APPLICATION FOR LICENSE
INFORMATION
RADIO STATION WCPT
WILLOW SPRINGS, ILLINOIS

April 6, 2010

820 KHZ 5 KW – D 1.5 KW - N U DA-N

APPLICATION FOR LICENSE
INFORMATION
RADIO STATION WCPT
WILLOW SPRINGS, ILLINOIS

820 KHZ 5 KW - D 1.5 KW – N U DA-N

Table of Contents

Executive Summary - WCPT

This engineering exhibit supports an application for license for the newly constructed nighttime directional antenna system of radio station WCPT in Willow Springs, Illinois. WCPT is presently licensed to operate daytime (from local sunrise at Chicago, Illinois until local sunset at Grapevine, Texas) on 820 kilohertz with 5 kilowatts and a nondirectional antenna. Construction Permit BP-20050725ACV authorizes operation nighttime (from local sunset at Grapevine, Texas until local sunrise at Chicago, Illinois) with 1.5 kilowatts and a six-tower directional antenna system at a separate transmitter site.

The towers and ground system have been constructed in accordance with the terms of the construction permit and specifications that were provided in the application for construction permit. The directional antenna phasing and coupling equipment has been adjusted to produce the nighttime directional antenna pattern authorized by the construction permit.

Tower 6 supports an STL receiving antenna at approximately 280 feet above ground level. A coaxial transmission line that is bonded to tower potential connects the antenna to an isocoupler at the base of the tower, through which the signal is carried on to receiving equipment.

Information is provided herein demonstrating that the directional antenna parameters have been determined in accordance with the requirements of section 73.151(c) of the FCC Rules. The antenna system has been adjusted to produce antenna monitor parameters within +/- 5 percent in ratio and +/- 3 degrees in phase of the modeled values, as required by the Rules.

Information regarding direct measurement of power, radiofrequency radiation protection measures at the site and the detuning of a nearby communications tower is also included herein.

Program test authority for the nighttime directional antenna is hereby requested.

Ronald D. Rackley, P.E.
April 6, 2010

Analysis of Tower Impedance Measurements to Verify Method of Moments Model - WCPT

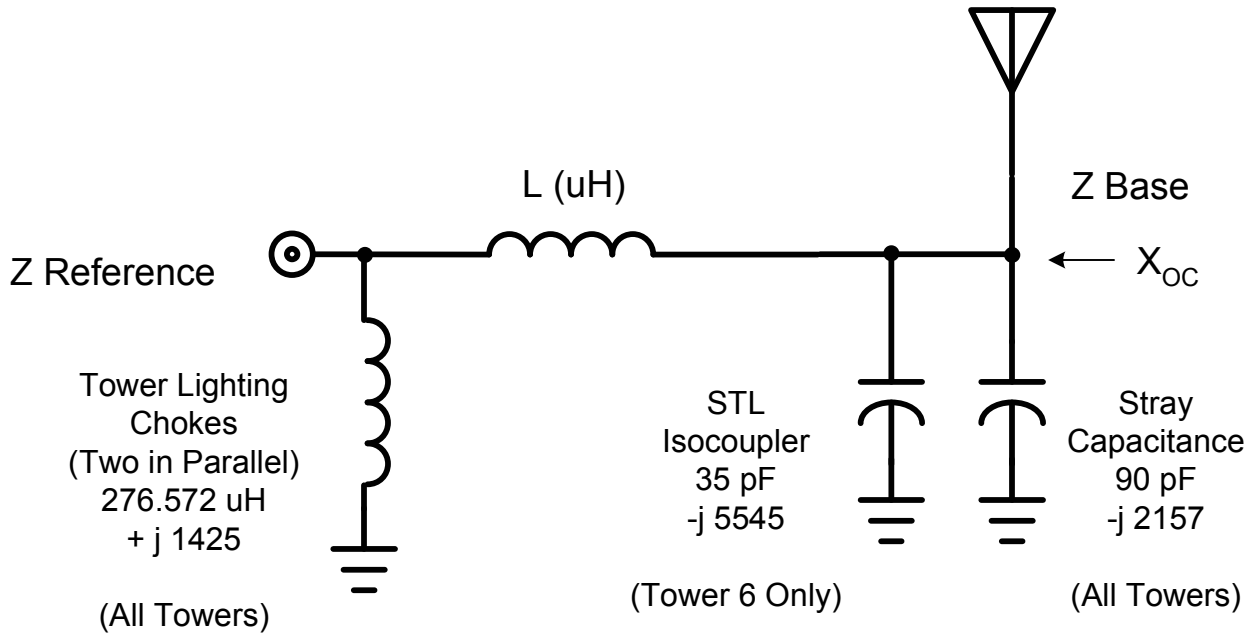
Tower base impedance measurements were made at the final J-plugs within the antenna tuning units ("ATUs") using a Hewlett-Packard 8751A network analyzer and a Tunwall Radio directional coupler in a calibrated measurement system. The other towers were all open circuited at the same points where impedance measurements were made for them (the "reference points") for each of the measurements.

The reference point at each tower is adjacent to the sampling transformer of the antenna monitor system at the output of the ATU enclosure. The current passes directly from that point over conductors through the enclosure insulator and on to the tower above the base insulator. There are no adjustable shunt components following the sampling transformers. An assumed value for the sum of the base insulator and base region stray capacitances and the measured reactance of the two parallel tower lighting chokes (one 3-wire choke and one 4-wire choke) across the ATU output were employed in the base circuit calculations for each tower. In addition, a capacitance representing the STL isocoupler across the base of tower 6 was included in the analysis. Circuit calculations were performed to relate the method of moments modeled impedances of the tower feedpoints to the ATU output measurement (reference) points as shown on the following pages. The Xoc shown for each tower, which was calculated for the assumed base conditions, was used in the method of moments model as a load at ground level for the open circuited case.

In addition to the page showing the schematic of the assumed circuit and tabulation of calculated values, pages showing the results of calculations using the WCAP network analysis program from Westberg Consulting are provided. WCAP performs such calculations using nodal analysis, as do other modern circuit analysis programs such as the commonly available ones based on SPICE software.

In each of the WCAP tabulations, node 2 represents the ATU output reference point and node 3 represents the tower feedpoint. Node 0 represents ground potential. The numerals in the file names shown on the tabulations correspond to the tower numbers. It should be noted that the calculated reference point impedances appear under the "TO NODE IMPEDANCE" columns of the WCAP tabulations, following the phantom 1.0 ohm resistors (R 1 - 2) that were included in series with the drive current sources (I 0 -1)) to provide calculation points for the impedances. The tower base impedances from the method of moments model are represented by complex loads from node 3 to ground (R 3 - 0). The shunt capacitive reactances shown for the towers on the schematic were used for the calculations, although they only appear to the nearest 0.0001 microfarad on the WCAP printout due to rounding.

The modeled and measured base impedances at the ATU output jacks with the other towers open circuited at their filter unit output jacks agree within +/- 2 ohms and +/- 4 percent for resistance and reactance, as required by the FCC Rules.



TOWER	L (uH)	X_L	X_{OC}	Z Base (Modeled)	Z Reference (Modeled)	Z Reference (Measured)
1	1.708	+ j 8.8	+ j 4276	51.37 +j 53.24	49.5 +j 61.3	50.4 +j 61.3
2	2.659	+ j 13.7	+ j 4320	47.91 +j 45.45	46.0 +j 58.2	46.2 +j 58.2
3	3.008	+ j 15.5	+ j 4337	50.82 +j 46.56	48.7 +j 61.0	49.0 +j 61.0
4	2.193	+ j 11.3	+ j 4299	51.44 +j 52.73	49.4 +j 63.1	50.3 +j 63.1
5	3.377	+ j 17.4	+ j 4354	46.66 +j43.40	44.6 +j59.6	45.2 +j59.6
6	5.512	+j 28.4	+ j 22662	48.81 +j41.03	46.8 +j67.3	47.3 +j67.3

ANALYSIS OF TOWER IMPEDANCE MEASUREMENTS TO VERIFY METHOD OF MOMENTS MODEL

RADIO STATION WCPT
WILLOW SPRINGS, ILLINOIS
820 KHZ 5 KW-D 1.5 KW-N U DA-N

du Treil, Lundin & Rackley, Inc. Sarasota, Florida

Tower 1 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt1oc.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     1.7080    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    51.3680    3    0   53.2440     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE       VOLT MAG     VOLT PHASE
    1         79.4015        50.5122
    2         78.7693        51.0735
    3         72.6206        46.7069
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     50.49     61.28     49.49     61.28
 L    2-  0   276.572     78.77    51.074       .06   -38.926       .00   1424.96       .00       .00
 L    2-  3     1.708      8.43    92.079       .96     2.079     53.97     62.07     53.97     53.27
 C    3-  0      .000     72.62    46.707       .03   136.707       .00  -2156.57       .00       .00
 R    3-  0    51.368     72.62    46.707       .98      .680     51.37     53.24       .00       .00
```

Tower 2 Individually Driven Base Circuit Analysis

```
 WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = WCPT2OC.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     2.6590    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    47.9090    3    0   45.4500     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE       VOLT MAG     VOLT PHASE
    1         74.8209        51.0632
    2         74.1965        51.6639
    3         64.7242        44.1198
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     47.02     58.20     46.02     58.20
 L    2-  0   276.572     74.20    51.664       .05   -38.336       .00   1424.96       .00       .00
 L    2-  3     2.659     13.15    91.929       .96     1.929     49.97     58.99     49.97     45.29
 C    3-  0      .000     64.72    44.120       .03   134.120       .00  -2156.57       .00       .00
 R    3-  0    47.909     64.72    44.120       .98      .629     47.91     45.45       .00       .00
```

Tower 3 Individually Driven Base Circuit Analysis

```
 WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt3oc.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     3.0080    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    50.8220    3    0   46.5610     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE       VOLT MAG     VOLT PHASE
    1         78.6503        50.8303
    2         78.0226        51.3997
    3         67.4559        43.1587
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     49.68     60.98     48.68     60.98
 L    2-  0   276.572     78.02    51.400       .05   -38.600       .00   1424.96       .00       .00
 L    2-  3     3.008     14.84    92.044       .96     2.044     53.06     61.81     53.06     46.31
 C    3-  0      .000     67.46    43.159       .03   133.159       .00  -2156.57       .00       .00
 R    3-  0    50.822     67.46    43.159       .98      .664     50.82     46.56       .00       .00
```

Tower 4 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt4oc.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     2.1930    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    51.4390    3    0   52.7270     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE       VOLT MAG     VOLT PHASE
    1         80.7349        51.3656
    2         80.1144        51.9243
    3         72.1923        46.3855
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     50.41     63.07     49.41     63.07
 L    2-  0   276.572     80.11    51.924       .06   -38.076       .00   1424.96       .00       .00
 L    2-  3     2.193     10.81    92.078       .96     2.078     54.02     64.03     54.02     52.73
 C    3-  0      .000     72.19    46.385       .03   136.385       .00  -2156.57       .00       .00
 R    3-  0    51.439     72.19    46.385       .98      .677     51.44     52.73       .00       .00
```

Tower 5 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt5oc.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     3.3770    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    46.6630    3    0   43.4030     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1        75.0761        52.5566
    2        74.4723        53.1674
    3        62.3345        43.5349
                         BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                         MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     45.64     59.61     44.64     59.61
 L    2-  0   276.572     74.47    53.167       .05   -36.833       .00   1424.96       .00       .00
 L    2-  3     3.377     16.68    91.873       .96     1.873     48.58     60.62     48.58     43.22
 C    3-  0      .000     62.33    43.535       .03   133.535       .00  -2156.57       .00       .00
 R    3-  0    46.663     62.33    43.535       .98      .608     46.66     43.40       .00       .00
```

Tower 6 Individually Driven Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt6oc.txt

 I     1.0000    0    1     .0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     5.5120    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    48.8130    3    0   41.0290     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1        82.5333        54.6471
    2        81.9588        55.2173
    3        62.4070        40.1711
                         BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                         MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000      1.00      .000      1.00      .000     47.75     67.31     46.75     67.31
 L    2-  0   276.572     81.96    55.217       .06   -34.783       .00   1424.96       .00       .00
 L    2-  3     5.512     27.07    91.972       .95     1.972     51.44     68.88     51.44     40.48
 C    3-  0      .000     62.41    40.171       .04   130.171       .00  -1552.73       .00       .00
 R    3-  0    48.813     62.41    40.171       .98      .123     48.81     41.03       .00       .00
```

Derivation of Operating Parameters for Directional Antenna - WCPT

The method of moments model of the array, following verification with the measured individual open circuited base impedances, was utilized for directional antenna calculations. Calculations were made to determine the complex voltage values for sources located at ground level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern. With these voltage sources, the tower currents were calculated. The currents at the ATU unit outputs, where the antenna monitor samples are taken, were calculated from the method of moments tower currents for directional antenna operation using WCAP circuit modeling with the assumptions that were derived from the single tower measurements on the array and the method of moments calculated tower operating impedances. In each of the following WCAP tabulations, node 2 represents the reference point and node 3 represents the tower feedpoint. Node 0 represents ground potential. The tower operating impedances are represented by complex loads from node 3 to ground (R 3 - 0). It should be noted that the calculated reference point current magnitudes and phases appear in the first and fourth columns following the drive current sources (I 0 -1)). As the current transformers and sampling lines are identical, the antenna monitor ratios and phases corresponding to the theoretical parameters were calculated directly from the modeled reference point currents.

TOWER	Modeled Current Pulse	Modeled Current Magnitude @ Toroid (amperes)	Modeled Current Phase @ Toroid (degrees)	Modeled Antenna Monitor Ratio	Modeled Antenna Monitor Phase (degrees)
1	1	1.801	+101.2	0.397	+100.5
2	21	4.534	+0.7	1.000	0.0
3	41	2.418	-118.5	0.533	-119.2
4	61	1.544	-129.6	0.341	-130.3
5	81	3.446	-30.0	0.760	-30.7
6	101	1.806	+78.1	0.398	+77.4

Tower 1 DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt1da.txt

 I    18.0080    0    1  101.1600     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     1.7080    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    10.4120    3    0   29.1240     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1       701.7974       174.5412
    2       696.8608       175.9602
    3       549.8102       171.6262
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000     18.01   101.160     18.01   101.160     11.15     37.34     10.15     37.34
 L    2-  0   276.572    696.86   175.960       .49    85.960       .00   1424.96       .00       .00
 L    2-  3     1.708    154.32  -168.421     17.54   101.579     10.70     38.27     10.70     29.47
 C    3-  0      .000    549.81   171.626       .25   -98.374       .00  -2156.57       .00       .00
 R    3-  0    10.412    549.81   171.626     17.78   101.299     10.41     29.12       .00       .00
```

Tower 2 DA Base Circuit Analysis

```
 WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt2da.txt

 I    45.3440    0    1     .7300     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     2.6590    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    35.6390    3    0   40.5120     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1      2896.3410         57.1655
    2      2871.5200         57.9195
    3      2400.7430         49.8595
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000     45.34      .730     45.34      .730     35.31     53.22     34.31     53.22
 L    2-  0   276.572   2871.52    57.919      2.02   -32.081       .00   1424.96       .00       .00
 L    2-  3     2.659    598.18    92.163     43.66     2.163     37.01     54.36     37.01     40.66
 C    3-  0      .000   2400.74    49.860      1.11   139.860       .00  -2156.57       .00       .00
 R    3-  0    35.639   2400.74    49.860     44.49     1.198     35.64     40.51       .00       .00
```

Currents are multiplied X 10 for improved resolution.

Tower 3 DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt3da.txt

 I    24.1830    0    1  241.5260     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     3.0080    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    60.3730    3    0  130.6200     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1      3656.2850       -50.4861
    2      3647.2900       -50.1339
    3      3341.5010       -52.5065
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000     24.18  -118.474     24.18  -118.474     56.67    140.17     55.67    140.17
 L    2-  0   276.572   3647.29   -50.134      2.56  -140.134       .00   1424.96       .00       .00
 L    2-  3     3.008    338.23   -25.993     21.82  -115.993     68.35    152.50     68.35    137.00
 C    3-  0      .000   3341.50   -52.506      1.55    37.494       .00  -2156.57       .00       .00
 R    3-  0    60.373   3341.50   -52.506     23.22  -117.700     60.37    130.62       .00       .00
```

Tower 4 DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt4da.txt

 I    15.4380    0    1  230.4180     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     2.1930    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R   105.2300    3    0   61.4690     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1      1934.3010       -93.7829
    2      1921.8010       -93.5137
    3      1839.7540       -97.9090
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000     15.44  -129.582     15.44  -129.582    101.62     73.29    100.62     73.29
 L    2-  0   276.572   1921.80   -93.514      1.35   176.486       .00   1424.96       .00       .00
 L    2-  3     2.193    165.92   -35.325     14.68  -125.325    111.21     68.99    111.21     57.69
 C    3-  0      .000   1839.75   -97.909       .85    -7.909       .00  -2156.57       .00       .00
 R    3-  0   105.230   1839.75   -97.909     15.10  -128.200    105.23     61.47       .00       .00
```

Currents are multiplied X 10 for improved resolution.

Tower 5 DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt5da.txt

 I    34.4610    0    1  330.0000     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     3.3770    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R    22.8530    3    0   27.9810     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1      1724.7110        32.6151
    2      1709.1350        33.6409
    3      1222.1030        21.0591
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCER
 R    1-  2     1.000     34.46   -30.000     34.46   -30.000     23.02     44.44     22.02     44.44
 L    2-  0   276.572   1709.13    33.641      1.20   -56.359       .00   1424.96       .00       .00
 L    2-  3     3.377    580.96    60.914     33.39   -29.086     23.46     45.50     23.46     28.10
 C    3-  0      .000   1222.10    21.059       .57   111.059       .00  -2156.57       .00       .00
 R    3-  0    22.853   1222.10    21.059     33.83   -29.701     22.85     27.98       .00       .00
```

Tower 6 DA Base Circuit Analysis

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


 FILE NAME = wcpt6da.txt

 I    18.0620    0    1   78.0500     .0000     .0000
 R     1.0000    1    2     .0000     .0000     .0000
 L   276.5720    2    0     .0000     .0000     .0000
 L     5.5120    2    3     .0000     .0000     .0000
 C      .0001    3    0     .0000     .0000     .0000
 R   -20.9270    3    0   26.8070     .0000     .0000
 EX     .0000    0    0     .0000     .0000     .0000


 FREQ =  .820

   NODE      VOLT MAG     VOLT PHASE
    1      1027.6000      -172.3661
    2      1033.7940      -171.4229
    3       601.5423      -154.0252
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE
REACTANCE
 R    1-  2     1.000     18.06    78.050     18.06    78.050    -19.07     53.60    -20.07     53.60
 L    2-  0   276.572   1033.79  -171.423       .73    98.577       .00   1424.96       .00       .00
 L    2-  3     5.512    493.70   167.212     17.38    77.212    -21.66     55.38    -21.66     26.98
 C    3-  0      .000    601.54  -154.025       .39   -64.025       .00  -1552.73       .00       .00
 R    3-  0   -20.927    601.54  -154.025     17.69    77.997    -20.93     26.81       .00       .00
```

Currents are multiplied X 10 for improved resolution.

Method of Moments Model Details for Towers Driven Individually – WCPT

The array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5. One wire was used to represent each tower. The tower geometry was specified using the geographic coordinate system. Each tower was modeled using 20 wire segments. As the towers are physically 87.0 degrees in electrical height, the segment length is 4.35 electrical degrees.

The individual tower characteristics were adjusted to provide a match of their modeled impedances, when presented to a circuit model which included branches representing the shunt capacitances and feedline hookup inductances with the base impedances that were measured at the output jacks of the filter units while the other towers of the array were open circuited. The method of moments model assumed loads at ground level having the reactances that were calculated for them using the base circuit models for the open circuited towers of the array.

Each tower's modeled height relative to its physical height falls within the required range of 75 to 125 percent and each modeled radius falls within the required range of 80 percent to 150 percent of the radius of a circle having a circumference equal to the sum of the widths of the tower sides. The array consists of identical, triangular uniform cross section towers having a face width of 24 inches.

TOWER	Physical Height (degrees)	Modeled Height (degrees)	Modeled Percent of Height	Modeled Radius (meters)	Percent Equivalent Radius
1	87.0	95.6	109.9	0.291	100
2	87.0	94.6	108.7	0.291	100
3	87.0	94.6	108.7	0.291	100
4	87.0	95.6	109.9	0.291	100
5	87.0	94.1	108.2	0.291	100
6	87.0	93.5	107.5	0.291	100

The following pages show the details of the method of moments models for the individually driven towers. The numerals in the file names shown on the tabulations correspond to the tower numbers.

Tower 1 Driven Individually

C:\MBPRO14.5\WCPT1OC 04-01-2010 07:35:57

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
.82	51.368	53.244	73.984	46.	2.7395	-6.6479	-1.0589

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	1	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	21	0	4,320.	0	0	0
2	41	0	4,337.	0	0	0
3	61	0	4,299.	0	0	0
4	81	0	4,354.	0	0	0
5	101	0	22,662.	0	0	0

Tower 2 Driven Individually

C:\MBPRO14.5\WCPT2OC 04-01-2010 07:41:49

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 21, sector 1							
.82	47.909	45.45	66.037	43.5	2.4572	-7.504	-.8495

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	21	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	4,276.	0	0	0
2	41	0	4,337.	0	0	0
3	61	0	4,299.	0	0	0
4	81	0	4,354.	0	0	0
5	101	0	22,662.	0	0	0

Tower 3 Driven Individually

C:\MBPRO14.5\WCPT3OC 04-01-2010 07:45:10

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 41, sector 1							
.82	50.822	46.561	68.926	42.5	2.4443	-7.5489	-.83988

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	41	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	4,276.	0	0	0
2	21	0	4,320.	0	0	0
3	61	0	4,299.	0	0	0
4	81	0	4,354.	0	0	0
5	101	0	22,662.	0	0	0

Tower 4 Driven Individually

```
C:\MBPRO14.5\WCPT4OC  04-01-2010   07:48:09

IMPEDANCE
   normalization = 50.
freq     resist   react    imped    phase    VSWR    S11      S12
(MHz)    (ohms)   (ohms)   (ohms)   (deg)            dB       dB
source =  1; node 61, sector 1
.82      51.439   52.727   73.662   45.7     2.7132  -6.7188  -1.0395

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire  caps Distance     Angle        Z            radius      segs
 1    none 0            0            0            .291         20
           0            0            95.6
 2    none 93.2         36.9         0            .291         20
           93.2         36.9         94.6
 3    none 164.6        37.2         0            .291         20
           164.6        37.2         94.6
 4    none 327.4        70.          0            .291         20
           327.4        70.          95.6
 5    none 251.6        81.          0            .291         20
           251.6        81.          94.1
 6    none 198.         98.5         0            .291         20
           198.         98.5         93.5

Number of wires          =  6
          current nodes  =  120

                        minimum                  maximum
Individual wires      wire    value             wire  value
segment length         6      4.675              1    4.78
radius                 1      .291               1    .291


ELECTRICAL DESCRIPTION
Frequencies (MHz)
     frequency                no. of  segment length (wavelengths)
 no. lowest       step         steps   minimum        maximum
 1   .82          0             1      .0129861       .0132778


Sources
source node    sector  magnitude      phase          type
 1      61      1      1.             0              voltage

Lumped loads
            resistance    reactance     inductance  capacitance passive
load  node  (ohms)        (ohms)        (mH)        (uF)        circuit
 1     1    0             4,276.        0           0            0
 2     21   0             4,320.        0           0            0
 3     41   0             4,337.        0           0            0
 4     81   0             4,354.        0           0            0
 5     101  0             22,662.       0           0            0
```

Tower 5 Driven Individually

C:\MBPRO14.5\WCPT5OC 04-01-2010 07:50:22

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 81, sector 1							
.82	46.663	43.403	63.727	42.9	2.3946	-7.7269	-.80282

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	81	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	4,276.	0	0	0
2	21	0	4,320.	0	0	0
3	41	0	4,337.	0	0	0
4	61	0	4,299.	0	0	0
5	101	0	22,662.	0	0	0

Tower 6 Driven Individually

C:\MBPRO14.5\WCPT6OC 04-01-2010 07:52:36

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 101, sector 1							
.82	48.813	41.029	63.766	40.	2.2448	-8.3217	-.69139

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

no.	frequency lowest	step	no. of steps	segment length (wavelengths) minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	101	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	4,276.	0	0	0
2	21	0	4,320.	0	0	0
3	41	0	4,337.	0	0	0
4	61	0	4,299.	0	0	0
5	81	0	4,354.	0	0	0

Method of Moments Model Details for Directional Antenna- WCPT

The array of towers was modeled using Expert MININEC Broadcast Professional Version 14.5 with the individual towers characteristics that were verified by the individual tower impedance measurements. Calculations were made to determine the complex voltage values for sources located at ground level under each tower of the array to produce current moment sums for the towers that, when normalized, equated to the theoretical field parameters of the authorized directional antenna pattern. The following pages contain details of the method of moments model of the directional antenna pattern.

Tower	Wire	Base Node
1	1	1
2	2	21
3	3	41
4	4	61
5	5	81
6	6	101

It should be noted that voltages and currents shown on the tabulations that are not specified as “rms” values are the corresponding peak values.

C:\MBPRO14.5\WCPTDA 04-01-2010 07:56:55

MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .82 MHz

tower	field ratio magnitude	phase (deg)
1	.418	100.
2	1.06	-2.5
3	.644	-122.9
4	.382	-138.6
5	.783	-32.1
6	.406	80.

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	54.9857	171.7	1.77778	101.3
21	240.079	49.9	4.44942	1.2
41	334.182	307.5	2.32237	242.3
61	183.992	262.1	1.50978	231.8
81	122.224	21.	3.38312	330.3
101	60.1691	206.	1.76925	78.

Sum of square of source currents = 90.4127
Total power = 1,500. watts

IMPEDANCE
normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 1, sector 1							
.82	10.412	29.124	30.929	70.3	6.4853	-2.7002	-3.3443
source = 2; node 21, sector 1							
.82	35.639	40.512	53.957	48.7	2.661	-6.8647	-1.0009
source = 3; node 41, sector 1							
.82	60.373	130.62	143.9	65.2	7.5554	-2.3128	-3.8416
source = 4; node 61, sector 1							
.82	105.23	61.469	121.87	30.3	2.96	-6.1087	-1.2204
source = 5; node 81, sector 1							
.82	22.853	27.981	36.128	50.8	2.9965	-6.0283	-1.2468
source = 6; node 101, sector 1							
.82	-20.927	26.807	34.008	128.	****	****	****

GEOMETRY
Wire coordinates in degrees; other dimensions in meters
Environment: perfect ground

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.291	20
		0	0	95.6		
2	none	93.2	36.9	0	.291	20
		93.2	36.9	94.6		
3	none	164.6	37.2	0	.291	20
		164.6	37.2	94.6		
4	none	327.4	70.	0	.291	20
		327.4	70.	95.6		
5	none	251.6	81.	0	.291	20
		251.6	81.	94.1		
6	none	198.	98.5	0	.291	20
		198.	98.5	93.5		

Number of wires = 6
current nodes = 120

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	6	4.675	1	4.78
radius	1	.291	1	.291

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.82	0	1	.0129861	.0132778

Sources

source	node	sector	magnitude	phase	type
1	1	1	77.7615	171.7	voltage
2	21	1	339.523	49.9	voltage
3	41	1	472.604	307.5	voltage
4	61	1	260.204	262.1	voltage
5	81	1	172.851	21.	voltage
6	101	1	85.0919	206.	voltage

CURRENT rms
Frequency = .82 MHz
Input power = 1,500. watts
Efficiency = 100. %
coordinates in degrees

current				mag	phase	real	imaginary
no.	X	Y	Z	(amps)	(deg)	(amps)	(amps)
GND	0	0	0	1.77779	101.3	-.349247	1.74315
2	0	0	4.78	1.80004	101.	-.343919	1.76688
3	0	0	9.56	1.80175	100.8	-.337964	1.76977
4	0	0	14.34	1.78993	100.6	-.330344	1.75918
5	0	0	19.12	1.76555	100.5	-.320975	1.73613
6	0	0	23.9	1.72914	100.3	-.309871	1.70115
7	0	0	28.68	1.68113	100.2	-.297083	1.65467
8	0	0	33.46	1.62192	100.	-.282695	1.59709
9	0	0	38.24	1.55194	99.9	-.266807	1.52883
10	0	0	43.02	1.47162	99.8	-.249533	1.45031
11	0	0	47.8	1.38146	99.6	-.231002	1.36201
12	0	0	52.58	1.28197	99.5	-.211352	1.26443

13	0	0	57.36	1.17368	99.4	-.190725	1.15808
14	0	0	62.14	1.05713	99.2	-.169267	1.04349
15	0	0	66.92	.932809	99.1	-.147117	.921135
16	0	0	71.7	.801198	98.9	-.124409	.79148
17	0	0	76.48	.662588	98.8	-.101251	.654806
18	0	0	81.26	.51698	98.6	-.0777062	.511107
19	0	0	86.04	.363633	98.5	-.05373	.359641
20	0	0	90.82	.199859	98.3	-.0290053	.197743
END	0	0	95.6	0	0	0	0
GND	74.5306	-55.9591	0	4.44942	1.2	4.44838	.0961581
22	74.5306	-55.9591	4.73	4.5321	.2	4.53208	.0145222
23	74.5306	-55.9591	9.46	4.55407	359.5	4.55392	-.0372667
24	74.5306	-55.9591	14.19	4.53936	359.	4.53865	-.0798628
25	74.5306	-55.9591	18.92	4.49101	358.5	4.48952	-.115684
26	74.5306	-55.9591	23.65	4.41064	358.1	4.40823	-.145717
27	74.5306	-55.9591	28.38	4.29934	357.7	4.29596	-.170418
28	74.5306	-55.9591	33.11	4.15814	357.4	4.1538	-.190021
29	74.5306	-55.9591	37.84	3.98808	357.1	3.98283	-.20466
30	74.5306	-55.9591	42.57	3.79025	356.8	3.78418	-.21442
31	74.5306	-55.9591	47.3	3.56584	356.5	3.55909	-.219363
32	74.5306	-55.9591	52.03	3.31609	356.2	3.30882	-.21954
33	74.5306	-55.9591	56.76	3.0423	355.9	3.03469	-.215
34	74.5306	-55.9591	61.49	2.74578	355.7	2.73806	-.20579
35	74.5306	-55.9591	66.22	2.4278	355.5	2.4202	-.191954
36	74.5306	-55.9591	70.95	2.08946	355.2	2.08224	-.17352
37	74.5306	-55.9591	75.68	1.73146	355.	1.7249	-.150483
38	74.5306	-55.9591	80.41	1.35371	354.8	1.34814	-.12276
39	74.5306	-55.9591	85.14	.954181	354.6	.949921	-.0900629
40	74.5306	-55.9591	89.87	.525665	354.4	.52313	-.05156
END	74.5306	-55.9591	94.6	0	0	0	0
GND	131.109	-99.517	0	2.32236	242.3	-1.07796	-2.05703
42	131.109	-99.517	4.73	2.47619	240.6	-1.21408	-2.15813
43	131.109	-99.517	9.46	2.55732	239.7	-1.29156	-2.20721
44	131.109	-99.517	14.19	2.606	238.9	-1.34586	-2.23157
45	131.109	-99.517	18.92	2.627	238.3	-1.38124	-2.23457
46	131.109	-99.517	23.65	2.62247	237.7	-1.39956	-2.21779
47	131.109	-99.517	28.38	2.59362	237.3	-1.40183	-2.18215
48	131.109	-99.517	33.11	2.54134	236.9	-1.38871	-2.12836
49	131.109	-99.517	37.84	2.46641	236.5	-1.36076	-2.05706
50	131.109	-99.517	42.57	2.36956	236.2	-1.31847	-1.96888
51	131.109	-99.517	47.3	2.2516	235.9	-1.26234	-1.86446
52	131.109	-99.517	52.03	2.11333	235.6	-1.19288	-1.74448
53	131.109	-99.517	56.76	1.95561	235.4	-1.11063	-1.60964
54	131.109	-99.517	61.49	1.77931	235.2	-1.01613	-1.46062
55	131.109	-99.517	66.22	1.58524	235.	-.909906	-1.2981
56	131.109	-99.517	70.95	1.37416	234.8	-.792427	-1.12266
57	131.109	-99.517	75.68	1.14651	234.6	-.664004	-.934662
58	131.109	-99.517	80.41	.902254	234.4	-.524638	-.734041
59	131.109	-99.517	85.14	.639974	234.3	-.373531	-.519655
60	131.109	-99.517	89.87	.354745	234.1	-.207801	-.287511
END	131.109	-99.517	94.6	0	0	0	0
GND	111.977	-307.655	0	1.50978	231.8	-.934351	-1.18593
62	111.977	-307.655	4.78	1.55674	228.7	-1.02801	-1.16903
63	111.977	-307.655	9.56	1.5779	226.8	-1.08009	-1.15029
64	111.977	-307.655	14.34	1.58493	225.3	-1.11502	-1.12637
65	111.977	-307.655	19.12	1.57904	224.	-1.13578	-1.09697
66	111.977	-307.655	23.9	1.56075	222.9	-1.14368	-1.06205
67	111.977	-307.655	28.68	1.53042	221.9	-1.13943	-1.02171
68	111.977	-307.655	33.46	1.48833	221.	-1.12352	-.976126
69	111.977	-307.655	38.24	1.43478	220.2	-1.09638	-.925498
70	111.977	-307.655	43.02	1.37012	219.4	-1.0584	-.870074
71	111.977	-307.655	47.8	1.29475	218.7	-1.00997	-.810147
72	111.977	-307.655	52.58	1.20908	218.1	-.951505	-.745991

73	111.977	-307.655	57.36	1.11356	217.5	-.883418	-.677935
74	111.977	-307.655	62.14	1.00868	216.9	-.806145	-.606277
75	111.977	-307.655	66.92	.894896	216.4	-.720097	-.531318
76	111.977	-307.655	71.7	.772622	215.9	-.625657	-.453318
77	111.977	-307.655	76.48	.642134	215.5	-.523076	-.37246
78	111.977	-307.655	81.26	.503417	215.	-.412367	-.288759
79	111.977	-307.655	86.04	.355729	214.6	-.292933	-.201826
80	111.977	-307.655	90.82	.196403	214.1	-.162558	-.110223
END	111.977	-307.655	95.6	0	0	0	0
GND	39.3589	-248.502	0	3.38312	330.3	2.93819	-1.67706
82	39.3589	-248.502	4.705	3.42322	329.6	2.95273	-1.732
83	39.3589	-248.502	9.41	3.42538	329.2	2.94176	-1.75479
84	39.3589	-248.502	14.115	3.40233	328.8	2.91128	-1.76077
85	39.3589	-248.502	18.82	3.35577	328.5	2.86221	-1.75184
86	39.3589	-248.502	23.525	3.28666	328.3	2.79515	-1.72895
87	39.3589	-248.502	28.23	3.19576	328.	2.71066	-1.69269
88	39.3589	-248.502	32.935	3.08378	327.8	2.60931	-1.64354
89	39.3589	-248.502	37.64	2.95147	327.6	2.49171	-1.58196
90	39.3589	-248.502	42.345	2.79964	327.4	2.35853	-1.50842
91	39.3589	-248.502	47.05	2.62915	327.2	2.2105	-1.42341
92	39.3589	-248.502	51.755	2.44092	327.1	2.0484	-1.32746
93	39.3589	-248.502	56.46	2.2359	326.9	1.87301	-1.22108
94	39.3589	-248.502	61.165	2.01503	326.8	1.68515	-1.10482
95	39.3589	-248.502	65.87	1.77925	326.6	1.48558	-.979181
96	39.3589	-248.502	70.575	1.52933	326.5	1.27494	-.844612
97	39.3589	-248.502	75.28	1.26578	326.3	1.05368	-.701411
98	39.3589	-248.502	79.985	.988528	326.2	.821708	-.549531
99	39.3589	-248.502	84.69	.696056	326.1	.577795	-.388133
100	39.3589	-248.502	89.395	.383119	326.	.317594	-.214275
END	39.3589	-248.502	94.1	0	0	0	0
GND	-29.2663	-195.825	0	1.76925	78.	.368478	1.73045
102	-29.2663	-195.825	4.675	1.78903	78.6	.353743	1.7537
103	-29.2663	-195.825	9.35	1.78939	79.	.342213	1.75636
104	-29.2663	-195.825	14.025	1.77672	79.3	.330386	1.74573
105	-29.2663	-195.825	18.7	1.75188	79.5	.317867	1.7228
106	-29.2663	-195.825	23.375	1.71534	79.8	.304508	1.6881
107	-29.2663	-195.825	28.05	1.66751	80.	.290256	1.64205
108	-29.2663	-195.825	32.725	1.60875	80.2	.275101	1.58505
109	-29.2663	-195.825	37.4	1.53945	80.3	.259055	1.5175
110	-29.2663	-195.825	42.075	1.46003	80.5	.24214	1.43981
111	-29.2663	-195.825	46.75	1.37094	80.6	.224389	1.35245
112	-29.2663	-195.825	51.425	1.27265	80.7	.205835	1.25589
113	-29.2663	-195.825	56.1	1.16566	80.8	.186517	1.15064
114	-29.2663	-195.825	60.775	1.05045	80.9	.166466	1.03718
115	-29.2663	-195.825	65.45	.927512	81.	.145714	.915994
116	-29.2663	-195.825	70.125	.797238	81.	.124278	.787491
117	-29.2663	-195.825	74.8	.659878	81.1	.102156	.651923
118	-29.2663	-195.825	79.475	.515386	81.1	.0792957	.50925
119	-29.2663	-195.825	84.15	.362958	81.2	.0555364	.358684
120	-29.2663	-195.825	88.825	.19984	81.2	.0304261	.197511
END	-29.2663	-195.825	93.5	0	0	0	0

Sampling System Measurements – WCPT

Impedance measurements were made of the antenna monitor sampling system using a Hewlett-Packard 8751A network analyzer and a Tunwall Radio directional coupler in a calibrated measurement system. The measurements were made looking into the antenna monitor ends of the sampling lines for two conditions – with them open circuited at their tower ends and with them connected to the sampling devices at the tower bases.

The following table shows the frequencies above and below the carrier frequency where resonance – zero reactance corresponding with low resistance – was found. As the length of a distortionless transmission line is 180 electrical degrees at the difference frequency between adjacent frequencies of resonance, and frequencies of resonance occur at odd multiples of 90 degrees electrical length, the sampling line length at the resonant frequency above carrier frequency – which is the closest one to the carrier frequency in terms of the ratio of frequencies – was found to be 450 electrical degrees. The electrical lengths at carrier frequency appearing in the table below were calculated by ratioing the frequencies.

Tower	Sampling Line Open-Circuited Resonance Below 820 kHz (kHz)	Sampling Line Open-Circuited Resonance Above 820 kHz (kHz)	Sampling Line Calculated Electrical Length at 820 kHz (degrees)	820 kHz Measured Impedance with Sampling Loop Connected (Ohms)
1	585.50	978.80	377.0	46.6 – j 166.6
2	585.20	978.35	377.2	48.2 – j 174.2
3	585.65	978.95	376.9	48.7 – j 175.0
4	585.35	978.65	377.1	49.5 – j 171.6
5	585.35	978.65	377.1	47.0 – j 169.4
6	585.65	978.65	377.1	50.4 – j 170.2

The sampling line lengths meet the requirement that they be equal in length within 1 electrical degree.

The characteristic impedance was calculated using the following formula, where $R_1 + j X_1$ and $R_2 + j X_2$ are the measured impedances at the +45 and –45 degree offset frequencies, respectively:

$$Zo = ((R_1^2 + X_1^2)^{1/2} \bullet (R_2^2 + X_2^2)^{1/2})^{1/2}$$

Tower	-45 Degree Offset Frequency (kHz)	-45 Degree Measured Impedance (Ohms)	+45 Degree Offset Frequency (kHz)	+45 Degree Measured Impedance (Ohms)	Calculated Characteristic Impedance (Ohms)
1	880.92	7.1 – j 49.0	1076.68	9.0 + j 49.5	49.9
2	880.52	7.2 – j 50.0	1076.19	9.0 + j 50.1	50.7
3	881.06	7.2 – j 49.9	1076.85	9.0 + j 50.1	50.7
4	880.79	7.2 – j 49.1	1076.52	8.9 + j 48.7	49.6
5	880 79	7.1 – j 49.2	1076.52	9.0 + j 49.4	50.0
6	880.79	7.4 – j 48.8	1076.52	9.2 + j 48.8	49.5

The sampling line measured characteristic impedances meet the requirement that they be equal within 2 ohms.

The toroidal transformers were calibrated by measuring their outputs with a common reference signal using a Hewlett-Packard 8751A network analyzer in a calibrated measurement system. They were placed side-by-side with a conductor carrying the reference signal passing through them and their outputs were fed into the A and B receiver inputs of the analyzer which was configured to measure the relative ratios and phases of their output voltages. The following results were found for carrier frequency, 820 kilohertz:

Tower	Toroid Ratio	Toroid Phase (Degrees)
1	1.000	- 0.099
2	Reference	Reference
3	0.999	-0.106
4	0.999	-0.289
5	0.998	-0.194
6	0.998	-0.167

Delta type TCT-5 toroidal transformers are rated for absolute magnitude accuracy of +/- 2% and absolute phase accuracy of +/- 3 degrees. As the maximum measured transformer-to-transformer variations among of the six were less than 0.1 percent and 0.3 degree, they provide far more accurate relative indications than could be the case within their rated accuracies.

Reference Field Strength Measurements – WCPT

No radial azimuths are specified to have monitor points on the construction permit. Reference field strength measurements were made at three locations each along radials at azimuths corresponding to the pattern minima, rounded to the nearest 0.5 degree, at 113.0, 190.5, 228.0, 247.0, and 311.5 degrees true. Additionally, measurements were made on the major lobe maximum radiation radial at 17.0 degrees true. The measured field strengths, descriptions and GPS coordinates for the reference measurement points are shown on the following page.

Reference Field Strength Measurements

WCPT DA-N

Radial (Deg.)	Point	Distance (Km)	Field (mV/m)	Coordinates (NAD 27)		Description
				N	W	
17.00	1	4.56	165	41:34:48	88:01:05	Fire Hydrant at intersection of Mohican and Swift Arrow Rds.
	2	6.70	138	41:35:54	88:00:38	Northeast corner of Illinois Rt. 7 bridge deck over I-355, at north guard rail expansion joint
	3	14.5	37	41:39:54	87:58:57	At mailbox of 1155 Country Ln., next to driveway
113.0	1	5.84	1.30	41:31:15	88:58:11	At east driveway curb along Elm Dr. just south of Kimberly (address not evident)
	2	10.7	2.0	41:30:13	87:55:00	Driveway at curb, 755 Westwind
	3	11.6	1.75	41:30:00	87:54:22	Mailbox of 21407 Prestancia
190.5	1	3.64	7.0	41:30:31	88:02:32	50ft. East of Briggs on south side of Carey St.
	2	8.33	4.9	41:28:01	88:03:07	Across from driveway of 18041 Schwietzer.
	3	11.6	3.9	41:26:20	88:03:34	Center of creek bridge on Rowell Rd.
228.0	1	4.12	750uV	41:50:38	88:04:17	Center of south school parking area between retaining wall, school and playground.
	2	6.22	650uV	41:30:12	88:05:24	East side of Patterson at railroad grade crossing.
	3	10.2	460uV	41:28:46	88:07:33	On Laraway at driveway island before “Road Closed” fence gate.

Radial (Deg.)	Point	Distance (Km)	Field (mV/m)	Coordinates (NAD 27)		Description
				N	W	
247.0	1	4.87	2.7	41:31:38	88:05:16	Along east curb at sidewalk, northwest corner of 30 N. Bluff. (100 ft. south of Jefferson St.)
	2	6.8	550uV	41:31:03	88:06:32	At stop sign, southwest corner of Reed and Morgan.
	3	12.6	420uV	41:29:51	88:10:22	On Joliet Community College entrance drive, at 30MPH speed limit sign (200ft. in from street)
311.5	1	8.33	4.1	41:35:03	88:06:49	At intersection Spirea and Palm Dr., southwest sidewalk crossing
	2	12.0	3.5	41:36:44	88:08:03	At mail box/driveway of 318 Zinna
	3	14.0	1.55	41:37:28	88:09:39	At driveway of 14258 Napa

All measurements were taken on April 3, 2010 with Potomac Instruments FIM-41 serial number 302, which was most recently calibrated by its manufacturer in July of 2004. Prior to making the measurements, its readings were compared with those made with Potomac Instruments FIM-41 serial number 1128, which was most recently calibrated by its manufacturer on March 21, 2007. The readings with both meters were found to be in agreement.

Direct Measurement of Power - WCPT

Common point impedance measurements were made using the permanently installed Delta Electronics CPB-1 Common Point Bridge. The bridge is located in the circuit adjacent to the common point current meter that is used to determine operating power. The bridge readings were confirmed by comparison with those made by a calibrated network analyzer measurement system employing a Hewlett-Packard 8751A vector network analyzer. The common point impedance was adjusted to 50.0 – j 6.0 ohms for the directional pattern. The reactance was set to – j 6.0 to compensate for series inductance in the circuit between the transmitter and the common point in the phasor cabinet, including the main-auxiliary transmitter switching contactor, in order to provide a non-reactive load for the transmitter's output port at carrier frequency.

Antenna Monitor - WCPT

The antenna monitor is a Potomac Instruments model AM-1901. The sampling devices are Delta Electronics Type TCT-5 shielded toroidal transformers located at the ATU output reference points. The TCT-5 transformers have a sensitivity of 2.0 volt per ampere of RF current. The toroids are connected through equal length ½ inch foam heliax sampling lines to the antenna monitor.

The antenna monitor is new. As it was calibrated by its manufacturer prior to installation, no calibration measurements are necessary for this proof of performance.

RFR Protection - WCPT

The operation of WCPT will not result in the exposure of workers or the general public to levels of radio frequency radiation in excess of the limits specified in 47 CFR 1.1310. Fences have been installed about the tower bases to restrict access beyond the distances necessary to prevent electric and magnetic exposure above the required levels.

The minimum fence distances from the tower bases were determined with reference to Table 2 of Supplement A to FCC OET Bulletin 65 (Edition 97-01). According to Table 2, the predicted "Distance for Compliance with FCC Limits" at 820 kilohertz, for 5 kilowatts fed into a single tower 0.25 wavelengths in height, is 2 meters. As the total input power is lower than that, at 1.5 kilowatts, and it is divided between the six towers, the 5-kilowatt assumption is a very conservative one for predicting the minimum fence distances for the WCPT nighttime directional antenna system. Fences have been installed to restrict access to a radius of 20 feet (6.1 meters) around each tower base to ensure that the requirement is met.

The fences limit access to areas with fields that exceed the requirements of the Rules when the WCPT nighttime site is in operation. If it is necessary for workers to be inside them for extended periods of time, the antenna system has the ability to be switched for nondirectional operation with either tower 3 or tower 5 to de-activate the remaining towers. In the daytime, WCPT operates from a separate site and all of the towers at the nighttime site are de-activated. The WCPT nighttime facility is, therefore, in full compliance with the FCC's requirements with regard to radio frequency radiation exposure. The established radio frequency protection measures at the daytime site remain in effect.

Detuning of Communications Tower - WCPT

A communications tower is located outside the ground system area to the south of the WCPT array. The array location was chosen to reduce coupling of field from the WCPT directional antenna pattern to this tower and it is in an area of high signal suppression. In addition, the communications tower is detuned by means of a six-wire skirt connected to a detuning network in a weatherproof enclosure at its base. To monitor the state of its detuning, a sampling loop has been permanently mounted on the tower at the height where tower current is nulled for the detuned condition. A sampling line has been installed from this loop to the WCPT transmitter building to allow regular monitoring of its induced voltage.

The detuning system was tested, found to be functioning correctly and adjusted to detune the tower before the tower base impedances included herein were measured. With a field strength meter connected to the sampling line to monitor the loop voltage on 820 kilohertz and the tower exposed to incident field from the daytime WCPT transmitter site, the detuning network was adjusted and a pronounced null in tower current was found while adjusting the detuning network either side of the minimum condition. The network adjustment was left for the minimum condition.

Summary of Certified Array Geometry - WCPT

The tower locations based on the relative distances in meters and azimuths (referenced to True North) provided in the Tower Location Certification of Appendix A were compared to the relative distances and azimuths of the array elements specified on the construction permit. The Certified and specified values were converted to the rectangular coordinate system to facilitate calculating the individual tower specified-to-certified distances, which were then converted to the polar coordinate system to determine their magnitudes. This tabulation shows those distances and other information that is relevant to their determination.

Tower	Specified Array Geometry			Post-Construction Certification*		Distance From Specified Base Location	
	Spacing (Deg.)	Spacing (Meters)	Azimuth (Deg. T.)	Spacing (Meters)	Azimuth (Deg. T.)	(Meters)	(Deg.)
1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
2	93.2	94.65	36.9	94.596	36.899	0.05	0.05
3	164.6	167.16	37.2	167.209	37.185	0.07	0.07
4	327.4	332.49	70.0	332.467	70.000	0.02	0.02
5	251.6	255.51	81.0	255.528	80.998	0.02	0.02
6	198.0	201.08	98.5	201.117	98.507	0.04	0.04

* As built tower locations from March 16, 2010 Tower Location Certification prepared by Robert A. Rogina, P.E., I.P.L.S. of Rogina & Associates, Ltd. Engineers, Surveyors and Planners, Joliet, Illinois.

Appendix A

Certified Post Construction Array Geometry

ROGINA
& ASSOCIATES, LTD.
ENGINEERS • SURVEYORS • PLANNERS

March 16, 2010

Newsweb Radio Company
6012 S. Pulaski Ave.
Chicago, IL. 60629
Attn: Michael G. McCarthy, CSRE, CEA
Director of Engineering

Re: Tower Location Certification
FCC Construction Permit # BP20050725ACV, WYPA, Inc (WCPT-AM), Night site
Job No. 4669.03

Dear Mr. McCarthy,

We are certifying to the as built location of the six new towers located at 750 Fox Street, Joliet, Illinois.

The locations are located at designated positions and orientation as specified on sheet C5 on the drawings prepared by Jacob & Hefner Associates, Inc., dated March 13, 2009.
The following tower location distances and orientations are referenced to True North and from Tower #1. Electrical distance to each succeeding tower from the reference tower is based on 3.33333 ft./1.01626M per electrical degree. Full wave free space of 820 khz is 1200.000ft./365.853M.
Tower #1: Reference
Tower #2: 36.8994 deg. True, 93.1051 Degrees Distant. (310.35 ft., 94.596M)
Tower #3: 37.1847 deg. True, 164.5772 Degrees Distant. (548.59 ft., 167.209M)
Tower #4: 70.0008 deg. True, 327.2313 Degrees Distant. (1090.77 ft., 332.467M)
Tower #5: 80.9981 deg. True, 251.5053 Degrees Distant. (838.35 ft., 255.528M)
Tower #6: 98.5072 deg. True, 197.9492 Degrees Distant. (659.83 ft., 201.117M)

Sincerely,

Robert A. Rogina P.E., I.P.L.S.
Rogina & Associates, Ltd.

ROBERT A. ROGINA
2017
PROFESSIONAL
LAND
SURVEYOR
STATE OF
ILLINOIS
JOLIET, ILL.

93 Caterpillar Drive • Joliet, Illinois 60436 • 815/729-0777 • FAX 815/729-0782

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
WYPA, Inc. (License for new night site only)

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

☑ Station License ☐ Direct Measurement of Power

1. Facilities authorized in construction permit

Call Sign	File No. of Construction Permit (if applicable)	Frequency (kHz)	Hours of Operation	Power in kilowatts	
				Night	Day
WCPT	BP-20050725ACV	820	Unlimited	1.5	5.0

2. Station location

State	City or Town
Illinois	Willow Springs

3. Transmitter location

State	County	City or Town	Street address (or other identification)
Illinois	Will	Joliet Township	750 Fox Street

4. Main studio location

State	County	City or Town	Street address (or other identification)
Illinois	Cook	Chicago	6012 S Pulaski Avenue

5. Remote control point location (specify only if authorized directional antenna)

State	County	City or Town	Street address (or other identification)
Illinois	Cook	Chicago	6012 S Pulaski Avenue

6. Has type-approved stereo generating equipment been installed? ☐ Yes ☑ No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68? ☐ Yes ☐ No ☐ Not Applicable

Attach as an Exhibit a detailed description of the sampling system as installed. Exhibit No. Eng

8. Operating constants:

RF common point or antenna current (in amperes) without modulation for night system	RF common point or antenna current (in amperes) without modulation for day system
5.69	No Change

Measured antenna or common point resistance (in ohms) at operating frequency		Measured antenna or common point reactance (in ohms) at operating frequency	
Night	Day	Night	Day
50	No Change	-j 6	No Change

Antenna indications for directional operation

Towers	Antenna monitor Phase reading(s) in degrees		Antenna monitor sample current ratio(s)		Antenna base currents	
	Night	Day	Night	Day	Night	Day
1	+ 100.5	--	0.397	--	Not Required	--
2	0.0	--	1.000	--	"	--
3	- 119.2	--	0.533	--	"	--
4	- 130.3	--	0.341	--	"	--
5	- 30.7	--	0.760	--	"	--
6	+ 77.4	--	0.398	--	"	--

Manufacturer and type of antenna monitor: Potomac Instruments AM-1901

SECTION III - Page 2

9. Description of antenna system ((f directional antenna is used, the information requested below should be given for each element of the array. Use separate sheets if necessary.)

Type Radiator	Overall height in meters of radiator above base insulator, or above base, if grounded.	Overall height in meters above ground (without obstruction lighting)	Overall height in meters above ground (include obstruction lighting)	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.
Towers 1, 2, 3, 4, 5, 6	88.4, 88.4, 88.4, 88.4, 88.4, 88.4	91.7, 91.1, 90.8, 90.8, 90.8, 90.8	91.7, 91.1, 90.8, 90.8, 90.8, 90.8	Exhibit No. N/A

Excitation ☑ Series ☐ Shunt

Geographic coordinates to nearest second. For directional antenna give coordinates of center of array. For single vertical radiator give tower location.

North Latitude	West Longitude
41 ° 32 ' 30 "	88 ° 02 ' 03 "

If not fully described above, attach as an Exhibit further details and dimensions including any other antenna mounted on tower and associated isolation circuits. Exhibit No. Eng

Also, if necessary for a complete description, attach as an Exhibit a sketch of the details and dimensions of ground system. Exhibit No. N/A

10. In what respect, if any, does the apparatus constructed differ from that described in the application for construction permit or in the permit?

None

11. Give reasons for the change in antenna or common point resistance.

N/A

I certify that I represent the applicant in the capacity indicated below and that I have examined the foregoing statement of technical information and that it is true to the best of my knowledge and belief.

Name (Please Print or Type)	Signature (check appropriate box below)
Ronald D. Rackley, P.E.	Ronald D. Rackley
Address (include ZIP Code)	Date
du Treil, Lundin & Rackley, Inc. 201 Fletcher Avenue Sarasota, Florida 34237	April 6, 2010
	Telephone No. (Include Area Code) 941 329 6000

☐ Technical Director ☑ Registered Professional Engineer

☐ Chief Operator ☐ Technical Consultant

☐ Other (specify)