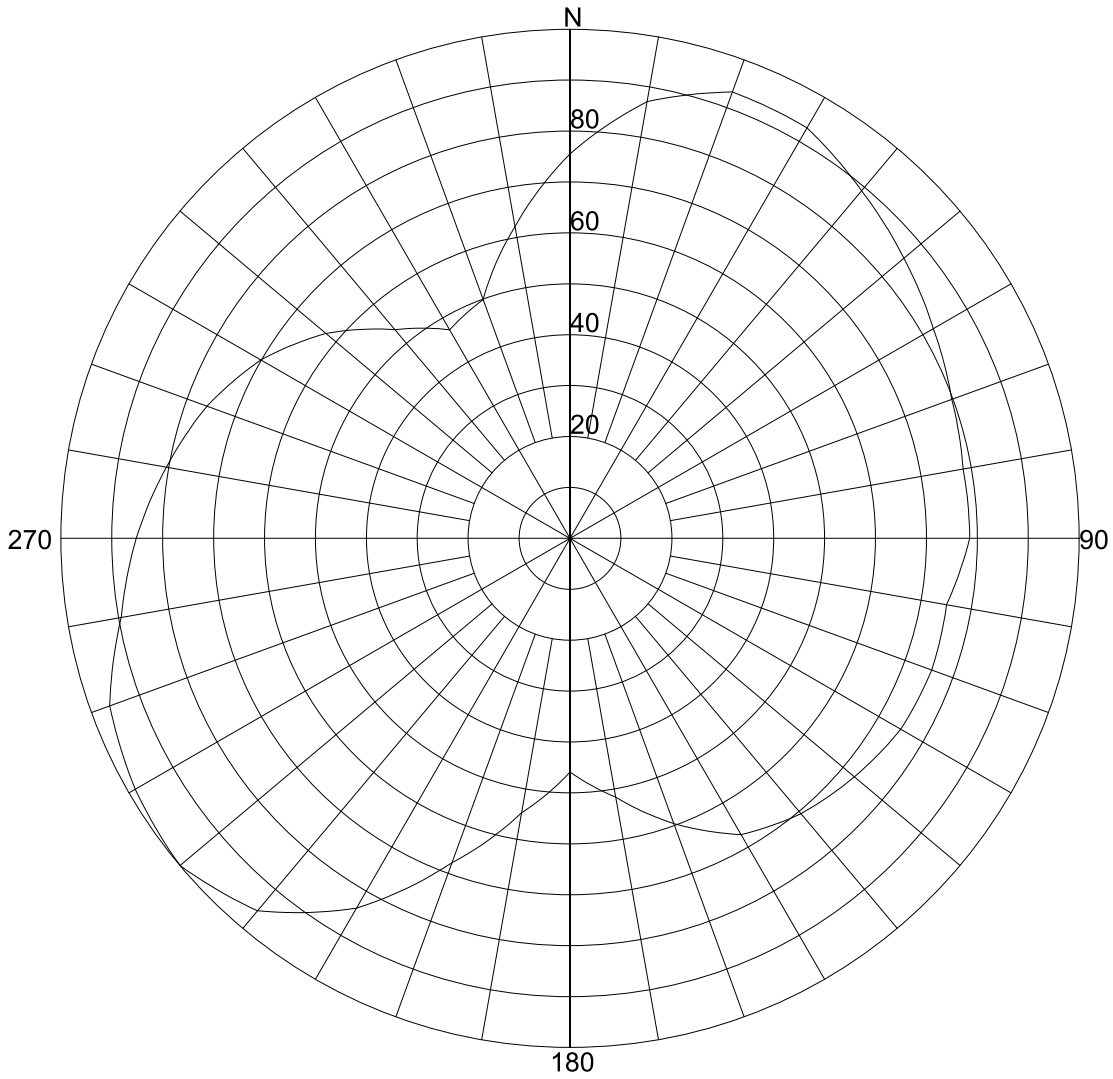
ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Circular CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.44118 / 1.59dB PATTERN RMS: *0.833*

Exhibit 2: Measured Horizontal Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability

CLIENT: *KRNR*

Date: 2/28/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Horizontal

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.70013 / 2.3dB

PATTERN RMS: *0.767*

Micro-Tek Eng. Ver. 2.6

Exhibit 2 (cont'd): Measured Horizontal Polarized Azimuth Pattern Tabulations

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.7550 (-2.44)	180	.4590 (-6.76)
5	.8130 (-1.8)	185	.5030 (-5.97)
10	.8710 (-1.2)	190	.5470 (-5.24)
15	.9020 (-0.9)	195	.6125 (-4.26)
20	.9330 (-0.6)	200	.6780 (-3.38)
25	.9320 (-0.61)	205	.7585 (-2.4)
30	.9310 (-0.62)	210	.8390 (-1.52)
35	.9110 (-0.81)	215	.8970 (-0.94)
40	.8910 (-1)	220	.9550 (-0.4)
45	.8735 (-1.17)	225	.9775 (-0.2)
50	.8560 (-1.35)	230	1.0000 (0)
55	.8400 (-1.51)	235	.9930 (-0.06)
60	.8240 (-1.68)	240	.9860 (-0.12)
65	.8110 (-1.82)	245	.9740 (-0.23)
70	.7980 (-1.96)	250	.9620 (-0.34)
75	.7910 (-2.04)	255	.9285 (-0.64)
80	.7840 (-2.11)	260	.8950 (-0.96)
85	.7845 (-2.11)	265	.8735 (-1.17)
90	.7850 (-2.1)	270	.8520 (-1.39)
95	.7680 (-2.29)	275	.8285 (-1.63)
100	.7510 (-2.49)	280	.8050 (-1.88)
105	.7535 (-2.46)	285	.7820 (-2.14)
110	.7560 (-2.43)	290	.7590 (-2.4)
115	.7530 (-2.46)	295	.7300 (-2.73)
120	.7500 (-2.5)	300	.7010 (-3.09)
125	.7395 (-2.62)	305	.6635 (-3.56)
130	.7290 (-2.75)	310	.6260 (-4.07)
135	.7175 (-2.88)	315	.5805 (-4.72)
140	.7060 (-3.02)	320	.5350 (-5.43)
145	.6890 (-3.24)	325	.5040 (-5.95)
150	.6720 (-3.45)	330	.4730 (-6.5)
155	.6340 (-3.96)	335	.4860 (-6.27)
160	.5960 (-4.5)	340	.4990 (-6.04)
165	.5560 (-5.1)	345	.5605 (-5.03)
170	.5160 (-5.75)	350	.6220 (-4.12)
175	.4875 (-6.24)	355	.6885 (-3.24)

Systems With Reliability

CLIENT: *KRNR* Date: 2/28/2019

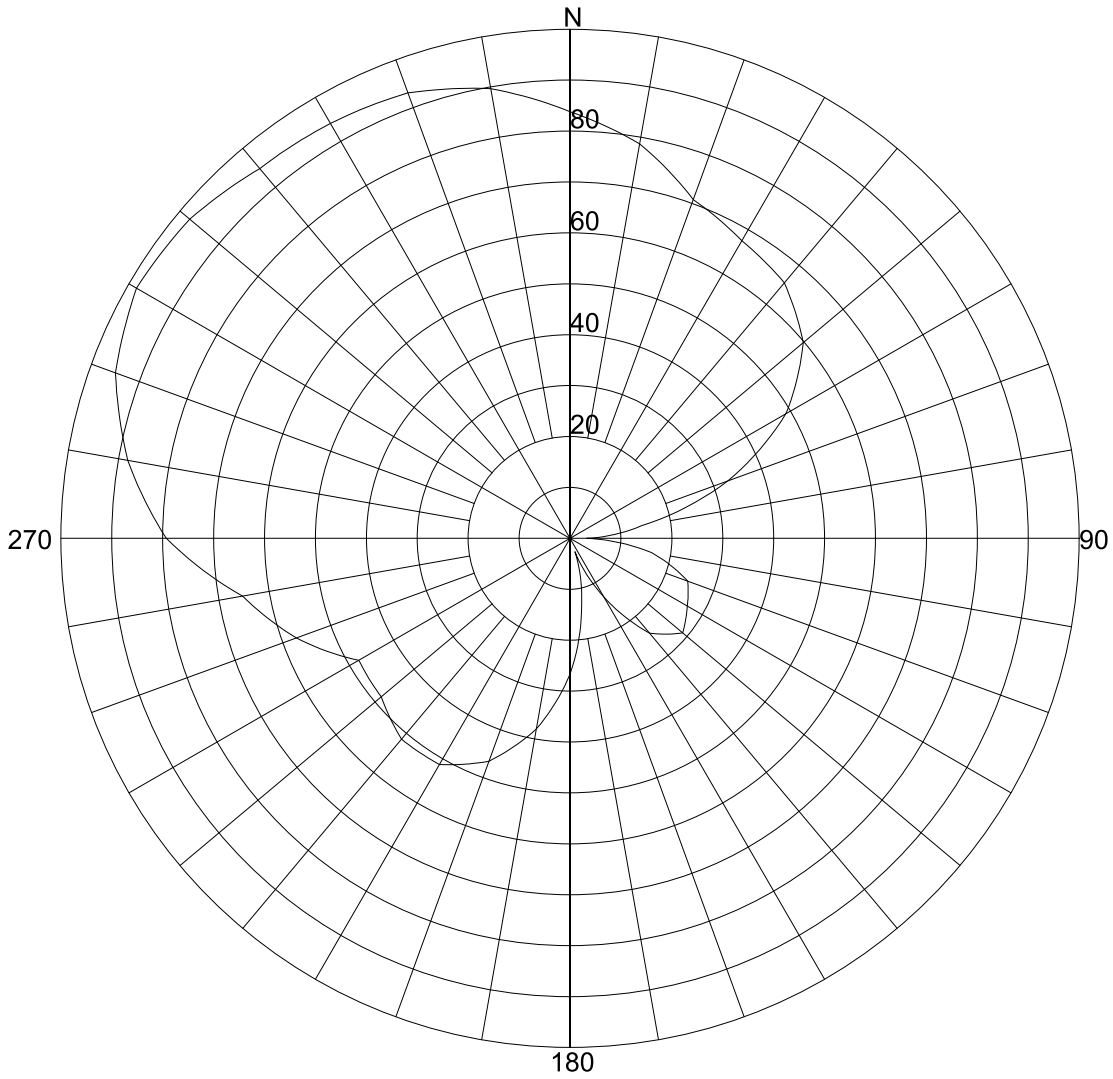
ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Horizontal CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 1.70013 / 2.3dB PATTERN RMS: *0.767*

Exhibit 3: Measured Vertical Polarized Azimuth Pattern



Azimuth Pattern

Scale: Linear

Unit: Relative Field

Systems With Reliability

CLIENT: *KRNR*

Date: 2/28/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Vertical

CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.6490 / 4.23dB

PATTERN RMS: *0.614*

Micro-Tek Eng. Ver. 2.6

Exhibit 3 (cont'd): Measured Vertical polarized Azimuth Pattern Tabulations

Relative Field Tabulation(Azimuth)

Azimuth Heading	Normalized Field(dB)	Azimuth Heading	Normalized Field(dB)
0	.8380 (-1.54)	180	.2670 (-11.47)
5	.8125 (-1.8)	185	.3235 (-9.8)
10	.7870 (-2.08)	190	.3800 (-8.4)
15	.7475 (-2.53)	195	.4230 (-7.47)
20	.7080 (-3)	200	.4660 (-6.63)
25	.6915 (-3.2)	205	.4895 (-6.2)
30	.6750 (-3.41)	210	.5130 (-5.8)
35	.6650 (-3.54)	215	.5140 (-5.78)
40	.6550 (-3.68)	220	.5150 (-5.76)
45	.6265 (-4.06)	225	.4995 (-6.03)
50	.5980 (-4.47)	230	.4840 (-6.3)
55	.5440 (-5.29)	235	.4815 (-6.35)
60	.4900 (-6.2)	240	.4790 (-6.39)
65	.4100 (-7.74)	245	.5255 (-5.59)
70	.3300 (-9.63)	250	.5720 (-4.85)
75	.2365 (-12.52)	255	.6125 (-4.26)
80	.1430 (-16.89)	260	.6530 (-3.7)
85	.0880 (-21.11)	265	.7230 (-2.82)
90	.0330 (-29.63)	270	.7930 (-2.01)
95	.0980 (-20.18)	275	.8375 (-1.54)
100	.1630 (-15.76)	280	.8820 (-1.09)
105	.2045 (-13.79)	285	.9160 (-0.76)
110	.2460 (-12.18)	290	.9500 (-0.45)
115	.2560 (-11.84)	295	.9665 (-0.3)
120	.2660 (-11.5)	300	.9830 (-0.15)
125	.2775 (-11.13)	305	.9790 (-0.18)
130	.2890 (-10.78)	310	.9750 (-0.22)
135	.2660 (-11.5)	315	.9615 (-0.34)
140	.2430 (-12.29)	320	.9480 (-0.46)
145	.1880 (-14.52)	325	.9445 (-0.5)
150	.1330 (-17.52)	330	.9410 (-0.53)
155	.0805 (-21.88)	335	.9360 (-0.57)
160	.0280 (-31.06)	340	.9310 (-0.62)
165	.0795 (-21.99)	345	.9140 (-0.78)
170	.1310 (-17.65)	350	.8970 (-0.94)
175	.1990 (-14.02)	355	.8675 (-1.23)

Systems With Reliability

CLIENT: *KRNR* Date: 2/28/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

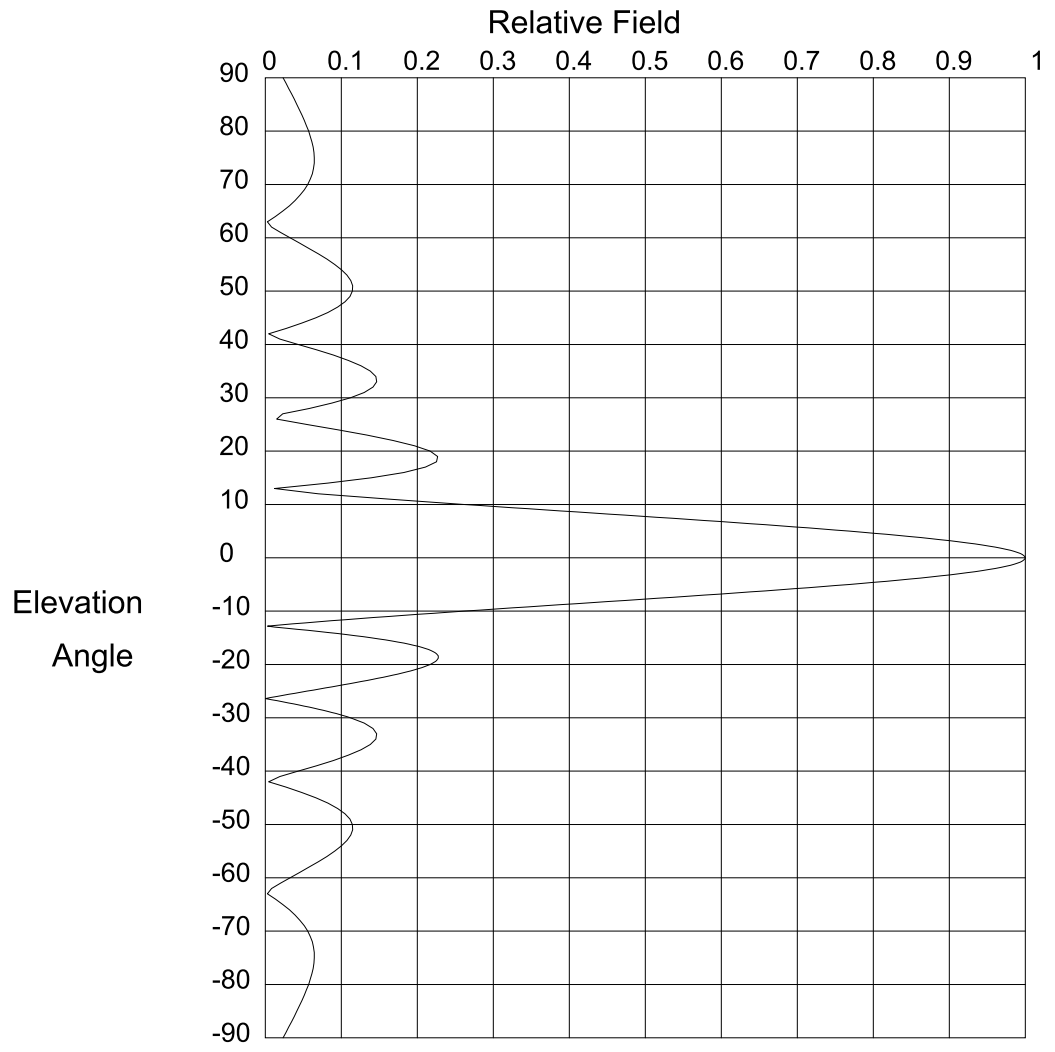
FREQUENCY: 100.5 MHz

PATTERN POL.: Vertical CIRCULARITY(+/-dB):

AZ. DIRECTIVITY: 2.6490 / 4.23dB PATTERN RMS: *0.614*

Micro-Tek Eng. Ver. 2.6

Exhibit 4: Elevation Pattern



Elevation Pattern

Scale: Linear

Units: Field, Relative

Systems With Reliability

CLIENT: *KRNR / Alan Brown*

Date: 3/4/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 5.513/7.414 dBd

Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 5.513/7.414 dBd

Null Fill(s)(%) : *0, 0, 0*

Micro-Tek Eng. Ver. 2.6

Exhibit 4 (cont'd): Elevation Pattern Tabulations

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
90.0	.024 (-32.553)	52.0	.112 (-18.981)	14.0	.083 (-21.657)
89.0	.027 (-31.289)	51.0	.115 (-18.791)	13.0	.012 (-38.117)
88.0	.031 (-30.193)	50.0	.115 (-18.812)	12.0	.07 (-23.126)
87.0	.035 (-29.23)	49.0	.111 (-19.062)	11.0	.162 (-15.807)
86.0	.038 (-28.375)	48.0	.105 (-19.577)	10.0	.262 (-11.635)
85.0	.042 (-27.613)	47.0	.095 (-20.413)	9.8	.283 (-10.976)
84.0	.045 (-26.93)	46.0	.083 (-21.666)	9.6	.303 (-10.358)
83.0	.048 (-26.32)	45.0	.067 (-23.516)	9.4	.324 (-9.777)
82.0	.051 (-25.776)	44.0	.048 (-26.353)	9.2	.346 (-9.23)
81.0	.054 (-25.297)	43.0	.027 (-31.311)	9.0	.367 (-8.713)
80.0	.057 (-24.88)	42.0	.004 (-47.008)	8.8	.388 (-8.224)
79.0	.059 (-24.527)	41.0	.019 (-34.24)	8.6	.409 (-7.76)
78.0	.061 (-24.238)	40.0	.044 (-27.201)	8.4	.431 (-7.319)
77.0	.063 (-24.017)	39.0	.067 (-23.429)	8.2	.452 (-6.9)
76.0	.064 (-23.868)	38.0	.09 (-20.946)	8.0	.473 (-6.501)
75.0	.065 (-23.799)	37.0	.11 (-19.205)	7.8	.494 (-6.12)
74.0	.064 (-23.817)	36.0	.126 (-17.985)	7.6	.515 (-5.758)
73.0	.064 (-23.934)	35.0	.138 (-17.18)	7.4	.536 (-5.411)
72.0	.062 (-24.164)	34.0	.145 (-16.744)	7.2	.557 (-5.081)
71.0	.059 (-24.528)	33.0	.147 (-16.665)	7.0	.578 (-4.765)
70.0	.056 (-25.052)	32.0	.142 (-16.965)	6.8	.598 (-4.463)
69.0	.051 (-25.775)	31.0	.13 (-17.702)	6.6	.618 (-4.175)
68.0	.046 (-26.758)	30.0	.112 (-19.002)	6.4	.638 (-3.899)
67.0	.039 (-28.097)	29.0	.088 (-21.129)	6.2	.658 (-3.636)
66.0	.032 (-29.964)	28.0	.058 (-24.763)	6.0	.677 (-3.385)
65.0	.023 (-32.727)	27.0	.023 (-32.743)	5.8	.696 (-3.144)
64.0	.013 (-37.413)	26.0	.015 (-36.405)	5.6	.715 (-2.915)
63.0	.003 (-50.638)	25.0	.055 (-25.157)	5.4	.733 (-2.697)
62.0	.008 (-41.546)	24.0	.095 (-20.404)	5.2	.751 (-2.488)
61.0	.02 (-33.851)	23.0	.134 (-17.468)	5.0	.768 (-2.29)
60.0	.033 (-29.722)	22.0	.168 (-15.48)	4.8	.785 (-2.101)
59.0	.045 (-26.897)	21.0	.197 (-14.127)	4.6	.802 (-1.921)
58.0	.058 (-24.781)	20.0	.217 (-13.277)	4.4	.817 (-1.751)
57.0	.07 (-23.127)	19.0	.227 (-12.88)	4.2	.833 (-1.589)
56.0	.081 (-21.815)	18.0	.225 (-12.94)	4.0	.848 (-1.436)
55.0	.091 (-20.774)	17.0	.211 (-13.522)	3.8	.862 (-1.292)
54.0	.10 (-19.968)	16.0	.182 (-14.784)	3.6	.875 (-1.156)
53.0	.107 (-19.374)	15.0	.14 (-17.107)	3.4	.888 (-1.028)

Systems With Reliability

CLIENT: *KRNR / Alan Brown*

Date: 3/4/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 5.513/7.414 dBd

Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 5.513/7.414 dBd

Null Fill(s)(%) : *0, 0, 0*

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
3.2	.901 (-0.908)	-4.4	.817 (-1.751)	-12.0	.07 (-23.126)
3.0	.912 (-0.796)	-4.6	.802 (-1.921)	-12.2	.052 (-25.603)
2.8	.923 (-0.692)	-4.8	.785 (-2.101)	-12.4	.036 (-28.979)
2.6	.934 (-0.595)	-5.0	.768 (-2.29)	-12.6	.019 (-34.373)
2.4	.943 (-0.506)	-5.2	.751 (-2.488)	-12.8	.003 (-50.138)
2.2	.952 (-0.425)	-5.4	.733 (-2.697)	-13.0	.012 (-38.117)
2.0	.96 (-0.35)	-5.6	.715 (-2.915)	-13.2	.027 (-31.221)
1.8	.968 (-0.283)	-5.8	.696 (-3.144)	-13.4	.042 (-27.528)
1.6	.975 (-0.224)	-6.0	.677 (-3.385)	-13.6	.056 (-25.023)
1.4	.981 (-0.171)	-6.2	.658 (-3.636)	-13.8	.07 (-23.145)
1.2	.986 (-0.125)	-6.4	.638 (-3.899)	-14.0	.083 (-21.657)
1.0	.99 (-0.087)	-6.6	.618 (-4.175)	-14.2	.095 (-20.435)
.8	.994 (-0.056)	-6.8	.598 (-4.463)	-14.4	.107 (-19.409)
.6	.996 (-0.031)	-7.0	.578 (-4.765)	-14.6	.118 (-18.531)
.4	.998 (-0.014)	-7.2	.557 (-5.081)	-14.8	.129 (-17.771)
.2	1.00 (-0.003)	-7.4	.536 (-5.411)	-15.0	.14 (-17.107)
.0	1.00 (0)	-7.6	.515 (-5.758)	-15.2	.149 (-16.524)
-.2	1.00 (-0.003)	-7.8	.494 (-6.12)	-15.4	.158 (-16.008)
-.4	.998 (-0.014)	-8.0	.473 (-6.501)	-15.6	.167 (-15.551)
-.6	.996 (-0.031)	-8.2	.452 (-6.9)	-15.8	.175 (-15.145)
-.8	.994 (-0.056)	-8.4	.431 (-7.319)	-16.0	.182 (-14.784)
-1.0	.99 (-0.087)	-8.6	.409 (-7.76)	-16.2	.189 (-14.464)
-1.2	.986 (-0.125)	-8.8	.388 (-8.224)	-16.4	.195 (-14.181)
-1.4	.981 (-0.171)	-9.0	.367 (-8.713)	-16.6	.201 (-13.931)
-1.6	.975 (-0.224)	-9.2	.346 (-9.23)	-16.8	.206 (-13.712)
-1.8	.968 (-0.283)	-9.4	.324 (-9.777)	-17.0	.211 (-13.522)
-2.0	.96 (-0.35)	-9.6	.303 (-10.358)	-17.2	.215 (-13.358)
-2.2	.952 (-0.425)	-9.8	.283 (-10.976)	-17.4	.218 (-13.22)
-2.4	.943 (-0.506)	-10.0	.262 (-11.635)	-17.6	.221 (-13.104)
-2.6	.934 (-0.595)	-10.2	.242 (-12.341)	-17.8	.224 (-13.012)
-2.8	.923 (-0.692)	-10.4	.221 (-13.102)	-18.0	.225 (-12.94)
-3.0	.912 (-0.796)	-10.6	.201 (-13.925)	-18.2	.227 (-12.89)
-3.2	.901 (-0.908)	-10.8	.182 (-14.822)	-18.4	.228 (-12.859)
-3.4	.888 (-1.028)	-11.0	.162 (-15.807)	-18.6	.228 (-12.847)
-3.6	.875 (-1.156)	-11.2	.143 (-16.9)	-18.8	.228 (-12.854)
-3.8	.862 (-1.292)	-11.4	.124 (-18.127)	-19.0	.227 (-12.88)
-4.0	.848 (-1.436)	-11.6	.106 (-19.527)	-19.2	.226 (-12.924)
-4.2	.833 (-1.589)	-11.8	.087 (-21.161)	-19.4	.224 (-12.985)

Systems With Reliability

CLIENT: *KRNR / Alan Brown*
Date: 3/4/2019
ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA
FREQUENCY: 100.5 MHz
PATTERN POL.: Circular
DIRECTIVITY(Peak): 5.513/7.414 dBd
Beam Tilt (Deg.) : *0*
DIRECTIVITY(Horiz): 5.513/7.414 dBd
Null Fill(s)(%) : *0, 0, 0*

Exhibit 4 (cont'd): Elevation Pattern Tabulations

Relative Field Tabulation

Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)	Elev. Angle	Rel. Fld(dB)
-19.6	.222 (-13.065)	-27.2	.03 (-30.364)	-54.0	.10 (-19.968)
-19.8	.22 (-13.162)	-27.4	.037 (-28.533)	-55.0	.091 (-20.774)
-20.0	.217 (-13.277)	-27.6	.044 (-27.053)	-56.0	.081 (-21.815)
-20.2	.214 (-13.41)	-27.8	.051 (-25.817)	-57.0	.07 (-23.127)
-20.4	.21 (-13.561)	-28.0	.058 (-24.763)	-58.0	.058 (-24.781)
-20.6	.206 (-13.731)	-28.2	.064 (-23.849)	-59.0	.045 (-26.897)
-20.8	.201 (-13.919)	-28.4	.07 (-23.046)	-60.0	.033 (-29.722)
-21.0	.197 (-14.127)	-28.6	.076 (-22.334)	-61.0	.02 (-33.851)
-21.2	.192 (-14.355)	-28.8	.082 (-21.699)	-62.0	.008 (-41.546)
-21.4	.186 (-14.603)	-29.0	.088 (-21.129)	-63.0	.003 (-50.638)
-21.6	.18 (-14.872)	-29.2	.093 (-20.615)	-64.0	.013 (-37.413)
-21.8	.174 (-15.164)	-29.4	.098 (-20.151)	-65.0	.023 (-32.727)
-22.0	.168 (-15.48)	-29.6	.103 (-19.73)	-66.0	.032 (-29.964)
-22.2	.162 (-15.82)	-29.8	.108 (-19.348)	-67.0	.039 (-28.097)
-22.4	.155 (-16.187)	-30.0	.112 (-19.002)	-68.0	.046 (-26.758)
-22.6	.148 (-16.583)	-31.0	.13 (-17.702)	-69.0	.051 (-25.775)
-22.8	.141 (-17.009)	-32.0	.142 (-16.965)	-70.0	.056 (-25.052)
-23.0	.134 (-17.468)	-33.0	.147 (-16.665)	-71.0	.059 (-24.528)
-23.2	.126 (-17.964)	-34.0	.145 (-16.744)	-72.0	.062 (-24.164)
-23.4	.119 (-18.501)	-35.0	.138 (-17.18)	-73.0	.064 (-23.934)
-23.6	.111 (-19.082)	-36.0	.126 (-17.985)	-74.0	.064 (-23.817)
-23.8	.103 (-19.714)	-37.0	.11 (-19.205)	-75.0	.065 (-23.799)
-24.0	.095 (-20.404)	-38.0	.09 (-20.946)	-76.0	.064 (-23.868)
-24.2	.087 (-21.16)	-39.0	.067 (-23.429)	-77.0	.063 (-24.017)
-24.4	.079 (-21.995)	-40.0	.044 (-27.201)	-78.0	.061 (-24.238)
-24.6	.071 (-22.925)	-41.0	.019 (-34.24)	-79.0	.059 (-24.527)
-24.8	.063 (-23.968)	-42.0	.004 (-47.008)	-80.0	.057 (-24.88)
-25.0	.055 (-25.157)	-43.0	.027 (-31.311)	-81.0	.054 (-25.297)
-25.2	.047 (-26.533)	-44.0	.048 (-26.353)	-82.0	.051 (-25.776)
-25.4	.039 (-28.164)	-45.0	.067 (-23.516)	-83.0	.048 (-26.32)
-25.6	.031 (-30.164)	-46.0	.083 (-21.666)	-84.0	.045 (-26.93)
-25.8	.023 (-32.747)	-47.0	.095 (-20.413)	-85.0	.042 (-27.613)
-26.0	.015 (-36.405)	-48.0	.105 (-19.577)	-86.0	.038 (-28.375)
-26.2	.007 (-42.754)	-49.0	.111 (-19.062)	-87.0	.035 (-29.23)
-26.4	.00 (-66.556)	-50.0	.115 (-18.812)	-88.0	.031 (-30.193)
-26.6	.008 (-41.809)	-51.0	.115 (-18.791)	-89.0	.027 (-31.289)
-26.8	.016 (-36.108)	-52.0	.112 (-18.981)	-90.0	.024 (-32.553)
-27.0	.023 (-32.743)	-53.0	.107 (-19.374)	90.0	.00 (-50)

Systems With Reliability

CLIENT: *KRNR / Alan Brown* Date: 3/4/2019

ANTENNA TYPE: FMEC/6-PLUS-0.75WS-DA

FREQUENCY: 100.5 MHz

PATTERN POL.: Circular

DIRECTIVITY(Peak): 5.513/7.414 dBd Beam Tilt (Deg.) : *0*

DIRECTIVITY(Horiz): 5.513/7.414 dBd Null Fill(s)(%) : *0, 0, 0*

Exhibit 5: Antenna Data Sheet

SYSTEMS WITH RELIABILITY, LP

BROADCAST ANTENNAS AND TRANSMISSION LINE

SYSTEM DATA SHEET

Customer	KRNR
Contact	Alan Brown
Location	Goldthwaite, TX
Antenna Model	FMEC/6-PLUS-0.75WS-DA
Channel / Frequency	263A/ 100.5 MHz

ELECTRICAL SPECIFICATIONS

Antenna Specifications:

	H-POL	dB		V. Pol.	dB	
License ERP (KW)	3.800			3.800		
FCC Limit Pattern Directivity	1.062	0.262	**dB**	1.062	0.262	**dB**
Elevation Directivity	5.513	7.414	**dB**	5.513	7.414	**dB**
Azimuth Directivity	1.700	2.305	**dB**	2.649	4.231	**dB**
Composite Pattern	1.441	1.587	**dB**	1.441	1.587	**dB**
Polarization Ratio	0.609			0.391		
Antenna Efficiency %	100			100		
Power Ratio (Pol. Ratio X Efficiency)	0.6091			0.3909		
Antenna Gain	5.709	7.565	**dB**	5.709	7.565	**dB**

MECHANICAL SPECIFICATIONS

No. Of Bays	6				
Antenna Aperture	36.70	**ft.**		11.19	**meter**
Center of Radiation AGL	148.00	**ft.**		45.11	**meter**
Antenna Weight (Everything)	295.00	**lbs.**		134.09	**kg**
Windload (50/33) - MAX	400.00	**lbs.**	**Windload CaAc**	11.43	**ft^2**

Prepared by:

Kevin W. Rager
SWR, LP ENGINEERING

Exhibit 6: RMS Calculations

SYSTEMS WITH RELIABILITY, LP
Broadcast Antennas and Transmission Systems

KRNR Antenna RMS Comparison

PROPOSED ANTENNA		DESIGNED ANTENNA	
Azimuth Heading	Relative Field	Azimuth Heading	Relative Field
0	1	0	0.838
10	1	10	0.871
20	1	20	0.933
30	1	30	0.931
40	1	40	0.891
50	1	50	0.856
60	1	60	0.824
70	1	70	0.798
80	1	80	0.784
90	1	90	0.785
100	1	100	0.751
110	1	110	0.756
120	1	120	0.750
130	1	130	0.729
140	1	140	0.706
150	0.84	150	0.672
160	0.665	160	0.596
170	0.698	170	0.516
180	0.786	180	0.459
190	0.811	190	0.522
200	1	200	0.678
210	1	210	0.839
220	1	220	0.955
230	1	230	1.000
240	1	240	0.986
250	1	250	0.962
260	1	260	0.895
270	1	270	0.852
280	1	280	0.882
290	1	290	0.950
300	1	300	0.983
310	1	310	0.975
320	1	320	0.948
330	1	330	0.941
340	1	340	0.931
350	1	350	0.897

Sum of Relative Field Squared :	**33.911**	**Sum of Relative Field Squared :**	**25.110**
Sum Divided by 36 (Readings) :	**0.942**	**Sum Divided by 36 (Readings) :**	**0.697**
Square Root :	**0.971**	**Square Root :**	**0.835**

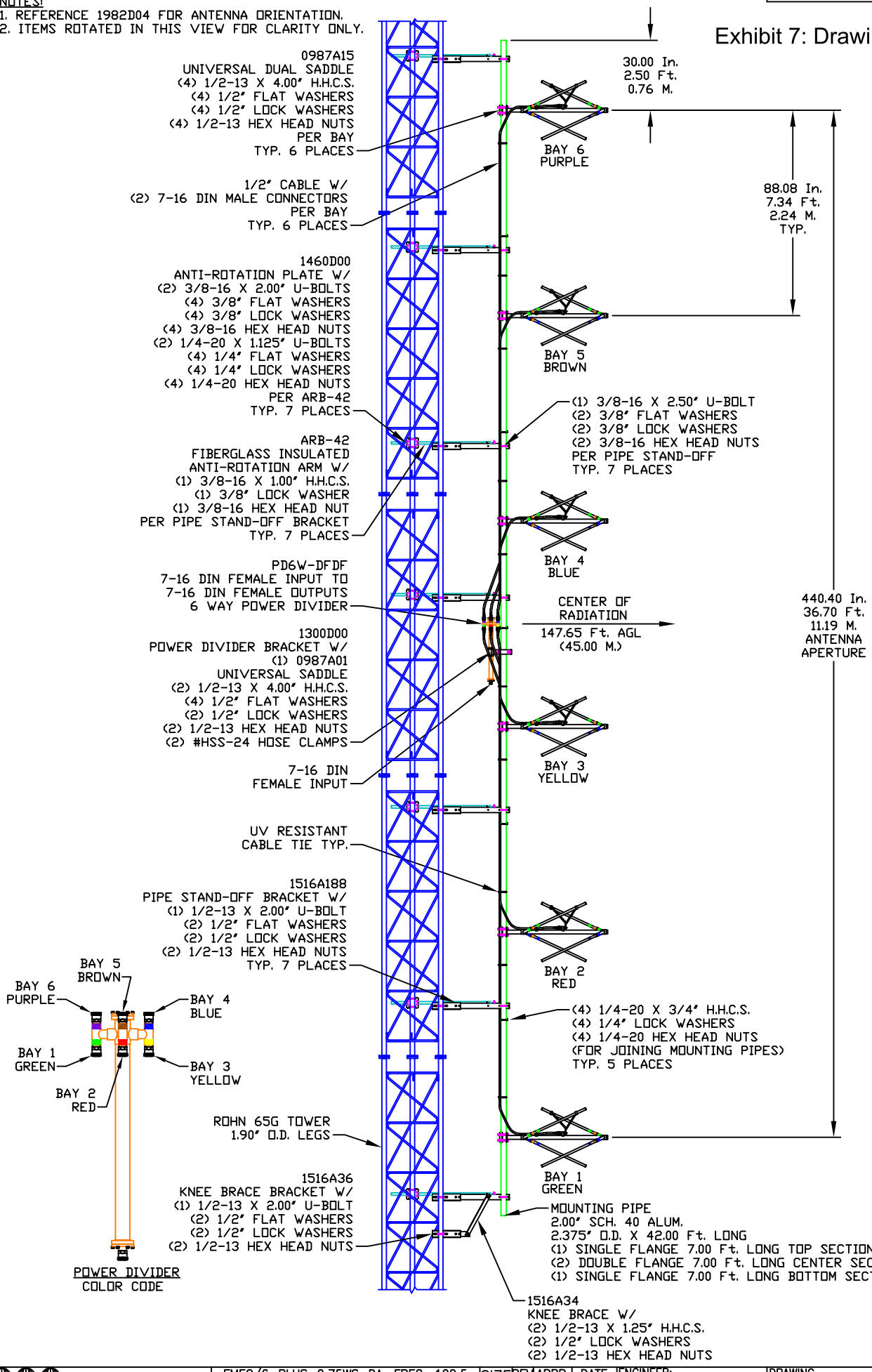
Percentage of Construction Permit Antenna Filled : **86.1%**

S.O. #18282

DRAWING NUMBER: 1982D03

NOTES:
1. REFERENCE 1982D04 FOR ANTENNA ORIENTATION.
2. ITEMS ROTATED IN THIS VIEW FOR CLARITY ONLY.

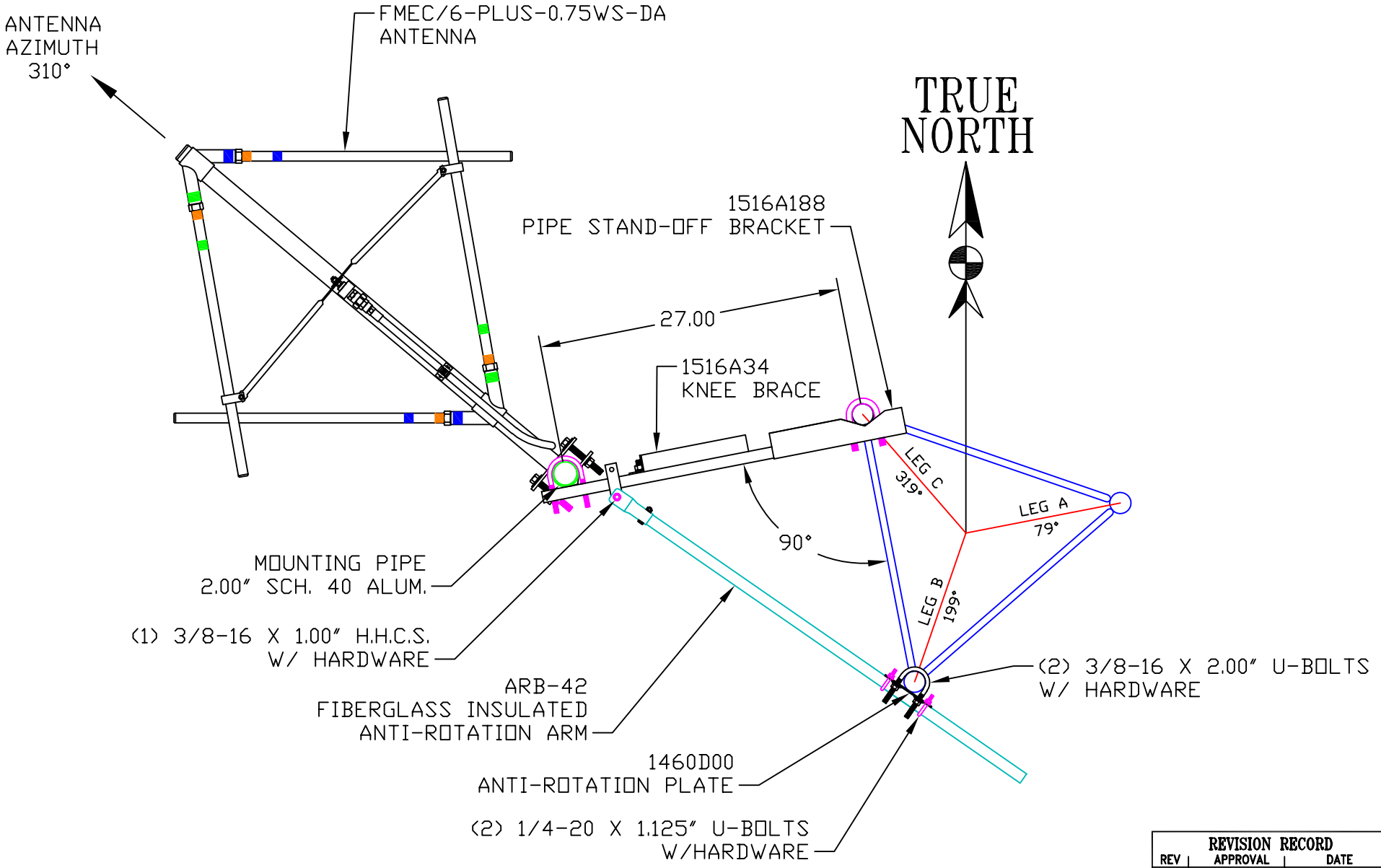
Exhibit 7: Drawings



SYSTEMS WITH RELIABILITY, LP 619 INDUSTRIAL PARK ROAD EBENSBURG, PENNSYLVANIA 15931	FMEC/6-PLUS-0.75WS-DA, FREQ. 100.5 KRNR, GOLDTHWAITE, TX	SIZE: C	REV / APPR. / DATE: 1 / 2 / 3	ENGINEER:	DRAWING NUMBER: 1982D03		
				SCALE: NTS	NAME: BJH	DATE: 3/13/19	SHEET 1 OF 1

NOTE: Exhibit 7 (cont'd): Drawings

DRAWING NUMBER: 1982D04



TOP VIEW

REVISION RECORD

REV	APPROVAL	DATE

SYSTEMS WITH RELIABILITY, LP
619 INDUSTRIAL PARK ROAD
EBENSBURG, PENNSYLVANIA 15931

TITLE: FMEC/6-PLUS-0.75WS-DA, FREQ. 100.5 KRNR, GOLDTHWAITE, TX

MATERIAL: ANTENNA ORIENTATION FROM TRUE NORTH

SIZE A

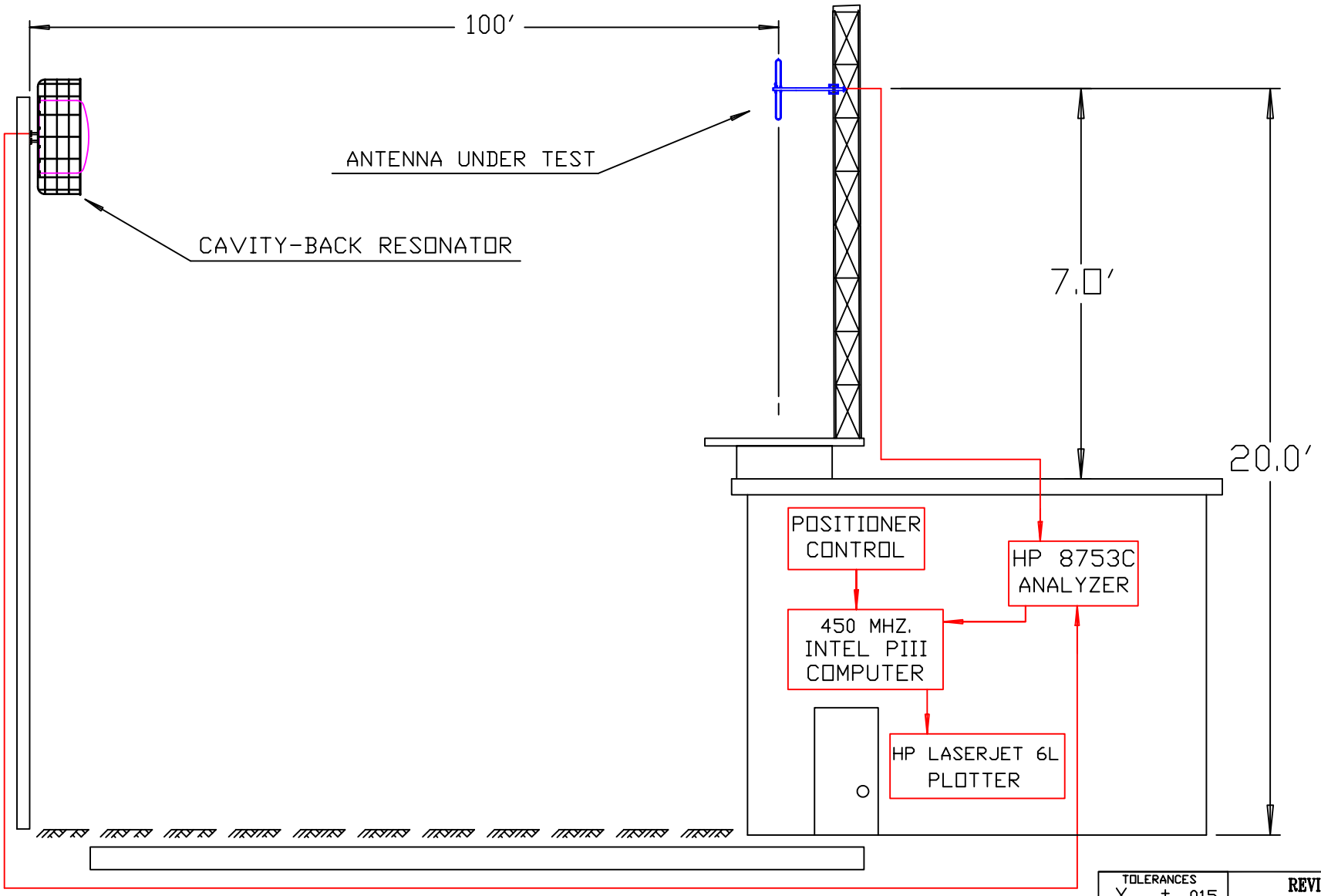
PARTS MADE BY THIS DRAWING

DRAWING NUMBER: 1982D04

SCALE: NTS | NAME: BJH | DATE: 3/13/19 | SHEET 1 OF 1

NOTE: Exhibit 7 (cont'd): Drawings

DRAWING NUMBER: 2105A10



TOLERANCES	
.X	± .015
.XX	± .005
.XXX	± .002
X/X	± 1/32
DEG.	± 1/2

UNLESS OTHERWISE SPECIFIED

REVISION RECORD

REV	APPROVAL	DATE
2		10/7/05
1		4/30/02

DRAWING NUMBER: 2105A10

SYSTEMS WITH RELIABILITY, INC
619 INDUSTRIAL PARK ROAD
EBENSBURG, PENNSYLVANIA 15931

TITLE: TEST RANGE SCHEMATIC

MATERIAL:

SIZE: A

PARTS MADE BY THIS DRAWING

SCALE: NTS | NAME: JRM | DATE: 11/1/98 | SHEET 1 OF 1