original

Federal Communications Commission
Washington, D. C. 20554

Approved by OMB
3060-0627
Expires 01/31/98

FOR FCC USE ONLY

FCC 302-AM
APPLICATION FOR AM BROADCAST STATION LICENSE

(Please read instructions before filling out form.

FOR COMMISSION USE ONLY
FILE NO. BNML-20160511ABK

SECTION I - APPLICANT FEE INFORMATION

1. PAYOR NAME (Last, First, Middle Initial)

Marconi Wireless of Colorado, LLC

MAILING ADDRESS (Line 1) (Maximum 35 characters)
6395 West Berry Ave.

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
Littleton	CO	80123

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
3033821000	KKCL	

2. A. Is a fee submitted with this application? 161314 [✓] Yes [ ] No

B. If No, indicate reason for fee exemption (see 47 C.F.R. Section

[ ] Governmental Entity [ ] Noncommercial educational licensee [X] Other (Please explain): Non-Fee Filing

C. If Yes, provide the following information:

Enter in Column (A) the correct Fee Type Code for the service you are applying for. Fee Type Codes may be found in the "Mass Media Services Fee Filing Guide." Column (B) lists the Fee Multiple applicable for this application. Enter fee amount due in Column (C).

(A) FEE TYPE CODE	(B) FEE MULTIPLE	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
	0001	$	

To be used only when you are requesting concurrent actions which result in a requirement to list more than one Fee Type Code.

(A)	(B)	(C)	FOR FCC USE ONLY
	0001	$	

ADD ALL AMOUNTS SHOWN IN COLUMN C, AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE.	TOTAL AMOUNT REMITTED WITH THIS APPLICATION	FOR FCC USE ONLY
	$	

RECEIVED
2016 MAY 12 A 10:32
FEDERAL COMMUNICATIONS COMMISSION

Received & Inspected

MAY 11 2016

FCC Mail Room

SECTION II - APPLICANT INFORMATION		
1. NAME OF APPLICANT Marconi Wireless of Colorado, LLC		
MAILING ADDRESS 6395 West Berry Ave,		
CITY Littleton	STATE CO	ZIP CODE 20123

2. This application is for:

☑ Commercial ☐ Noncommercial

☑ AM Directional ☑ AM Non-Directional

Call letters	Community of License	Construction Permit File No.	Modification of Construction Permit File No(s).	Expiration Date of Last Construction Permit
KKCL	Golden, CO	BMML-20140131ART		

3. Is the station now operating pursuant to automatic program test authority in accordance with 47 C.F.R. Section 73.1620?

☐ Yes ☑ No

If No, explain in an Exhibit.

Exhibit No. L-1

4. Have all the terms, conditions, and obligations set forth in the above described construction permit been fully met?

☐ Yes ☑ No

If No, state exceptions in an Exhibit.

Exhibit No. L-1

5. Apart from the changes already reported, has any cause or circumstance arisen since the grant of the underlying construction permit which would result in any statement or representation contained in the construction permit application to be now incorrect?

☐ Yes ☑ No

If Yes, explain in an Exhibit.

Exhibit No.

6. Has the permittee filed its Ownership Report (FCC Form 323) or ownership certification in accordance with 47 C.F.R. Section 73.3615(b)?

☐ Yes ☐ No

☑ Does not apply

If No, explain in an Exhibit.

Exhibit No.

7. Has an adverse finding been made or an adverse final action been taken by any court or administrative body with respect to the applicant or parties to the application in a civil or criminal proceeding, brought under the provisions of any law relating to the following: any felony; mass media related antitrust or unfair competition; fraudulent statements to another governmental unit; or discrimination?

☐ Yes ☑ No

If the answer is Yes, attach as an Exhibit a full disclosure of the persons and matters involved, including an identification of the court or administrative body and the proceeding (by dates and file numbers), and the disposition of the litigation. Where the requisite information has been earlier disclosed in connection with another application or as required by 47 U.S.C. Section 1.65(c), the applicant need only provide: (i) an identification of that previous submission by reference to the file number in the case of an application, the call letters of the station regarding which the application or Section 1.65 information was filed, and the date of filing; and (ii) the disposition of the previously reported matter.

Exhibit No.

8. Does the applicant, or any party to the application, have a petition on file to migrate to the expanded band (1605-1705 kHz) or a permit or license either in the existing band or expanded band that is held in combination (pursuant to the 5 year holding period allowed) with the AM facility proposed to be modified herein?

☐ Yes ☑ No

If Yes, provide particulars as an Exhibit.

Exhibit No.

The APPLICANT hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because use of the same, whether by license or otherwise, and requests and authorization in accordance with this application. (See Section 304 of the Communications Act of 1934, as amended).

The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

CERTIFICATION

1. By checking Yes, the applicant certifies, that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862, or, in the case of a non-individual applicant (e.g., corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits that includes FCC benefits pursuant to that section. For the definition of a "party" for these purposes, see 47 C.F.R. Section 1.2002(b).

☑ Yes ☐ No

2. I certify that the statements in this application are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

Name	Signature	
Chuck Lontine		
Title	Date	Telephone Number
Manager	5/5/2016	3033821000

WILLFUL FALSE STATEMENTS ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION

FCC NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT AND THE PAPERWORK REDUCTION ACT

The solicitation of personal information requested in this application is authorized by the Communications Act of 1934, as amended. The Commission will use the information provided in this form to determine whether grant of the application is in the public interest. In reaching that determination, or for law enforcement purposes, it may become necessary to refer personal information contained in this form to another government agency. In addition, all information provided in this form will be available for public inspection. If information requested on the form is not provided, the application may be returned without action having been taken upon it or its processing may be delayed while a request is made to provide the missing information. Your response is required to obtain the requested authorization.

Public reporting burden for this collection of information is estimated to average 639 hours and 53 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, can be sent to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0627), Washington, D. C. 20554. Do NOT send completed forms to this address.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507.

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant
Marconi Wireless of Colorado, LLC

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
KKCL		1550	Unlimited	0.35	0.99

2. Station location

State	City or Town
Colorado	Golden

3. Transmitter location

State	County	City or Town	Street address (or other identification)
CO	Jefferson	Golden	10800 Hwy 93 RockyFlats

4. Main studio location

State	County	City or Town	Street address (or other identification)
CO	Jefferson	Golden	10800 Hwy 93 RockyFlats

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

State	County	City or Town	Street address (or other identification)

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.

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
2.75	4.59
Measured antenna or common point resistance (in ohms) at operating frequency	**Measured antenna or common point reactance (in ohms) at operating frequency**
Night: 50 Day: 47	Night: j 0 Day: +j 26.3

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(W)	0.0 Ref		1.0 Ref			
2(E)	+20.6		0.754			

Manufacturer and type of antenna monitor: Potomac AM19 (204)

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.
Guyed Tower	45.7m	46m	46m	Exhibit No.

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
39 ° 53 ' 31 "	105 ° 14 ' 20 "

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.

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

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

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

Addition of FM translator antenna on east tower.

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)
Timothy C. Cutforth	
Address (include ZIP Code) Broadcast Engineering Consultants 965 S. Irving Street Denver CO 80219	Date May 3, 2016 Telephone No. (Include Area Code) 303-937-1900

☐ Technical Director

☑ Registered Professional Engineer

☐ Chief Operator

☐ Technical Consultant

☐ Other (specify)

EXHIBIT E-1

APPLICATION FOR LICENSE INFORMATION
RADIO STATION KKCL
GOLDEN, COLORADO

Marconi Wireless of Colorado, LLC
May 5, 2016

1550 kHz 0.99 kW-D/0.35 kW-N DA-N

EXECUTIVE SUMMARY

This engineering exhibit supports an application for modified license for the nighttime directional antenna system of radio station KKCL in Golden, Colorado (FCC FID No. 161314) pursuant to the AM technical rules permitting moment-method modeling of eligible AM directional arrays.

KKCL is licensed to operate on 1550 kHz with non-directional antenna daytime and a power of 0.99kW and directional antenna nighttime with a power of 0.35kW BMM20140131ART. The instant application requests modified license and program test authority based on Method of Moments certification of the facility after installation of an FM antenna on the East tower of the directional array.

Information is provided herein showing that the directional antenna parameters for the nighttime pattern authorized by the FCC have been determined in accordance with the requirements of 47 C.F.R. §73.151(c). The system has been preset to values computed to produce antenna monitor parameters within ±5 percent in ratio and ±3 degrees in phase of the modeled values, as required by the Rules. A station license is requested herewith specifying the new nighttime operating parameters.

Analysis of Tower Impedance Measurements to Verify Method of Moments Model

Tower base impedance measurements were made at the final J-plugs within the Antenna Tuning Units (ATUs) using a Delta OIB-1operating impedance bridge. The other tower was open-circuited at the same point where the impedance measurements were made for them. The static drain chokes at the ATU outputs are located on the ATU side of the antenna sample and are disconnected from all towers when the J-plugs are removed for measurements. On the East tower an isolation coil was used to connect to the FM feedline across the tower base insulator and the isocoil was disconnected from the tower during the reference measurement. This arrangement left only the short feed tubing between the ATU outputs and the tower base in series in the impedance measurements.

ACSModel (MININEC 3.1 core) was used to model the KKCL array.

A lumped load with a reactance of –j10,000 Ohms was modeled at the base of the other tower to simulate an open circuit at each tower base.

The tower heights were adjusted in the model in order to achieve calibration of the model with the measured base impedances. All modeled tower heights were within 75 to 125 percent of the physical tower height as required by the FCC Rules.

The modeled radius for each tower was near the physical radius of the tower as determined by the formula $3T/2\pi$, where T is the tower face width in meters. The KKCL radiators are uniform cross-section triangular towers and have face widths of 0.4256 meters resulting in an apparent radius of 0.2032 meter. The tower's radius was modeled at 0.2033 meter for tower 1 and 0.3040 meter for tower 2 within the allowable range of modeled radius to best fit the tower measured impedance characteristic.

Each tower is fed with a short length of large-diameter copper tubing that exhibits a small amount of series inductive reactance. This tubing connects to each tower immediately above the base insulator.

The two towers had slightly different impedances likely due to a 1 ft difference in the tower base pier height and a very short ground lead from the tower base from the ATU for tower 1. The ground contour around the base of the tower is also slightly different. This results in a different measured base resistance than the other tower. The ATU is also lower and situated very close to the tower base, resulting in a lower series inductance. The model calibration process was able to compensate for these differences well within the allowable tolerances specified in the rules.

A circuit model was constructed for each tower using the assumed series feed tubing and shunt base region reactances. This model was used with the Westberg Circuit Analysis Program (WCAP) to determine the effects of these reactances on the ATU output impedance at each tower. In each of the WCAP tabulations, node 2 represents the ATU output reference point and node 3 represents the tower base. Node 0 represents ground potential. The ATU output impedances can be found in the "TO NODE IMPEDANCE" column of each WCAP tabulation, following the phantom 1.0 ohm resistor inserted in the model to provide a calculation point for the impedance. The complex base impedance of each tower from the moment method model is represented in each case by the complex load from node 3 to ground. A value of 80 pF was assumed for the base insulator, and this appears in the WCAP tabulation from node 3 to ground as 0.001 (microfarads) due to rounding. The WCAP circuit model tabulation immediately follows the model for each tower.

§73.151(c)(1)(vii) permits the use of a lumped series inductance of 10 uH or less between the output port of each antenna tuning unit and the associated tower. In each case, the value of lumped series inductance was below this 10 uH limit.

The modeled and measured impedances at the ATU output J-plugs with the other tower open-circuited at their ATU output J-plugs agree within ±2 ohms and ±4 percent as required by the FCC rules.

Table 1 – Analysis of Tower Impedance Measurements to Verify Moment Method Model

Twr.	Z_{BASE} (Modeled)	Z_{ATU} (Modeled)	Z_{ATU} (Measured)	Series L (uH)	Shunt C pF	Phys. Height (deg.)	Model Height (deg.)	% Phys. Height
1 (W)	43.4+j20.1	44.9+j26.3	47.0 +j26.3	0.78	80	85.0	89.7	105.5
2 (E)	45.7 +j29.4	46.0+j52.1	48.0 +j51.1	2.34	80	85.0	91.5	107.6

****
ACSModel
(MININEC 3.1 Core)
05-03-2016 08:52:18
****

KKCL
mom west tower 1
calibration run

Frequency = 1.550 MHz Wavelength = 193.41936 Meters

No. of Wires: 2

Wire No. 1	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	48.19366	0.304	0	20

Wire No. 2	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-22.15771	105.1459	0		-2	
-22.15771	105.1459	49.16076	0.2033	0	20

**** ANTENNA GEOMETRY ****

Wire No. 1	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.304	-1	1	1
0	0	2.409683	0.304	1	1	2
0	0	4.819366	0.304	1	1	3
0	0	7.229048	0.304	1	1	4
0	0	9.638731	0.304	1	1	5
0	0	12.04841	0.304	1	1	6
0	0	14.4581	0.304	1	1	7
0	0	16.86778	0.304	1	1	8
0	0	19.27746	0.304	1	1	9
0	0	21.68715	0.304	1	1	10
0	0	24.09683	0.304	1	1	11
0	0	26.50651	0.304	1	1	12
0	0	28.91619	0.304	1	1	13
0	0	31.32588	0.304	1	1	14
0	0	33.73556	0.304	1	1	15
0	0	36.14524	0.304	1	1	16
0	0	38.55492	0.304	1	1	17
0	0	40.96461	0.304	1	1	18
0	0	43.37429	0.304	1	1	19
0	0	45.78397	0.304	1	0	20

Wire No. 2 Coordinates

X	Y	Z	Radius	Connection End1	Connection End2	Pulse No.
-22.15771	105.1459	0	0.2033	-2	2	21
-22.15771	105.1459	2.458038	0.2033	2	2	22
-22.15771	105.1459	4.916076	0.2033	2	2	23
-22.15771	105.1459	7.374114	0.2033	2	2	24
-22.15771	105.1459	9.832151	0.2033	2	2	25
-22.15771	105.1459	12.29019	0.2033	2	2	26
-22.15771	105.1459	14.74823	0.2033	2	2	27
-22.15771	105.1459	17.20626	0.2033	2	2	28
-22.15771	105.1459	19.6643	0.2033	2	2	29
-22.15771	105.1459	22.12234	0.2033	2	2	30
-22.15771	105.1459	24.58038	0.2033	2	2	31
-22.15771	105.1459	27.03842	0.2033	2	2	32
-22.15771	105.1459	29.49645	0.2033	2	2	33
-22.15771	105.1459	31.95449	0.2033	2	2	34
-22.15771	105.1459	34.41253	0.2033	2	2	35
-22.15771	105.1459	36.87057	0.2033	2	2	36
-22.15771	105.1459	39.32861	0.2033	2	2	37
-22.15771	105.1459	41.78664	0.2033	2	2	38
-22.15771	105.1459	44.24468	0.2033	2	2	39
-22.15771	105.1459	46.70272	0.2033	2	0	40

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 1, 191.1, 16.9

Number of Loads: 1
Pulse No., Resistance, Reactance: 21 , 0 ,-10000

********** SOURCE DATA **********
Pulse 1 Voltage = (182.8227, 55.6378j)
Current = (3.9529, -0.5509j)
Impedance = (43.444, 20.13j)
Power = 346.02 Watts

```
WESTBERG CIRCUIT ANALYSIS PROGRAM


FILE NAME = kkcl1cal.cir

I     1.0000    0    1     .0000     .0000     .0000
R     1.0000    1    2     .0000     .0000     .0000
L      .7800    2    3     .0000     .0000     .0000
C      .0001    3    0     .0000     .0000     .0000
R    43.4000    3    0   20.1000     .0000     .0000
EX     .0000    0    0     .0000     .0000     .0000


FREQ = 1.550

  NODE       VOLT MAG      VOLT PHASE
    1         52.9127        29.8273
    2         52.0475        30.3748
    3         48.6498        22.6329
                          BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                          MAG      PHASE       MAG      PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
VSWR
 R    1-  2     1.000      1.00      .000      1.00      .000     45.90     26.32     44.90     26.32
 L    2-  3      .780      7.60    90.000      1.00      .000     44.90     26.32     44.90     18.72
 C    3-  0      .000     48.65    22.633       .04   112.633       .00  -1140.90       .00       .00
 R    3-  0    43.400     48.65    22.633      1.02    -2.218     43.40     20.10       .00       .00
```

Copy of file KKCL1cal.CIR

```
1.550 0. 1
I 1 0 1
R 1.000 1 2
L 0.78 2 3
C .00009 3 0
R 43.4 3 0 +20.1
EX
```

```
****************************************
                ACSModel
           (MININEC 3.1 Core)
     05-03-2016          09:32:47
****************************************

KKCL
mom east tower 2
calibration run

Frequency = 1.550 MHz      Wavelength = 193.41936 Meters

No. of Wires: 2
```

Wire No. 1	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
0	0	0		-1	
0	0	48.19366	0.304	0	20

Wire No. 2	Coordinates			End	No. of
X	Y	Z	Radius	Connection	Segments
-22.15771	105.1459	0		-2	
-22.15771	105.1459	49.16076	0.2033	0	20

**** ANTENNA GEOMETRY ****

Wire No. 1	Coordinates			Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
0	0	0	0.304	-1	1	1
0	0	2.409683	0.304	1	1	2
0	0	4.819366	0.304	1	1	3
0	0	7.229048	0.304	1	1	4
0	0	9.638731	0.304	1	1	5
0	0	12.04841	0.304	1	1	6
0	0	14.4581	0.304	1	1	7
0	0	16.86778	0.304	1	1	8
0	0	19.27746	0.304	1	1	9
0	0	21.68715	0.304	1	1	10
0	0	24.09683	0.304	1	1	11
0	0	26.50651	0.304	1	1	12
0	0	28.91619	0.304	1	1	13
0	0	31.32588	0.304	1	1	14
0	0	33.73556	0.304	1	1	15
0	0	36.14524	0.304	1	1	16
0	0	38.55492	0.304	1	1	17
0	0	40.96461	0.304	1	1	18
0	0	43.37429	0.304	1	1	19
0	0	45.78397	0.304	1	0	20

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-22.15771	105.1459	0	0.2033	-2	2	21
-22.15771	105.1459	2.458038	0.2033	2	2	22
-22.15771	105.1459	4.916076	0.2033	2	2	23
-22.15771	105.1459	7.374114	0.2033	2	2	24
-22.15771	105.1459	9.832151	0.2033	2	2	25
-22.15771	105.1459	12.29019	0.2033	2	2	26
-22.15771	105.1459	14.74823	0.2033	2	2	27
-22.15771	105.1459	17.20626	0.2033	2	2	28
-22.15771	105.1459	19.6643	0.2033	2	2	29
-22.15771	105.1459	22.12234	0.2033	2	2	30
-22.15771	105.1459	24.58038	0.2033	2	2	31
-22.15771	105.1459	27.03842	0.2033	2	2	32
-22.15771	105.1459	29.49645	0.2033	2	2	33
-22.15771	105.1459	31.95449	0.2033	2	2	34
-22.15771	105.1459	34.41253	0.2033	2	2	35
-22.15771	105.1459	36.87057	0.2033	2	2	36
-22.15771	105.1459	39.32861	0.2033	2	2	37
-22.15771	105.1459	41.78664	0.2033	2	2	38
-22.15771	105.1459	44.24468	0.2033	2	2	39
-22.15771	105.1459	46.70272	0.2033	2	0	40

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 21, 212.7, 38.3

Number of Loads: 1
Pulse No., Resistance, Reactance: 1 , 0 ,-10000

********** SOURCE DATA **********
Pulse 21 Voltage = (166.9986, 131.7297j)
Current = (3.8952, 0.3758j)
Impedance = (45.709, 29.409j)
Power = 350.0 Watts

```
WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kkcl2cal.cir

I      1.0000     0     1      .0000      .0000      .0000
R      1.0000     1     2      .0000      .0000      .0000
L      2.3400     2     3      .0000      .0000      .0000
C       .0001     3     0      .0000      .0000      .0000
L    150.0000     3     0      .0000      .0000      .0000
R     45.7000     3     0    29.4000      .0000      .0000
EX     .0000     0     0      .0000      .0000      .0000


FREQ = 1.550

   NODE        VOLT MAG      VOLT PHASE
     1         70.1156         47.9584
     2         69.4499         48.5711
     3         54.4911         32.5059
                           BRANCH VOLTAGE       BRANCH CURRENT FROM NODE IMPEDANCE  TO NODE IMPEDANCE
                           MAG       PHASE      MAG       PHASE RESISTANCE REACTANCE RESISTANCE REACTANCE
VSWR
 R     1-  2      1.000     1.00       .000     1.00       .000     46.95     52.07     45.95     52.07
 L     2-  3      2.340    22.79     90.000     1.00       .000     45.95     52.07     45.95     29.28
 C     3-  0       .000    54.49     32.506      .04    122.506       .00  -1283.51       .00       .00
 L     3-  0    150.000    54.49     32.506      .04    -57.494       .00   1460.84       .00       .00
 R     3-  0     45.700    54.49     32.506     1.00      -.248     45.70     29.40       .00       .00
```

COPY OF KKCL2CAL.CIR

```
1.550 0. 1
I 1 0 1
R 1.0000 1 2
L 2.34 2 3
C .00008 3 0
L 150. 3 0
R 45.7 3 0 +29.4
EX
```

Derivation of Operating Parameters for Nighttime Directional Antenna

Once calibrated against the measured individual open-circuited base impedances, the moment method model was utilized for nighttime directional antenna calculations. These calculations were made to determine the complex voltage source values to be applied at ground level for each tower of the array to produce the current moment sums for the towers which, when normalized to the reference tower, equate to the theoretical field parameters of the authorized directional pattern. These voltage sources were then applied in the model and the tower currents were calculated.

Twenty segments were used for each tower. The KKCL towers are base sampled, which is permitted for towers of 120 electrical degrees or less. As such, the first (ground) segment of each tower was used to determine the model operating parameters of the array.

A circuit model was constructed to determine the effect of the series feed inductance, and shunt base region capacitance on the ATU output current. The circuit model for each tower is essentially the circuit model used for model verification above using the model-predicted operating impedance for each tower. Again, this model was used with the Westberg Circuit Analysis Program (WCAP).

This effect was, as expected, minimal, and the results are tabulated in the table below along with the base operating parameters for the daytime array.

Twr.	Node	Current Magnitude (amperes)	MoM Base Current Ratios	Current Phase (degrees)	WCAP Current Offset for Unity I_{BASE}	WCAP Phase Offset for Unity $Ø_{BASE}$ (degrees)	Antenna Monitor Ratio	Antenna Monitor Phase (degrees)
1 W	1	3.755	1.000	+4.76	0.993	+1.86	1. 0ref	0.0ref
2 E	21	2.931	0.750	+27.14	0.998	+0.12	0.754	+20.6

****
ACSModel
(MININEC 3.1 Core)
05-03-2016 09:57:58
****

kkcl
mom directional night
parameters determinationation

Frequency = 1.550 MHz Wavelength = 193.41936 Meters

No. of Wires: 2

Wire No. 1 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
0	0	0		-1	
0	0	48.19366	0.304	0	20

Wire No. 2 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
-22.15771	105.1459	0		-2	
-22.15771	105.1459	49.16076	0.2033	0	20

**** ANTENNA GEOMETRY ****

Wire No. 1 Coordinates X	Y	Z	Radius	Connection End1	End2	Pulse No.
0	0	0	0.304	-1	1	1
0	0	2.409683	0.304	1	1	2
0	0	4.819366	0.304	1	1	3
0	0	7.229048	0.304	1	1	4
0	0	9.638731	0.304	1	1	5
0	0	12.04841	0.304	1	1	6
0	0	14.4581	0.304	1	1	7
0	0	16.86778	0.304	1	1	8
0	0	19.27746	0.304	1	1	9
0	0	21.68715	0.304	1	1	10
0	0	24.09683	0.304	1	1	11
0	0	26.50651	0.304	1	1	12
0	0	28.91619	0.304	1	1	13
0	0	31.32588	0.304	1	1	14
0	0	33.73556	0.304	1	1	15
0	0	36.14524	0.304	1	1	16
0	0	38.55492	0.304	1	1	17
0	0	40.96461	0.304	1	1	18
0	0	43.37429	0.304	1	1	19
0	0	45.78397	0.304	1	0	20

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-22.15771	105.1459	0	0.2033	-2	2	21
-22.15771	105.1459	2.458038	0.2033	2	2	22
-22.15771	105.1459	4.916076	0.2033	2	2	23
-22.15771	105.1459	7.374114	0.2033	2	2	24
-22.15771	105.1459	9.832151	0.2033	2	2	25
-22.15771	105.1459	12.29019	0.2033	2	2	26
-22.15771	105.1459	14.74823	0.2033	2	2	27
-22.15771	105.1459	17.20626	0.2033	2	2	28
-22.15771	105.1459	19.6643	0.2033	2	2	29
-22.15771	105.1459	22.12234	0.2033	2	2	30
-22.15771	105.1459	24.58038	0.2033	2	2	31
-22.15771	105.1459	27.03842	0.2033	2	2	32
-22.15771	105.1459	29.49645	0.2033	2	2	33
-22.15771	105.1459	31.95449	0.2033	2	2	34
-22.15771	105.1459	34.41253	0.2033	2	2	35
-22.15771	105.1459	36.87057	0.2033	2	2	36
-22.15771	105.1459	39.32861	0.2033	2	2	37
-22.15771	105.1459	41.78664	0.2033	2	2	38
-22.15771	105.1459	44.24468	0.2033	2	2	39
-22.15771	105.1459	46.70272	0.2033	2	0	40

Sources: 2
Pulse No., Voltage Magnitude, Phase (Degrees): 1, 141.9, 17.6
Pulse No., Voltage Magnitude, Phase (Degrees): 21, 90.7, 72.2

Number of Loads: 0

********** SOURCE DATA **********
Pulse 1 Voltage = (135.3028, 42.8595j)
Current = (3.7417, 0.3115j)
Impedance = (36.859, 8.386j)
Power = 259.81 Watts

Pulse 21 Voltage = (27.6609, 86.3717j)
Current = (2.5074, 1.2855j)
Impedance = (22.72, 22.799j)
Power = 90.19 Watts

Total Power = 350.000 Watts

********** CURRENT DATA **********

Wire No. 1 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	3.7417	0.3115	3.7547	4.7583
2	3.7613	0.2158	3.7675	3.2838
3	3.7463	0.1623	3.7498	2.4812
4	3.7074	0.1173	3.7093	1.8128
5	3.6457	0.0785	3.6465	1.2331
6	3.5619	0.0445	3.5622	0.7156
7	3.4567	0.0148	3.4567	0.2457
8	3.3307	-0.0108	3.3307	-0.1862
9	3.1846	-0.0326	3.1848	-0.5868
10	3.0192	-0.0506	3.0196	-0.9609
11	2.8352	-0.065	2.8359	-1.3126
12	2.6334	-0.0756	2.6345	-1.6448
13	2.4147	-0.0826	2.4161	-1.9602
14	2.1799	-0.0861	2.1816	-2.2609
15	1.9298	-0.0859	1.9317	-2.5489
16	1.6648	-0.0822	1.6668	-2.8258
17	1.3851	-0.0748	1.3871	-3.0931
18	1.0903	-0.0639	1.0921	-3.3527
19	0.7777	-0.049	0.7793	-3.6065
20	0.4418	-0.0298	0.4428	-3.8616
E	0.0	0.0	0.0	0.0

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
21	2.5074	1.2855	2.8177	27.1433
22	2.5501	1.2659	2.847	26.4007
23	2.5584	1.2456	2.8455	25.9589
24	2.5469	1.2199	2.824	25.593
25	2.5171	1.1885	2.7836	25.2754
26	2.47	1.1514	2.7252	24.9921
27	2.4062	1.1085	2.6493	24.7354
28	2.3263	1.0602	2.5565	24.4999
29	2.2308	1.0064	2.4473	24.2821
30	2.1202	0.9475	2.3223	24.0792
31	1.9952	0.8837	2.1822	23.889
32	1.8564	0.8153	2.0276	23.7098
33	1.7045	0.7426	1.8593	23.5402
34	1.5401	0.6658	1.6779	23.3789
35	1.3638	0.5852	1.484	23.225
36	1.176	0.5011	1.2783	23.0775
37	0.977	0.4134	1.0609	22.9356
38	0.7666	0.3222	0.8316	22.7985
39	0.5434	0.2269	0.5888	22.6651
40	0.3029	0.1257	0.3279	22.5328
E	0.0	0.0	0.0	0.0

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kkcl1n.cir

I	3.7290	0	1	6.6223	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	.7800	2	3	.0000	.0000	.0000
C	.0001	3	0	.0000	.0000	.0000
R	36.8590	3	0	8.3860	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.550

NODE	VOLT MAG	VOLT PHASE
1	153.3852	27.7530
2	149.9129	28.2667
3	141.9283	17.5757

			VSWR	BRANCH VOLTAGE MAG	BRANCH VOLTAGE PHASE	BRANCH CURRENT MAG	BRANCH CURRENT PHASE	FROM NODE IMPEDANCE RESISTANCE	FROM NODE IMPEDANCE REACTANCE	TO NODE IMPEDANCE RESISTANCE	TO NODE IMPEDANCE REACTANCE
R	1-	2	1.000	3.73	6.622	3.73	6.622	38.37	14.83	37.37	14.83
L	2-	3	.780	28.33	96.622	3.73	6.622	37.37	14.83	37.37	7.23
C	3-	0	.000	141.93	17.576	.12	107.576	.00	-1140.90	.00	.00
R	3-	0	36.859	141.93	17.576	3.75	4.758	36.86	8.39	.00	.00

Copy of file KKCL1n.cir

```
1.550 0. 1
I 3.729 0 1 6.6223
R 1.000 1 2
L 0.78 2 3
C .00009 3 0
R 36.859 3 0 +8.386
EX
```

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = kkcl2n.cir

I	2.8120	0	1	27.2660	.0000	.0000
L	150.0000	0	3	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	2.3400	2	3	.0000	.0000	.0000
C	.0001	3	0	.0000	.0000	.0000
R	22.7200	3	0	22.8000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.550

NODE	VOLT MAG	VOLT PHASE
1	144.6387	89.6811
2	143.3582	90.6772''
3	90.7068	72.2433

			VSWR	BRANCH VOLTAGE MAG	BRANCH VOLTAGE PHASE	BRANCH CURRENT MAG	BRANCH CURRENT PHASE	FROM NODE IMPEDANCE RESISTANCE	FROM NODE IMPEDANCE REACTANCE	TO NODE IMPEDANCE RESISTANCE	TO NODE IMPEDANCE REACTANCE
L	0-	3	150.000	90.71	-107.757	.06	162.243	.00	.00	.00	-1460.84
R	1-	2	1.000	2.81	27.266	2.81	27.266	23.82	45.59	22.82	45.59
L	2-	3	2.340	64.08	117.266	2.81	27.266	22.82	45.59	22.82	22.80
C	3-	0	.000	90.71	72.243	.07	162.243	.00	-1283.51	.00	.00
R	3-	0	22.720	90.71	72.243	2.82	27.143	22.72	22.80	.00	.00

Copy of file KKCL2n.CIR

```
1.550 0. 1
I 2.812 0 1 27.266
L 150 0 3
R 1.0000 1 2
L 2.34 2 3
C .00008 3 0
R 22.72 3 0 +22.80
EX
```

Summary of tower Geometry

With respect to Question 9, Section III, Page 2 of the attached Form 302-AM, the tower information is as follows:

Tower No.	Height above base insulator (meters)	Height above ground w/o obst. lighting (meters)	Overall height above ground (meters)
1	45.7	46.0	46.0
2	45.7	46.0	46.0

All towers are uniform cross-section, steel, guyed vertical radiators.

Sampling System

The sampling system consists of Delta Electronics TCT-3 current transformers installed at the output of each antenna tuning unit, immediately adjacent to the final J-plug. Samples from the current transformers are fed to the antenna monitor via equal lengths of 1/4-inch foam-dielectric coaxial transmission lines. The antenna monitor is a Potomac Instruments AM19 Type 204.

Impedance measurements were made of the antenna sampling system using an AIM 4170 network analyzer. The measurements were made looking into the antenna monitor ends of the sample lines with the tower ends of the sample lines open-circuited.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. As the length of 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 sample line length at the resonant frequency above carrier frequency, which is the closest one to the carrier frequency, was found to be 90 electrical degrees. The electrical length at carrier frequency appearing in the table below was calculated by ratioing the frequencies.

Twr.	Sample Line Open-Circuited Resonance Below 1550 kHz (kHz)	Sample Line Open-Circuited Resonance Above 1550 kHz (kHz)	Sample Line Calculated Electrical Length At 1550 kHz (deg.)
1	1004.5	3004.3	138.9
2	1000.5	3046.2	139.4

Because the electrical lengths were determined to be 0.5 degrees different, the sample lines meet the requirement in the Rules that they be equal in length within one electrical degree.

To determine the characteristic impedance values of the sample lines, open-circuited measurements were made with frequencies offset to produce ± 45 degrees of electrical length from resonance.

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:

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

Twr.	+ 45 Deg. Offset Frequenc y (kHz)	+45 Deg. Measured Impedance (ohms)	- 45 Deg. Offset Frequenc y (kHz)	-45 Deg. Measured Impedance (ohms)	Calculated Characteristic Impedance (ohms)
1	1506.8	13.3+j48.2	502.3	8.6 –j49.8	50.2
2	1500.8	1.5 +j49.9	500.3	5.7 –j49.8	50.0

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

The calibration of the Delta TCT-3 current transformers was verified by removing them all from the ATUs and installing them on a test jig so that each was located very close to the adjacent transformer (spacing of less than two inches). Short transmission lines of equal length were connected between the outputs of all four current transformers and the inputs of the antenna monitor. The Potomac AM19 antenna monitor was calibrated using the internal calibration function. A single source of RF current on the carrier frequency was fed through a conductor passing through all of the current transformers, and the differential phases and ratios were noted on the antenna monitor as follows:

Twr.	Ratio	Phase (deg.)
1	1.003	0.0
2	Ref.	Ref.

The requirement that the sample current transformers are accurate to within the manufacturer's specification (±2% ratio and ±2 degrees phase) has thus been demonstrated.

The impedance of each of the sample lines was measured with the sample current transformers attached. These impedances are tabulated below:

Twr.	R (ohms)	X (ohms)
1	50.8	-j1.2
2	51.0	-j1.1

Direct Measurement of Power

Common point impedance measurements were made using a Delta OIB-1A bridge connected at the common point bus of the phasing and coupling system. The resistance value was adjusted to 50 ohms and the reactance value was adjusted to zero.

The base impedance for nondirectional operation on tower 1 (W) was measured using a Delta OIB-1A operating impedance bridge and from the measured impedance of 47 +j26.3 is computed as 4.59Amps for 990 Watts.