STEPHEN S. LOCKWOOD, PE, PMP
———
THOMAS M. ECKELS, PE
ERIK C. SWANSON, PE, PMP
THOMAS S. GORTON, PE
———
JAMES B. HATFIELD, PE
BENJAMIN F. DAWSON III, PE
STEPHEN PUMPLE, M.Eng, MBA, PMP
CONSULTANTS

HATFIELD & DAWSON
CONSULTING ELECTRICAL ENGINEERS
9500 GREENWOOD AVE. N.
SEATTLE, WASHINGTON 98103

TELEPHONE (206) 783-9151

E-MAIL hatdaw@hatdaw.com
———
MAURY L. HATFIELD, PE
(1942-2009)
PAUL W. LEONARD, PE
(1925-2011)

Engineering Statement
Minor Modification of CP for K20HB-D
Channel 17 at Billings, MT
April 2024

I. Background

This Engineering Statement has been prepared on behalf of Montana State University, licensee of low-power station K20HB-D Billings. K20HB-D holds a construction permit for displacement to Channel 17, FCC File No. 0000191689. This material has been prepared in connection with an application for minor modification of that construction permit, to adjust the antenna height on the tower.

II. Interference Study

Study has been made of all cochannel and adjacent-channel facilities in the vicinity of the proposed operation, including a detailed Longley-Rice interference study to demonstrate that the proposed operation will not cause interference to any authorized or pending proposed facilities. This study was performed using the Commission's TVStudy software.

This study was conducted using a study cell size of 1.0 km and a terrain extraction increment of 1.0 km.

The results of this study indicate that the proposed facility is predicted to cause zero additional interference to any of the listed stations, beyond the allowed values of 0.5% to full-power and Class A stations, and 2.0% to low-power stations. Based on the foregoing interference study, it is believed that the proposed facility can operate without risk of interference to other stations.

Study created: 2024.04.25 10:15:43

Study build station data: LMS TV 2024-04-25

```
    Proposal: K20HB-D D17+ LD APP BILLINGS, MT
 File number: K20HB-CH17-MOD
 Facility ID: 125475
Station data: User record
   Record ID: 1594
     Country: U.S.
```

Build options:
Protect pre-transition records not on baseline channel

Stations potentially affected by proposal:

IX	Call	Chan	Svc	Status	City, State	File Number	Distance
No	KBGS-TV	D16	DT	LIC	BILLINGS, MT	BLANK0000227445	0.0 km
No	K16NE-D	D16	LD	LIC	FORSYTH, MT	BLANK0000124956	149.4
No	K16DZ-D	D16	LD	LIC	HARDIN, MT	BLANK0000013267	71.5
No	K16DH-D	D16	LD	LIC	MILES CITY, MT	BLANK0000152874	214.4
No	KISU-TV	D17	DD	LIC	POCATELLO, ID	BLANK0000017402	417.0
No	KISU-TV	D17	DD	CP	POCATELLO, ID	BLANK0000243248	417.0
No	K17KB-D	D17	LD	LIC	BELGRADE, ETC., MT	BLDTT20120312ABX	218.6
Yes	K17JP-D	D17	LD	LIC	BIG TIMBER, ETC., MT	BLANK0000197923	179.4
No	KJJC-TV	D17	DT	LIC	GREAT FALLS, MT	BLANK0000063898	290.7
Yes	K17KZ-D	D17	LD	LIC	HARLOWTON, ETC, MT	BLDTT20120611ACB	145.3
No	KOOH-LD	D17	LD	LIC	HELENA, MT	BLANK0000185378	287.5
No	K17JS-D	D17	LD	LIC	PHILIPSBURG, MT	BLANK0000171357	374.0
No	K17OB-D	D17	LD	LIC	PLEVNA, MT	BLDTT20111229ABZ	310.8
No	K17MS-D	D17	LD	LIC	POPLAR, MT	BLANK0000067788	371.0
No	K17KU-D	D17	LD	LIC	SACO, MT	BLDTT20120514AEW	309.5
No	K17JZ-D	D17	LD	LIC	BONDURANT, WY	BLDTT20101203ABL	327.5
No	KTWO-TV	D17	DT	LIC	CASPER, WY	BLCDT20110315ABB	375.5
No	K17KC-D	D17	LD	LIC	MEETEETSE, WY	BLDTT20120601ASY	175.7
Yes	KSVI	D18	DT	LIC	BILLINGS, MT	BLCDT20090205ABS	10.1
No	K18MZ-D	D18	LD	LIC	FORSYTH, MT	BLANK0000124963	148.3

No non-directional AM stations found within 0.8 km

No directional AM stations found within 3.2 km

Record parameters as studied:

```
    Channel: D17+
       Mask: Full Service
   Latitude:  45 46  0.90 N (NAD83)
  Longitude: 108 27 28.80 W
Height AMSL: 1192.7 m
       HAAT: 0.0 m
   Peak ERP: 15.0 kW
    Antenna: Omnidirectional
Elev Pattrn: Generic
  Elec Tilt: 1.00
```

49.0 dBu contour:

Azimuth	ERP	HAAT	Distance
0.0 deg	15.0 kW	204.4 m	52.3 km
45.0	15.0	181.6	51.0
90.0	15.0	108.3	45.9
135.0	15.0	91.8	43.9
180.0	15.0	67.5	40.3
225.0	15.0	128.5	47.5
270.0	15.0	213.5	52.8
315.0	15.0	156.4	49.4

Database HAAT does not agree with computed HAAT

```
Database HAAT: 0 m   Computed HAAT: 144 m

Distance to Canadian border: 359.3 km

Distance to Mexican border: 1546.0 km

Conditions at FCC monitoring station: Grand Island NE
Bearing: 120.1 degrees   Distance: 972.1 km

Proposal is not within the West Virginia quiet zone area

Conditions at Table Mountain receiving zone:
Bearing: 156.2 degrees   Distance: 676.1 km

No land mobile station failures found

Proposal is not within the Offshore Radio Service protected area


Study cell size: 1.00 km
Profile point spacing: 1.00 km

Maximum new IX to full-service and Class A: 0.50%
Maximum new IX to LPTV: 2.00%


---- Below is IX received by proposal K20HB-CH17-MOD ----

Proposal receives 2.83% interference from scenario 1
No IX check failures found.
```

III. RF Exposure Study

The power density calculations shown below were made using the techniques outlined in OET Bulletin No. 65. "Ground level" calculations in this report have been made at a reference height of 2 meters above ground to provide a worst-case estimate of exposure for persons standing on the ground in the vicinity of the tower. The equation shown below was used to calculate the ground level power density figures from each antenna.

$$S(\mu W / cm^2) = \frac{33.4 \times AdjERP(Watts)}{D^2}$$

Where: *AdjERP(Watts)* is the maximum lobe effective radiated power times the element pattern factor times the array pattern factor.

D is the distance in meters from the center of radiation to the calculation point.

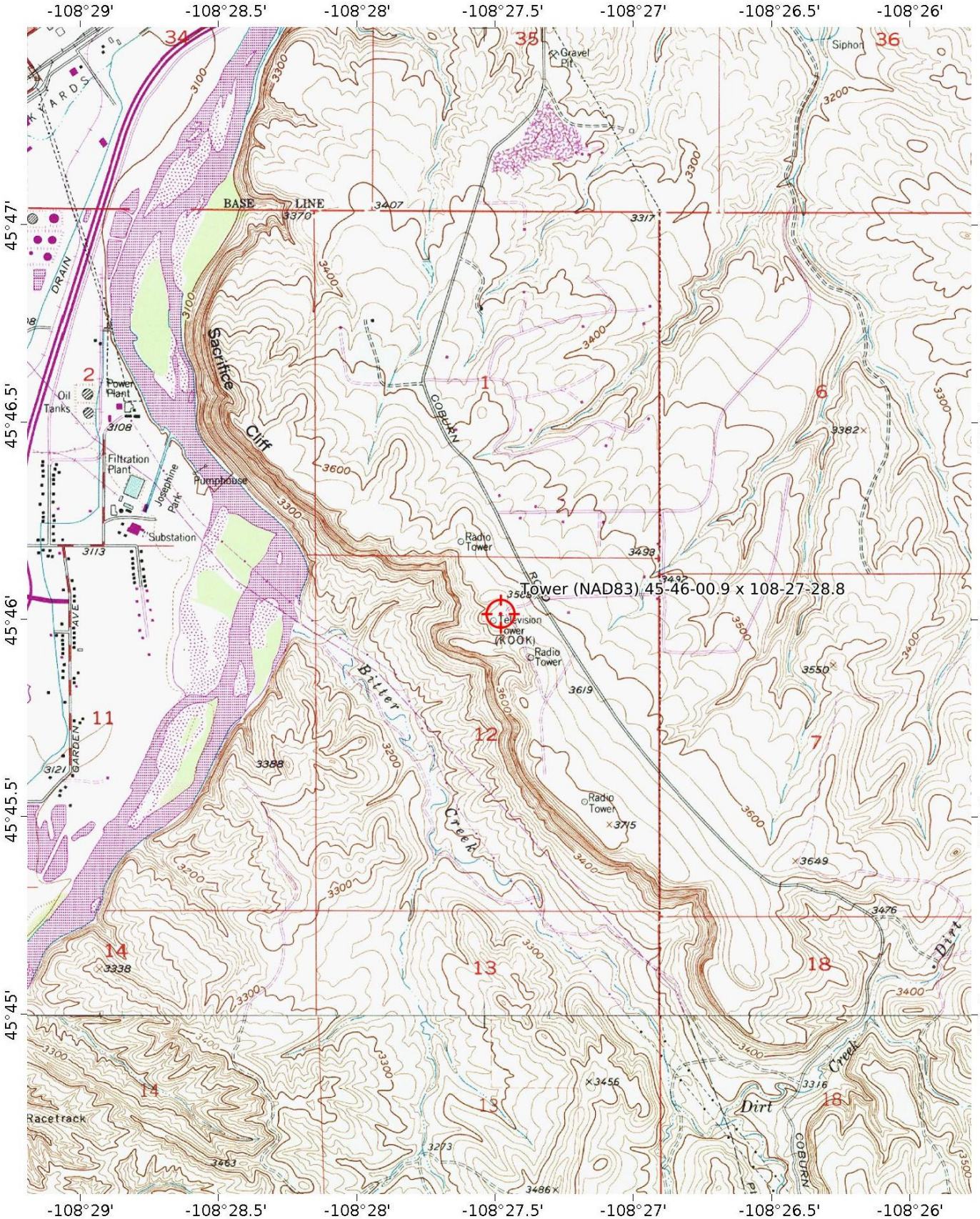
Power density levels produced by the proposed facility were calculated for an elevation of 2 meters above ground (i.e. 72.7 meters below the antenna radiation center), based on the manufacturer's vertical plane pattern for the elliptically-polarized Dielectric model TFU-16DSB/VP-R-A antenna proposed in this application. This antenna has a 70/30 power split (for 15 kW horizontal and 6.44 kW vertical).

The worst case power density levels occur at depression angles between 45 and 90 degrees below the horizontal. The calculations in this report assume a worst-case relative field value of 0.185 at these angles, based on the manufacturer's vertical plane pattern for the antenna proposed in this application. This relative field value yields a worst-case adjusted effective radiated power of 734 watts at depression angles between 45 and 90 degrees below the horizontal. Assuming this power and the shortest distance between the antenna radiation center and 2 meters above ground level (i.e. straight down), the highest calculated power density from the proposed antenna alone occurs at the base of the antenna support structure. At this point the power density is calculated to be 4.6 $\mu W/cm^2$, which is 1.4% of 325 $\mu W/cm^2$ (the FCC maximum for uncontrolled environments at the Channel 17 frequency).

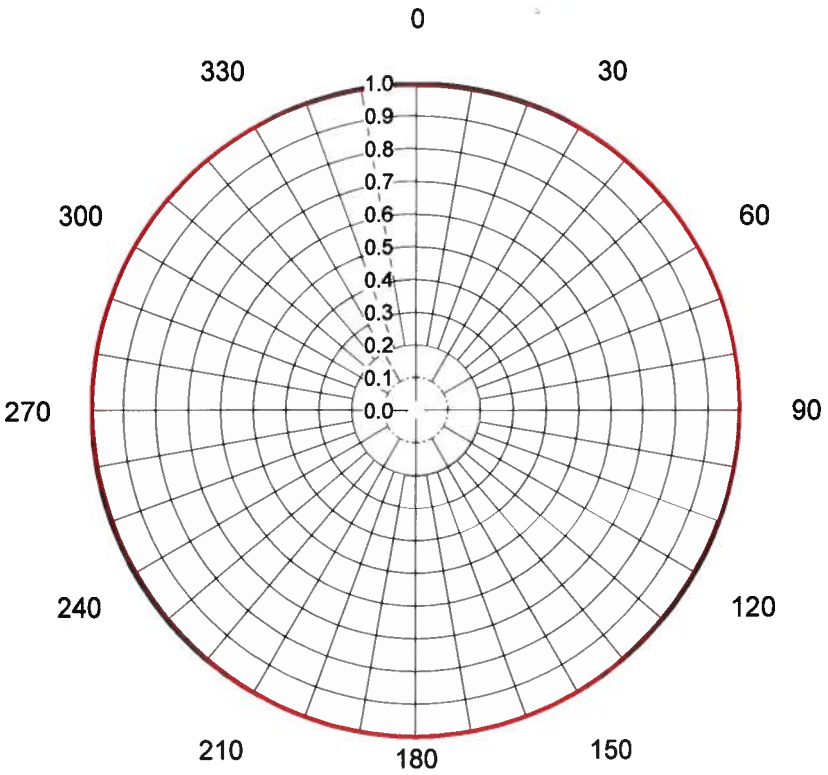
These calculations show that the maximum calculated power density produced at two meters above ground level by the proposed operation alone is less than 5% of the applicable FCC exposure limit at all locations between 1 and 500 meters from the base of the antenna support structure. Section 1.1307 of the Commission's Rules exempts applications for new facilities or modifications to existing facilities from the requirement of preparing an environmental assessment when the calculated emissions from the applicant's proposed facility are predicted to be less than 5% of the applicable FCC exposure limit. Therefore, the proposed facility is in compliance with Section 1.1301 *et seq* and no further analysis of RF exposure at this site is required in this application.

Pursuant to OET Bulletin No. 65, all station personnel and contractors are required to follow appropriate safety procedures before any work is commenced on the antenna tower, including reduction in power or discontinuance of operation before any maintenance work is undertaken. The permittee/licensee in coordination with other users of the site must reduce power or cease operation as necessary to protect persons having access to the site, tower or antenna from radiofrequency exposure in excess of FCC guidelines.

April 25, 2024
Erik C. Swanson, P.E.



Hatfield & Dawson Consulting Engineers

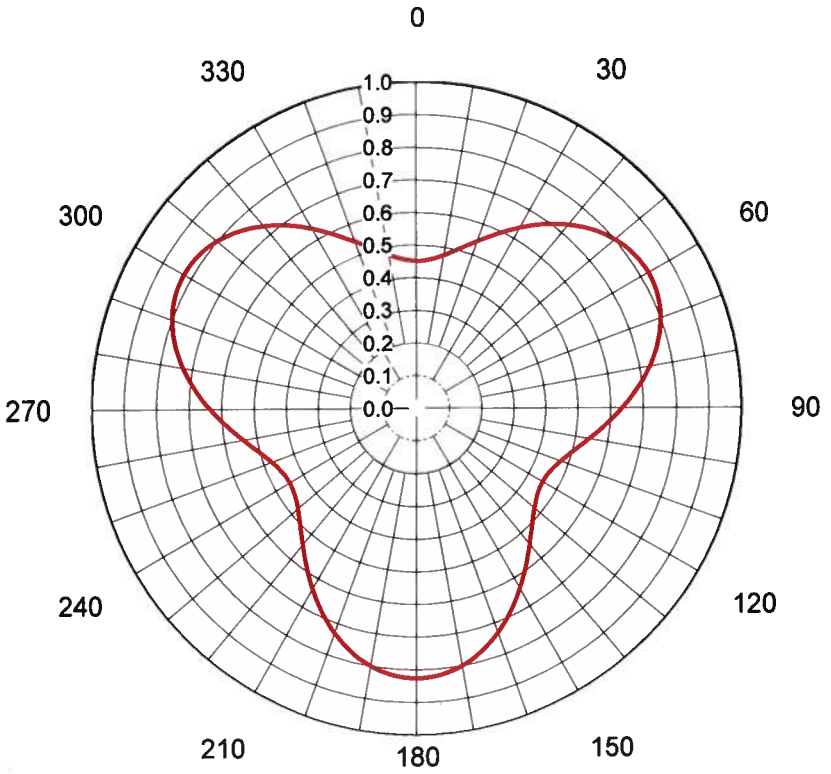


AZIMUTH PATTERN
Horizontal Polarization

In Free Space

Proposal No.	**C-71042-3**
Date	**10-May-22**
Call Letters	**0**
Channel	**17**
Frequency	**491 MHz**
Antenna Type	**TFU-16DSB/VP-R-A**
Gain	**1.01 (0.03dB)**
	Calculated
Circularity	**+/- 1.0 dB**

Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value
0	0.994	36	0.998	72	0.999	108	0.994	144	0.996	180	1.000	216	0.996	252	0.994	288	0.999	324	0.998
1	0.994	37	0.998	73	0.999	109	0.994	145	0.996	181	1.000	217	0.996	253	0.994	289	0.999	325	0.998
2	0.994	38	0.998	74	0.999	110	0.994	146	0.996	182	1.000	218	0.995	254	0.995	290	1.000	326	0.997
3	0.994	39	0.998	75	0.999	111	0.994	147	0.996	183	1.000	219	0.995	255	0.995	291	1.000	327	0.997
4	0.994	40	0.998	76	0.999	112	0.994	148	0.996	184	1.000	220	0.995	256	0.995	292	1.000	328	0.997
5	0.994	41	0.998	77	0.999	113	0.994	149	0.997	185	1.000	221	0.995	257	0.995	293	1.000	329	0.997
6	0.994	42	0.999	78	0.999	114	0.994	150	0.997	186	1.000	222	0.995	258	0.995	294	1.000	330	0.997
7	0.994	43	0.999	79	0.998	115	0.994	151	0.997	187	1.000	223	0.995	259	0.995	295	1.000	331	0.997
8	0.994	44	0.999	80	0.998	116	0.994	152	0.997	188	1.000	224	0.995	260	0.995	296	1.000	332	0.996
9	0.994	45	0.999	81	0.998	117	0.994	153	0.997	189	1.000	225	0.995	261	0.995	297	1.000	333	0.996
10	0.994	46	0.999	82	0.998	118	0.994	154	0.997	190	1.000	226	0.995	262	0.995	298	1.000	334	0.996
11	0.994	47	0.999	83	0.998	119	0.994	155	0.998	191	0.999	227	0.994	263	0.996	299	1.000	335	0.996
12	0.994	48	0.999	84	0.998	120	0.994	156	0.998	192	0.999	228	0.994	264	0.996	300	1.000	336	0.996
13	0.994	49	0.999	85	0.998	121	0.994	157	0.998	193	0.999	229	0.994	265	0.996	301	1.000	337	0.996
14	0.995	50	1.000	86	0.997	122	0.994	158	0.998	194	0.999	230	0.994	266	0.996	302	1.000	338	0.995
15	0.995	51	1.000	87	0.997	123	0.994	159	0.998	195	0.999	231	0.994	267	0.996	303	1.000	339	0.995
16	0.995	52	1.000	88	0.997	124	0.994	160	0.998	196	0.999	232	0.994	268	0.996	304	1.000	340	0.995
17	0.995	53	1.000	89	0.997	125	0.994	161	0.998	197	0.999	233	0.994	269	0.997	305	1.000	341	0.995
18	0.995	54	1.000	90	0.997	126	0.994	162	0.999	198	0.999	234	0.994	270	0.997	306	1.000	342	0.995
19	0.995	55	1.000	91	0.997	127	0.994	163	0.999	199	0.998	235	0.994	271	0.997	307	1.000	343	0.995
20	0.995	56	1.000	92	0.996	128	0.994	164	0.999	200	0.998	236	0.994	272	0.997	308	1.000	344	0.995
21	0.995	57	1.000	93	0.996	129	0.994	165	0.999	201	0.998	237	0.994	273	0.997	309	1.000	345	0.995
22	0.995	58	1.000	94	0.996	130	0.994	166	0.999	202	0.998	238	0.994	274	0.997	310	1.000	346	0.995
23	0.996	59	1.000	95	0.996	131	0.994	167	0.999	203	0.998	239	0.994	275	0.998	311	0.999	347	0.994
24	0.996	60	1.000	96	0.996	132	0.994	168	0.999	204	0.998	240	0.994	276	0.998	312	0.999	348	0.994
25	0.996	61	1.000	97	0.996	133	0.994	169	0.999	205	0.998	241	0.994	277	0.998	313	0.999	349	0.994
26	0.996	62	1.000	98	0.995	134	0.995	170	1.000	206	0.997	242	0.994	278	0.998	314	0.999	350	0.994
27	0.996	63	1.000	99	0.995	135	0.995	171	1.000	207	0.997	243	0.994	279	0.998	315	0.999	351	0.994
28	0.996	64	1.000	100	0.995	136	0.995	172	1.000	208	0.997	244	0.994	280	0.998	316	0.999	352	0.994
29	0.997	65	1.000	101	0.995	137	0.995	173	1.000	209	0.997	245	0.994	281	0.998	317	0.999	353	0.994
30	0.997	66	1.000	102	0.995	138	0.995	174	1.000	210	0.997	246	0.994	282	0.999	318	0.999	354	0.994
31	0.997	67	1.000	103	0.995	139	0.995	175	1.000	211	0.997	247	0.994	283	0.999	319	0.998	355	0.994
32	0.997	68	1.000	104	0.995	140	0.995	176	1.000	212	0.996	248	0.994	284	0.999	320	0.998	356	0.994
33	0.997	69	1.000	105	0.995	141	0.995	177	1.000	213	0.996	249	0.994	285	0.999	321	0.998	357	0.994
34	0.997	70	1.000	106	0.995	142	0.995	178	1.000	214	0.996	250	0.994	286	0.999	322	0.998	358	0.994
35	0.998	71	0.999	107	0.994	143	0.996	179	1.000	215	0.996	251	0.994	287	0.999	323	0.998	359	0.994



AZIMUTH PATTERN
Vertical Polarization

In Free Space

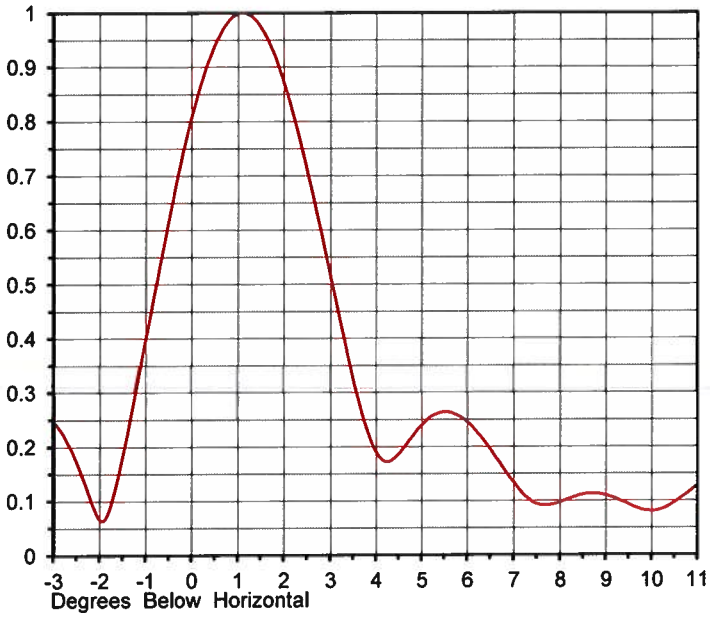
Proposal No.	**C-71042-3**
Date	**10-May-22**
Call Letters	**0**
Channel	**17**
Frequency	**491 MHz**
Antenna Type	**TFU-16DSB/VP-R-A**
Gain	**1.61 (2.07dB)**
	Calculated
Circularity	**+/- 3.0 dB**

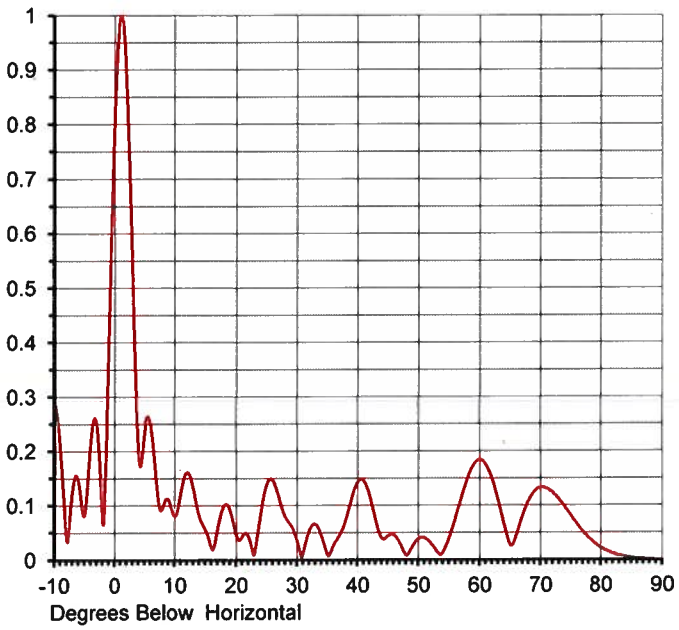
Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value	Deg	Value
0	0.451	36	0.695	72	0.790	108	0.486	144	0.579	180	0.826	216	0.579	252	0.486	288	0.790	324	0.695
1	0.451	37	0.704	73	0.784	109	0.480	145	0.588	181	0.826	217	0.569	253	0.492	289	0.795	325	0.685
2	0.452	38	0.713	74	0.777	110	0.475	146	0.598	182	0.825	218	0.560	254	0.498	290	0.801	326	0.676
3	0.453	39	0.722	75	0.770	111	0.471	147	0.607	183	0.824	219	0.552	255	0.505	291	0.805	327	0.666
4	0.455	40	0.731	76	0.763	112	0.467	148	0.617	184	0.822	220	0.543	256	0.512	292	0.810	328	0.656
5	0.457	41	0.740	77	0.756	113	0.463	149	0.627	185	0.820	221	0.535	257	0.519	293	0.813	329	0.647
6	0.460	42	0.748	78	0.748	114	0.460	150	0.637	186	0.817	222	0.527	258	0.527	294	0.817	330	0.637
7	0.463	43	0.756	79	0.740	115	0.457	151	0.647	187	0.813	223	0.519	259	0.535	295	0.820	331	0.627
8	0.467	44	0.763	80	0.731	116	0.455	152	0.656	188	0.810	224	0.512	260	0.543	296	0.822	332	0.617
9	0.471	45	0.770	81	0.722	117	0.453	153	0.666	189	0.805	225	0.505	261	0.552	297	0.824	333	0.607
10	0.475	46	0.777	82	0.713	118	0.452	154	0.676	190	0.801	226	0.498	262	0.560	298	0.825	334	0.598
11	0.480	47	0.784	83	0.704	119	0.451	155	0.685	191	0.795	227	0.492	263	0.569	299	0.826	335	0.588
12	0.486	48	0.790	84	0.695	120	0.451	156	0.695	192	0.790	228	0.486	264	0.579	300	0.826	336	0.579
13	0.492	49	0.795	85	0.685	121	0.451	157	0.704	193	0.784	229	0.480	265	0.588	301	0.826	337	0.569
14	0.498	50	0.801	86	0.676	122	0.452	158	0.713	194	0.777	230	0.475	266	0.598	302	0.825	338	0.560
15	0.505	51	0.805	87	0.666	123	0.453	159	0.722	195	0.770	231	0.471	267	0.607	303	0.824	339	0.552
16	0.512	52	0.810	88	0.656	124	0.455	160	0.731	196	0.763	232	0.467	268	0.617	304	0.822	340	0.543
17	0.519	53	0.813	89	0.647	125	0.457	161	0.740	197	0.756	233	0.463	269	0.627	305	0.820	341	0.535
18	0.527	54	0.817	90	0.637	126	0.460	162	0.748	198	0.748	234	0.460	270	0.637	306	0.817	342	0.527
19	0.535	55	0.820	91	0.627	127	0.463	163	0.756	199	0.740	235	0.457	271	0.647	307	0.813	343	0.519
20	0.543	56	0.822	92	0.617	128	0.467	164	0.763	200	0.731	236	0.455	272	0.656	308	0.810	344	0.512
21	0.552	57	0.824	93	0.607	129	0.471	165	0.770	201	0.722	237	0.453	273	0.666	309	0.805	345	0.505
22	0.560	58	0.825	94	0.598	130	0.475	166	0.777	202	0.713	238	0.452	274	0.676	310	0.801	346	0.498
23	0.569	59	0.826	95	0.588	131	0.480	167	0.784	203	0.704	239	0.451	275	0.685	311	0.795	347	0.492
24	0.579	60	0.826	96	0.579	132	0.486	168	0.790	204	0.695	240	0.451	276	0.695	312	0.790	348	0.486
25	0.588	61	0.826	97	0.569	133	0.492	169	0.795	205	0.685	241	0.451	277	0.704	313	0.784	349	0.480
26	0.598	62	0.825	98	0.560	134	0.498	170	0.801	206	0.676	242	0.452	278	0.713	314	0.777	350	0.475
27	0.607	63	0.824	99	0.552	135	0.505	171	0.805	207	0.666	243	0.453	279	0.722	315	0.770	351	0.471
28	0.617	64	0.822	100	0.543	136	0.512	172	0.810	208	0.656	244	0.455	280	0.731	316	0.763	352	0.467
29	0.627	65	0.820	101	0.535	137	0.519	173	0.813	209	0.647	245	0.457	281	0.740	317	0.756	353	0.463
30	0.637	66	0.817	102	0.527	138	0.527	174	0.817	210	0.637	246	0.460	282	0.748	318	0.748	354	0.460
31	0.647	67	0.813	103	0.519	139	0.535	175	0.820	211	0.627	247	0.463	283	0.756	319	0.740	355	0.457
32	0.656	68	0.810	104	0.512	140	0.543	176	0.822	212	0.617	248	0.467	284	0.763	320	0.731	356	0.455
33	0.666	69	0.805	105	0.505	141	0.552	177	0.824	213	0.607	249	0.471	285	0.770	321	0.722	357	0.453
34	0.676	70	0.801	106	0.498	142	0.560	178	0.825	214	0.598	250	0.475	286	0.777	322	0.713	358	0.452
35	0.685	71	0.795	107	0.492	143	0.569	179	0.826	215	0.588	251	0.480	287	0.784	323	0.704	359	0.451

ELEVATION PATTERN

Proposal No.	**C-71042-3**
Date	**10-May-22**
Call Letters	**0**
Channel	**17**
Frequency	**491 MHz**
Antenna Type	**TFU-16DSB/VP-R-A**

RMS Directivity at Main Lobe	**15.8 (11.99 dB)**	Beam Tilt	**1.00 deg**
RMS Directivity at Horizontal	**11.2 (10.49 dB)**	Pattern Number	**16B158100**
	Calculated		





Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field
-10.0	0.287	10.0	0.082	30.0	0.029	50.0	0.040	70.0	0.134
-9.0	0.177	11.0	0.134	31.0	0.021	51.0	0.041	71.0	0.131
-8.0	0.034	12.0	0.161	32.0	0.058	52.0	0.030	72.0	0.122
-7.0	0.141	13.0	0.125	33.0	0.065	53.0	0.014	73.0	0.109
-6.0	0.133	14.0	0.076	34.0	0.041	54.0	0.017	74.0	0.094
-5.0	0.095	15.0	0.053	35.0	0.008	55.0	0.046	75.0	0.079
-4.0	0.231	16.0	0.020	36.0	0.030	56.0	0.083	76.0	0.064
-3.0	0.236	17.0	0.065	37.0	0.048	57.0	0.122	77.0	0.051
-2.0	0.066	18.0	0.102	38.0	0.077	58.0	0.156	78.0	0.039
-1.0	0.446	19.0	0.086	39.0	0.118	59.0	0.178	79.0	0.030
0.0	0.841	20.0	0.042	40.0	0.146	60.0	0.185	80.0	0.022
1.0	1.000	21.0	0.047	41.0	0.144	61.0	0.172	81.0	0.016
2.0	0.842	22.0	0.040	42.0	0.112	62.0	0.144	82.0	0.012
3.0	0.471	23.0	0.021	43.0	0.066	63.0	0.103	83.0	0.008
4.0	0.178	24.0	0.095	44.0	0.039	64.0	0.057	84.0	0.006
5.0	0.249	25.0	0.144	45.0	0.046	65.0	0.027	85.0	0.004
6.0	0.237	26.0	0.143	46.0	0.045	66.0	0.052	86.0	0.003
7.0	0.122	27.0	0.106	47.0	0.028	67.0	0.087	87.0	0.002
8.0	0.101	28.0	0.076	48.0	0.009	68.0	0.112	88.0	0.001
9.0	0.107	29.0	0.060	49.0	0.027	69.0	0.128	89.0	0.000
								90.0	0.000

Summary

Proposal No.	**C-71042-3**
Date	**10-May-22**
Call Letters	**0**
Channel	**17**
Frequency	**491 MHz**
Antenna Type	**TFU-16DSB/VP-R-A**

Antenna

	Hpol		Vpol	
ERP:	**15.0 kW**	**(11.76 dBk)**	**6.44 kW**	**(8.09 dBk)**
RMS Gain*	11.05	(10.44 dB)	4.75	(6.76 dB)

Antenna Input Power **1.36 kW** **(1.33 dBk)**

Transmission Line

Type:	**Flexline Air**	Attenuation:	**(1.63 dB)**
Size:	**3"**	Efficiency:	**68.8%**
Impedance:	**50 Ohm**		
Length:	**453 ft**	**138.1 m**	

Transmitter Output

1.97 kW **(2.95 dBk)**

Transmitter filter losses not included

* Directivity and Gain are with respect to half wave dipole. The gain includes feed system losses