The Law Office of

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August 13, 2012

Federal Communications Commission
c/o U.S. Bank – Government Lockbox # 979089
SL-MO-C2-GL
1005 Convention Plaza
St. Louis, MO 63101

> **Re:** **Station WBKK(AM)**
> **File No. BMP-20120127AJM**
> **Facility No. 160559**
> **Wilton, MN**
> **FRN: 0018272773**

To whom this may concern:

Transmitted herewith in triplicate, on behalf of Bemidji Radio Inc., by its attorney, is an application (FCC Form 302-AM), for issuance of a license to cover the above-referenced construction permit.

Transmitted herewith also is the required $1,365.00 Filing Fee.

ISSUANCE OF PROGRAM TEST AUTHORITY RESPECTFULLY IS REQUESTED.

If there are any questions, please contact this office.

Very truly yours,

Dan J. Alpert

Counsel for Bemidji Radio Inc.

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. *BmmL-20120814ABP*

SECTION I - APPLICANT FEE INFORMATION

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

   Bemidji Radio Inc.

MAILING ADDRESS (Line 1) (Maximum 35 characters)
   P.O. Box 1021

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
Bemidji	MN	59918

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
218-444-2773	WBKK	160559

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

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

   [ ] Governmental Entity [ ] Noncommercial educational licensee [ ] Other (Please explain):

   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
M M R	0 0 0 1	$ 635.00	

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
M O R	0 0 0 1	$ 730.00	

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 $ 1365.00	FOR FCC USE ONLY

FCC 302-AM
August 1995

SECTION II - APPLICANT INFORMATION

1. NAME OF APPLICANT		
Bemidji Radio Inc.		

MAILING ADDRESS
P.O. Box 1021

CITY Bemidji	STATE MN	ZIP CODE 59918

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
WBKK	Wilton, MN	BNP-20050118AAX	BMP-20120127AJM	8/15/2012

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

If No, explain in an Exhibit.

[ ] Yes [✔] No

Exhibit No.
N/A

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

If No, state exceptions in an Exhibit.

[✔] Yes [ ] No

Exhibit No.
N/A

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?

If Yes, explain in an Exhibit.

[ ] Yes [✔] No

Exhibit No.
N/A

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)?

If No, explain in an Exhibit.

[✔] Yes [ ] No

[ ] Does not apply

Exhibit No.
N/A

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.
N/A

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 Edward Paul DeLaHunt	Signature Edward P Wilha
Title President/Bemidji Radio, Inc	Date 8/13/12	Telephone Number 703-887-6000

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.

Name of Applicant

BEMIDJI RADIO, INC.

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

[X] 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
WBKK	BMP-20120127AJM	820	UNLIMITED	0.75	10.0

2. Station location

State	City or Town
MINNESOTA	WILTON

3. Transmitter location

State	County	City or Town	Street address (or other identification)
MN	HUBBARD	BEMIDJI	50375 COUNTY 3

4. Main studio location

State	County	City or Town	Street address (or other identification)
MN	BELTRAMI	BEMIDJI	324 BELTRAMI AVE.

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

State	County	City or Town	Street address (or other identification)
MN	BELTRAMI	BEMIDJI	324 BELTRAMI AVE.

6. Has type-approved stereo generating equipment been installed?   [ ] Yes   [X] No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68?   [X] 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
4.02	14.5

Measured antenna or common point resistance (in ohms) at operating frequency		Measured antenna or common point reactance (in ohms) at operating frequency	
Night 50.0	Day 50.0	Night -3.3	Day -3.3

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 (S)	+120.7	+120.7	.895	.895		
2 (C)	0.0	0.0	1.000	1.000		
3 (N)	-125.2	-125.2	.342	.342		

Manufacturer and type of antenna monitor: **GORMAN-REDLICH MODEL CMR**

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

Type Radiator **Uniform cross section guyed Towers**	Overall height in meters of radiator above base insulator, or above base, if grounded. **91.4**	Overall height in meters above ground (without obstruction lighting) **92.0**	Overall height in meters above ground (include obstruction lighting) **93.2 Twrs 1 & 3 92.0 Twr 2**	If antenna is either top loaded or sectionalized, describe fully in an Exhibit. Exhibit No. **N/A**

Excitation   [X] 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	**47** °	**23** '	**29** "	West Longitude	**95** °	**04** '	**40** "

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.
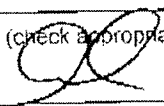
Exhibit No.
ENG

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.

     NEW CONSTRUCTION

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) **KURT GORMAN**	Signature (check appropriate box below)
Address (include ZIP Code) **PHASETEK INC.** **550 CALIFORNIA ROAD , UNIT 11** **QUAKERTOWN , PA 18951**	Date **AUGUST 14 ,2012**
	Telephone No. (Include Area Code) **215 536-6648**

[ ] Technical Director   [ ] Registered Professional Engineer

[ ] Chief Operator   [X] Technical Consultant

[ ] Other (specify)

ENGINEERING STATEMENT CONCERNING

APPLICATION FOR LICENSE INFORMATION

EMPLOYING MOMENT METHOD MODELING

WBKK, 820 KHZ, DA-2

WILTON, MINNESOTA

AUGUST, 2012

PHASETEK INC.

ENGINEERING STATEMENT CONCERNING
APPLICATION FOR LICENSE INFORMATION
EMPLOYING MOMENT METHOD MODELING
WBKK, 820 KHZ, DA-2
WILTON, MINNESOTA
AUGUST, 2012

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302-AM

ENGINEERING STATEMENT

PHASETEK INC.

ENGINEERING STATEMENT CONCERNING
APPLICATION FOR LICENSE INFORMATION
EMPLOYING MOMENT METHOD MODELING
WBKK, 820 KHZ, DA-2
WILTON, MINNESOTA
AUGUST, 2012

SUMMARY

Adjustment of the Antenna System and a Proof of Performance employing Moment Method Modeling was performed on Radio Station WBKK, 820 kHz, Wilton, Minnesota, after installation of Antenna Phasing equipment, Transmission and Sampling Lines, and new Tower Feed Assemblies. WBKK holds Construction Permit Number: BMP-20120127AJM to construct this Transmitter site. This report was prepared on behalf of Bemidji Radio Inc., licensee of Radio Station WBKK.

SITE MODIFICATIONS

The WBKK Transmitter site is newly constructed. New Towers, Ground System, Transmission Lines, Sampling Lines, and Antenna Phasing and Branching equipment have been installed. A License Application employing Moment Method Modeling as set forth in Section 73.151(C) has been done to cover the Radio Station WBKK Construction Permit and license under the new rules.

REFERENCE POINTS

Reference Points were measured at pattern minima and maxima for the Directional mode of operation. These Points and their measured field intensity are shown in Figure 12.

METHOD OF MOMENTS DETAIL

All Moment Method Modeling was done with Expert MININEC Broadcast Professional, Version 23. One wire was used to represent each Tower. Towers were driven individually to verify the Model compared to measured impedance data. Once the Model was verified, both the Day and Night Directional Antenna Systems were computed. For Directional modes, the complex voltage values for sources located at ground level were computed. These sources produce current moment sums for each Tower that, when normalized, equate to the Theoretical Field Parameters for each respective Tower.

PHASETEK INC.

ENGINEERING STATEMENT CONCERNING
APPLICATION FOR LICENSE INFORMATION
EMPLOYING MOMENT METHOD MODELING
WBKK, 820 KHZ, DA-2
WILTON, MINNESOTA
AUGUST, 2012

MEASURING EQUIPMENT AND PERSONNEL

All Tower Resistance and Reactance measurements were made with a Delta Electronics OIB-3 Operating Impedance Bridge and an Array Solutions Power AIM 120 Vector Network Analyzer. Before use, tests of known impedances were made to verify operation. All Field Intensity Measurements were made with a Potomac Instruments Field Intensity Meter; FIM-41, Serial Number 2181, calibrated on October 19, 2009. The meter was calibrated by Potomac Instruments, Silver Spring, Maryland. All measurements were taken by Phasetek Inc. personnel supervised by Kurt Gorman of Phasetek Inc.

CONCLUSION

It is believed that the WBKK Antenna System has been constructed and adjusted in accordance with all applicable Commission rules and regulations. The foregoing was prepared on behalf of Bemidji Radio Inc., under the immediate supervision of Kurt Gorman, Phasetek Inc., Quakertown, Pennsylvania, whose qualifications are a matter of record with the Federal Communications Commission. The statements herein are true and correct of his knowledge, except such statements made on information and belief, and as to these statements he believes them to be true and correct.

Kurt Gorman, President
Phasetek Inc.
Quakertown, Pennsylvania

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152

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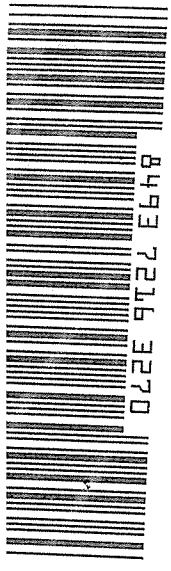
|||| 8493 7216 3270 ||||
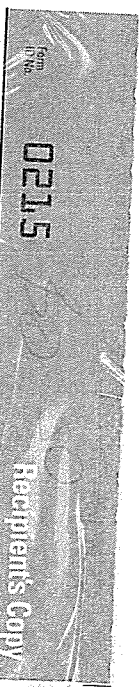
4a Express Package Service

Form I.D. No. **0215**

Packages up to 150 lbs.

- [ ] FedEx Priority Overnight
  Next business morning.*
- [ ] FedEx Standard Overnight
  Next business afternoon.*
- [ ] FedEx First Overnight
  Earliest next business morning delivery to select locations.*

- [ ] FedEx 2Day
  Second business day.*
- [ ] FedEx Express Saver
  Third business day.*

FedEx Envelope rate not available. Minimum charge: One-pound rate.

4b Express Freight Service

Packages over 150 lbs.

- [ ] FedEx 1Day Freight*
  Next business day.*
- [ ] FedEx 2Day Freight
  Second business day.*
- [ ] FedEx 3Day Freight
  Third business day.*

*Call for Confirmation.

5 Packaging

- [ ] FedEx Envelope*
- [ ] FedEx Pak*
  Includes FedEx Small Pak, FedEx Large Pak, and FedEx Sturdy Pak.
- [ ] FedEx Box
- [ ] FedEx Tube
- [ ] Other

6 Special Handling

Include FedEx address in Section 3.

- [ ] SATURDAY Delivery
  Available ONLY for FedEx Priority Overnight, FedEx 2Day, FedEx 1Day Freight, and FedEx 2Day Freight to select ZIP codes.
- [ ] HOLD Weekday
  at FedEx Location
  Not available for FedEx First Overnight
- [ ] HOLD Saturday
  at FedEx Location
  Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations

Does this shipment contain dangerous goods?
One box must be checked.

- [ ] No
- [ ] Yes
  As per attached Shipper's Declaration
- [ ] Yes
  Shipper's Declaration not required
- [ ] Dry Ice
  Dry Ice, 9, UN 1845

Dangerous goods (including Dry Ice) cannot be shipped in FedEx packaging.

- [ ] Cargo Aircraft Only

7 Payment Bill to:

- [ ] Sender
  Acct No. in Section 1 will be billed.
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

Enter FedEx Acct. No. or Credit Card No. below.

Total Packages | Total Weight | Total Charges

8 Sign to Authorize Delivery Without a Signature

*Your liability is limited to $100 unless you declare a higher value. See the FedEx Service Guide for details.

By signing you authorize us to deliver this shipment without obtaining a signature and agree to indemnify and hold us harmless from any resulting claims.

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ARLINGTON, VA 222013602
UNITED STATES US

SHIP DATE: 13AUG12
ACTWGT: 1.4 LB
CAD: /OFFC1302
DIMS: 0x0x0 IN

BILL SENDER

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GOVT LOCKBOX 979089
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PO: DEPT:

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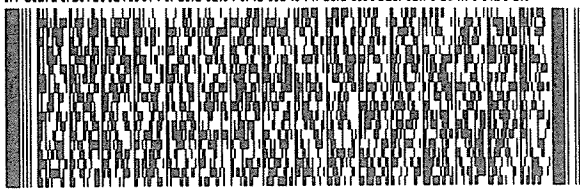
TRK# 8493 7216 3270
0215

TUE – 14 AUG A1
STANDARD OVERNIGHT

XX CPSA

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MO-US   STL

US BANK/FCC AUG 1 4 2012

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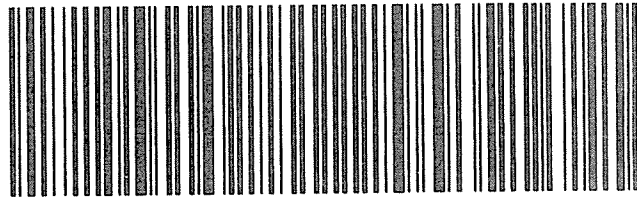
FIGURE 1
ANTENNA SYSTEM AS ADJUSTED

APPLICATION FOR LICENSE INFORMATION
EMPLOYING MOMENT METHOD MODELING
WBKK 820 KHZ, DA-2
WILTON, MINNESOTA
AUGUST, 2012

ANTENNA SYSTEM DESCRIPTION

1. The Antenna System consists of three (3), uniform, guyed, vertical steel transmitting Towers. All Towers stand 91.4M (90°) above their Base Insulators. The Towers are arranged with Tower 1 as a reference; Tower 2 is spaced 80.5° on a bearing of 20.0°T. Tower 3 is spaced 170.4° on a bearing of 20.0°T. Towers 1 and 3 have aviation obstruction lighting. Lighting feeds are isolated at both Tower bases with a choke.

2. The Ground System for each Tower consists of (120) buried copper Radials, 91.4M in length, except where they intersect with copper transverse straps between Towers or property boundaries. Copper strap connects all Towers to the main Transmitter grounding point.

3. The Sampling System consists of three (3), Phasetek Inc. P600-203, 1.0 V/A Toroidal Current Transformers. All TCT's are at the Output of each Antenna Tuning Unit. These TCT's are connected to a Gorman-Redlich Model CMR Antenna Monitor via three (3) equal lengths of Cablewave LCF-12-50J, 1/2" phase stabilized foam coaxial cable.

TOWER REGISTRATION NUMBERS

Tower 1:	1260980
Tower 2:	1260984
Tower 3:	1260983

FIGURE 1 - CONTINUED
ANTENNA SYSTEM AS ADJUSTED

APPLICATION FOR LICENSE INFORMATION
EMPLOYING MOMENT METHOD MODELING
WBKK 820 KHZ, DA-2
WILTON, MINNESOTA
AUGUST, 2012

DIRECTIONAL OPERATION (DAY)

COMMON POINT

Impedance   = 50.0 − j 3.3 Ohms
Current   = 14.5 Amperes
Power   = 10,530 Watts

DIRECTIONAL OPERATION (NIGHT)

COMMON POINT

Impedance   = 50.0 − j 3.3 Ohms
Current   = 4.02 Amperes
Power   = 810 Watts

Directional Antenna Monitor indications are within ±5% and ±3° of the modeled TCT values.

NOTE: WBKK utilizes the same Antenna Monitor parameters for Day and Night modes of operation.

FIGURE 2
WBKK SAMPLING SYSTEM DESCRIPTION/MEASUREMENTS
AUGUST, 2012

SAMPLING SYSTEM DESCRIPTION

The Sampling System consists of Phasetek Inc. P600-203 Toroidal Sampling Transformers (1.0 volt/amp) mounted at the base of each Tower. The sampling devices are connected to the Antenna Monitor with equal lengths of Andrew LDF4-50A. The Antenna Monitor is a Gorman-Redlich Model CMR, Serial Number 1041.

SAMPLE LINE MEASUREMENTS

Impedance measurements were made of the Antenna Sampling Lines using an Array Solutions Power Aim 120 Vector Network Analyzer (VNA). Measurements were done with the lines open circuited and then connected to the TCT's.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. Frequencies of resonance occur at odd multiples of 90 degrees electrical length, the Sample Line length at the resonant frequency below the 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.

SAMPLE LINE MEASUREMENTS

	Resonant Frequency (kHz) below 820 kHz	Resonant Frequency (kHz) above 820 kHz	Calculated Electrical Length (deg) at 820 kHz	Measured Impedance (ohms) Connected to TCT @ 820 kHz
Tower 1	526.0	1582.6	140.3	48.4 − j 1.7
Tower 2	525.7	1581.9	140.4	48.7 − j 2.0
Tower 3	525.8	1581.7	140.4	49.9 − j 1.9

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 R1 +j X1 and R2 +j X2 are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

$$Z_0 = ((R_1^2 + X_1^2)^{1/2} \cdot (R_2^2 + X_2^2)^{1/2})^{1/2}$$

FIGURE 2 – CONTINUED

WBKK SAMPLING SYSTEM DESCRIPTION/MEASUREMENTS
AUGUST, 2012

TOWER SAMPLE LINE MEASUREMENTS

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	789.9	6.24 +j 49.63	263.0	3.22 −j 48.89	49.51
2	788.6	6.36 +j 49.80	262.9	3.12 −j 48.75	49.52
3	788.7	6.17 +j 49.30	262.9	3.12 −j 49.00	49.39

SAMPLING TCT MEASUREMENTS

Measurements of the Phasetek Inc. Model P600-203, 1.0 V/A Toroidal Current Transformers were performed by a Hewlett Packard 8752A, Network Analyzer. Measurements are normalized to Tower #2 (reference).

Tower	TCT Serial #	Magnitude	Phase
1	451	.995	0.2^0
2	452	1.000	0.0^0
3	453	.997	0.1^0

ANTENNA MONITOR MEASUREMENT

Measurement of the Gorman-Redlich Model CMR Antenna Monitor was performed to verify calibration. A single RF Voltage was applied to the Reference Input (Tower #2) and each other Input by use of a "T" divider and equal electrical length coaxial cables. This yields the following:

Tower	Ratio	Phase
1	.994	0.0^0
2	1.000	0.0^0
3	.991	$+0.1^0$

FIGURE 3
WBKK TOWER IMPEDANCE MEASUREMENTS COMPARED TO
METHOD OF MOMENTS MODEL
AUGUST, 2012
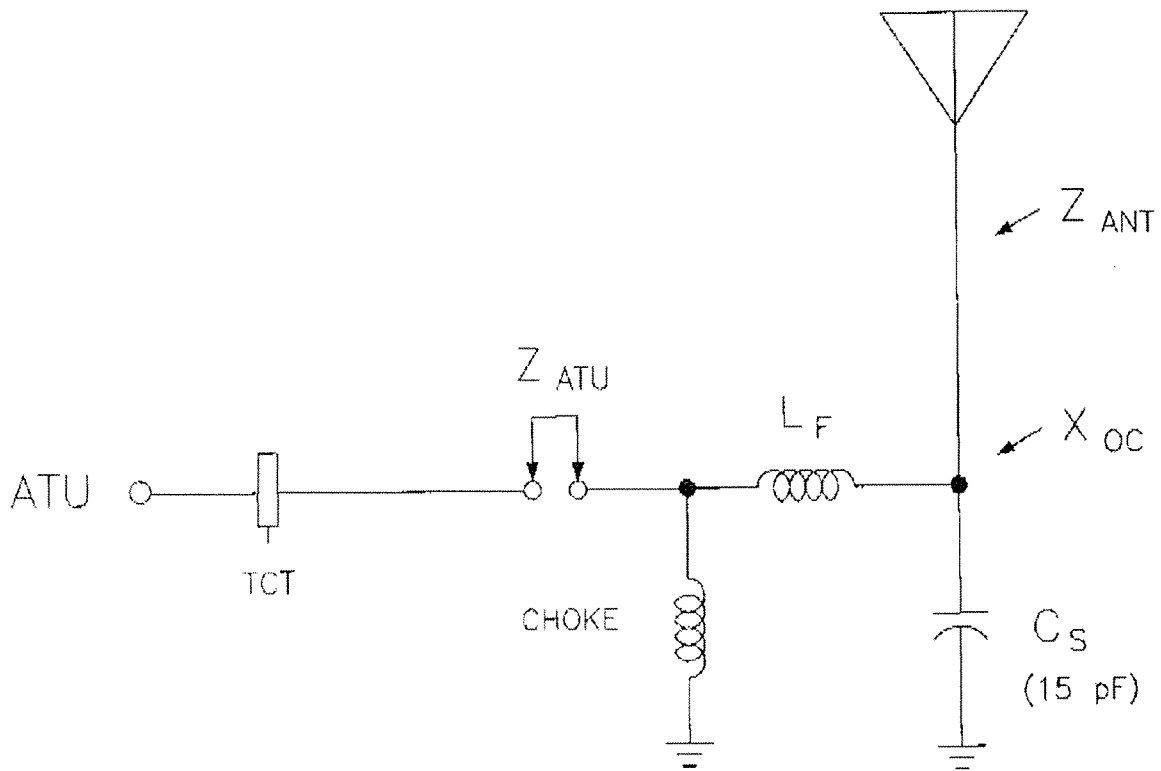
Tower	Calculated X_{oc} (Ω)	Measured L_F (μH)	Measured X_F (Ω)	Modeled Z_{ANT} (Ω)	Modeled Z_{ATU} (Ω)	Measured Z_{ATU} (Ω)
1	+j3775.5	4.41	+j22.7	52.60 +j61.31	50.13 +j82.61	50.98 +j81.60
2	-j4316.0	4.64	+j23.9	49.95 +j57.56	51.68 +j82.15	50.67 +j81.53
3	+j3761.3	2.76	+j14.2	52.29 +j60.75	50.14 +j74.02	50.88 +j74.25

FIGURE 4
WBKK MOMENT MODEL PARAMETERS
AUGUST, 2012

Tower#	Wire #	# of Segments	Base Node
1	1	12	1
2	2	12	13
3	3	12	25

Tower #	Physical Height Degrees	Modeled Height Degrees	Modeled Radius Meters	% of Equivalent Radius
1	90.0	97.3	.250	114.5
2	90.0	96.8	.255	113.6
3	90.0	97.1	.255	113.6

All Towers are uniform cross section, guyed with Base Insulator. Tower #1, is three (3) sided, 18" face width. Towers #2 and #3 are three (3) sided, 18.5" face width.

The Tower #1 Base Insulator was manufactured by Austin Insulators, the Base Insulators for Towers #2 and #3 were manufactured by Lapp Insulators; all insulators have an assumed capacity of 15pf (-j 12,939.4 ohms @ 820 kHz.

Towers #1 and #3 have Phasetek Inc. Model #P600-160-2 Lighting Choke. These measure +j 2,900 ohms @ 820 kHz. Tower #2 has a Phasetek Inc. Model P600-161-1 Static Drain Choke. This measures –j 6,500 ohms @ 820 kHz.

FIGURE 5
WBKK MOMENT MODEL SUMMARY
FOR INDIVIDUAL TOWERS

WBKK TOWER 1 (OTHERS OPEN)

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

wire	caps	Distance	Angle	z	radius	segs
1	none	0	0	0	.25	12
		0	0	97.3		
2	none	80.5	20.	0	.255	12
		80.5	20.	96.8		
3	none	170.4	20.	0	.255	12
		170.4	20.	97.1		

Number of wires   = 3
        current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	2	8.06667	1	8.10833
radius	1	.25	2	.255

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.82	0	1	.0224074	.0225232

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	13	0	-4,316.	0	0	0
2	25	0	3,761.3	0	0	0

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	52.6	61.313	80.784	49.4	3.1105	-5.7902	-1.329

FIGURE 5
WBKK MOMENT MODEL SUMARY
INDIVIDUAL TOWERS
CONTINUED

WBKK TOWER 2 (OTHERS OPEN)

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.25	12
		0	0	97.3		
2	none	80.5	20.	0	.255	12
		80.5	20.	96.8		
3	none	170.4	20.	0	.255	12
		170.4	20.	97.1		

Number of wires   = 3
          current nodes = 36

	minimum			maximum	
Individual wires	wire	value		wire	value
segment length	2	8.06667		1	8.10833
radius	1	.25		2	.255

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.82	0	1	.0224074	.0225232

Sources

source	node	sector	magnitude	phase	type
1	13	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	3,775.5	0	0	0
2	25	0	3,761.3	0	0	0

IMPEDANCE
    normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	s11 dB	s12 dB
source = 1; node 13, sector 1							
.82	49.951	57.561	76.213	49.	2.9925	-6.037	-1.2439

FIGURE 5
WBKK MOMENT MODEL SUMARY
INDIVIDUAL TOWERS
CONTINUED

WBKK TOWER 3 (OTHERS OPEN)

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

wire	caps	Distance	Angle	z	radius	segs
1	none	0	0	0	.25	12
		0	0	97.3		
2	none	80.5	20.	0	.255	12
		80.5	20.	96.8		
3	none	170.4	20.	0	.255	12
		170.4	20.	97.1		

Number of wires   = 3
         current nodes = 36

Individual wires	minimum wire	value	maximum wire	value
segment length	2	8.06667	1	8.10833
radius	1	.25	2	.255

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.82	0	1	.0224074	.0225232

Sources

source node	sector	magnitude	phase	type
1	25	1	1.	0	voltage

Lumped loads

load	node	resistance (ohms)	reactance (ohms)	inductance (mH)	capacitance (uF)	passive circuit
1	1	0	3,775.5	0	0	0
2	13	0	-4,316.	0	0	0

IMPEDANCE
   normalization = 50.

freq (MHz)	resist (ohms)	react (ohms)	imped (ohms)	phase (deg)	VSWR	S11 dB	S12 dB
source = 1; node 25, sector 1							
.82	52.29	60.746	80.152	49.3	3.0898	-5.832	-1.3141

FIGURE 6
WBKK MOMENT MODEL ARRAY SYNTHESIS
(DIRECTIONAL DAY)

<u>WBKK DIRECTIONAL</u>

MEDIUM WAVE ARRAY SYNTHESIS FROM FIELD RATIOS

Frequency = .82 MHz

```
        field ratio
tower   magnitude    phase (deg)
1       1.                    0
2       1.25             237.1
3       .481             114.7
```

VOLTAGES AND CURRENTS - rms

source node	voltage magnitude	phase (deg)	current magnitude	phase (deg)
1	546.792	64.2	11.0475	2.4
13	1,230.42	305.8	12.8891	240.8
25	919.845	200.1	4.03553	116.6

Sum of square of source currents = 608.92
Total power = 10,000. watts

TOWER ADMITTANCE MATRIX

admittance	real (mhos)	imaginary (mhos)
Y(1, 1)	.00642934	-.00791343
Y(1, 2)	.00369695	.00394566
Y(1, 3)	.000990205	-.000413907
Y(2, 1)	.00369693	.0039457
Y(2, 2)	.0049846	-.00663867
Y(2, 3)	.0038136	.00353948
Y(3, 1)	.000990201	-.000413907
Y(3, 2)	.00381361	.00353945
Y(3, 3)	.00702755	-.0077596

TOWER IMPEDANCE MATRIX

impedance	real (ohms)	imaginary (ohms)
Z(1, 1)	53.05	61.5224
Z(1, 2)	30.2011	-20.8602
Z(1, 3)	-12.4262	-23.1556
Z(2, 1)	30.2009	-20.8604
Z(2, 2)	49.3115	57.4118
Z(2, 3)	25.1189	-23.5378
Z(3, 1)	-12.4262	-23.1556
Z(3, 2)	25.1191	-23.5377
Z(3, 3)	52.7205	60.865

FIGURE 7
WBKK MOMENT MODEL SUMMARY
FOR DIRECTIONAL DAY MODE

WBKK DIRECTIONAL

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

wire	caps	Distance	Angle	Z	radius	segs
1	none	0	0	0	.25	12
		0	0	97.3		
2	none	80.5	20.	0	.255	12
		80.5	20.	96.8		
3	none	170.4	20.	0	.255	12
		170.4	20.	97.1		

Number of wires   = 3
       current nodes = 36

	minimum		maximum	
Individual wires	wire	value	wire	value
segment length	2	8.06667	1	8.10833
radius	1	.25	2	.255

ELECTRICAL DESCRIPTION
Frequencies (MHz)

	frequency		no. of	segment length (wavelengths)	
no.	lowest	step	steps	minimum	maximum
1	.82	0	1	.0224074	.0225232

Sources

source	node	sector	magnitude	phase	type
1	1	1	773.281	64.2	voltage
2	13	1	1,740.07	305.8	voltage
3	25	1	1,300.86	200.1	voltage

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	23.427	43.6	49.495	61.7	3.974	-4.4673	-1.9212
source = 2; node 13, sector 1							
.82	40.448	86.469	95.462	64.9	5.5624	-3.1574	-2.868
source = 3; node 25, sector 1							
.82	25.863	226.47	227.94	83.5	42.087	-.41284	-10.425

CURRENT rms
Frequency   = .82 MHz
Input power = 10,000. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
GND	0	0	0	11.0474	2.4	11.0374	.471321
2	0	0	8.10833	11.293	1.5	11.289	.30126
3	0	0	16.2167	11.2362	.9	11.2347	.183134
4	0	0	24.325	10.9459	.4	10.9455	.0852595
5	0	0	32.4333	10.4374	0.0	10.4374	4.19E-03
6	0	0	40.5417	9.72362	359.6	9.72343	-.0606547

FIGURE 7
WBKK MOMENT MODEL SUMMARY
FOR DIRECTIONAL DAY MODE
CONTINUED

WBKK DIRECTIONAL - Contd

CURRENT rms
Frequency   = .82 MHz
Input power = 10,000. watts
Efficiency = 100. %
coordinates in degrees

current no.	X	Y	Z	mag (amps)	phase (deg)	real (amps)	imaginary (amps)
7	0	0	48.65	8.81873	359.3	8.81805	-.108942
8	0	0	56.7583	7.73815	359.	7.73689	-.140028
9	0	0	64.8667	6.49868	358.6	6.49687	-.153181
10	0	0	72.975	5.11659	358.3	5.11446	-.147654
11	0	0	81.0833	3.6037	358.1	3.60161	-.122597
12	0	0	89.1917	1.95511	357.8	1.95361	-.0765175
END	0	0	97.3	0	0	0	0
GND	75.6453	-27.5326	0	12.8891	240.8	-6.2833	-11.2538
14	75.6453	-27.5326	8.06667	13.565	239.3	-6.92733	-11.6628
15	75.6453	-27.5326	16.1333	13.7468	238.4	-7.21101	-11.7037
16	75.6453	-27.5326	24.2	13.5893	237.6	-7.27309	-11.4791
17	75.6453	-27.5326	32.2667	13.1192	237.1	-7.13528	-11.0091
18	75.6453	-27.5326	40.3333	12.3545	236.6	-6.80982	-10.3083
19	75.6453	-27.5326	48.4	11.3132	236.1	-6.30736	-9.39173
20	75.6453	-27.5326	56.4667	10.0144	235.7	-5.63905	-8.27584
21	75.6453	-27.5326	64.5333	8.47899	235.4	-4.81678	-6.97795
22	75.6453	-27.5326	72.6	6.72711	235.1	-3.85208	-5.51503
23	75.6453	-27.5326	80.6667	4.77311	234.8	-2.75317	-3.89905
24	75.6453	-27.5326	88.7333	2.60888	234.5	-1.51513	-2.12383
END	75.6453	-27.5326	96.8	0	0	0	0
GND	160.124	-58.2802	0	4.03553	116.6	-1.80748	3.60811
26	160.124	-58.2802	8.09167	4.64106	115.7	-2.01345	4.18156
27	160.124	-58.2802	16.1833	4.94467	115.2	-2.10852	4.47257
28	160.124	-58.2802	24.275	5.07246	114.9	-2.13654	4.60055
29	160.124	-58.2802	32.3667	5.043	114.7	-2.1042	4.58304
30	160.124	-58.2802	40.4583	4.8658	114.5	-2.01508	4.42893
31	160.124	-58.2802	48.55	4.54858	114.3	-1.87222	4.1454
32	160.124	-58.2802	56.6417	4.09928	114.2	-1.67872	3.73979
33	160.124	-58.2802	64.7333	3.52634	114.1	-1.43787	3.21988
34	160.124	-58.2802	72.825	2.83802	114.	-1.15291	2.5933
35	160.124	-58.2802	80.9167	2.04014	113.9	-.826043	1.86543
36	160.124	-58.2802	89.0083	1.12875	113.8	-.455629	1.0327

FIGURE 8
WBKK, 820 KHZ, DA-2
DERIVED DIRECTIONAL PARAMETERS
AUGUST, 2012

DIRECTIONAL:

	Theoretical		Base Network Input Current		Normalized TCT	
Tower	Field	Phase	Amplitude	Phase	Amplitude	Phase
1 (S)	1.000	0.0°	11.26	+2.1°	.895	+120.7°
2 (C)	1.250	+237.1°	12.58	-118.6°	1.000	0.0°
3 (N)	.481	+114.7°	4.30	+116.2°	.342	-125.2°

FIGURE 9
WBKK TOWER BASE CIRCUIT ANALYSIS DESCRIPTION
AUGUST, 2012

CIRCUIT ANALYSIS

Circuit Analysis was performed on each Tower of the WBKK model. "Phasetek" nodal Circuit Analysis program was used to compute base model Input/Output voltages and currents. For the Directional modes, the calculated Mininec Tower Base Drive Voltage was used to determine the Base Network Input Current. This point is the location of the Sampling TCT. "Z_1" represents the ATU Shunt impedance, "Z_2" represents the Tower Feed impedance, and "Z_3" represents the Tower Base Shunt impedance.

FIGURE 10
WBKK CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS
AUGUST, 2012

WBKK TOWER 1(OTHERS OPEN)

```
FREQUENCY :   820.00 kHz
ATU SHUNT IMPEDANCE    (R,X) :    0.00,   2900.00 OHMS
TOWER FEED IMPEDANCE   (R,X) :    0.00,     22.70 OHMS
TOWER SHUNT IMPEDANCE  (R,X) :    0.00,-12939.40 OHMS
TOWER IMPEDANCE        (R,X) :   52.60,     61.31 OHMS
```

			IMPEDANCE (OHMS)	
NODE	TO	NODE	R	X
1		GROUND	0.00	2900.00
2		GROUND	53.10	61.38
1		2	0.00	22.70

	VOLTAGE	
NODE	MAGNITUDE	PHASE
1	100.00	0.00
2	81.62	-8.59

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	50.13	82.61	96.63	58.75
INPUT CURRENT (AMPS) :	0.54	-0.88	1.03	-58.75
OUTPUT CURRENT (AMPS) :	0.54	-0.86	1.01	-57.96

```
INPUT/OUTPUT CURRENT RATIO =  1.0243
INPUT/OUTPUT PHASE         = -0.79 DEGREES
```
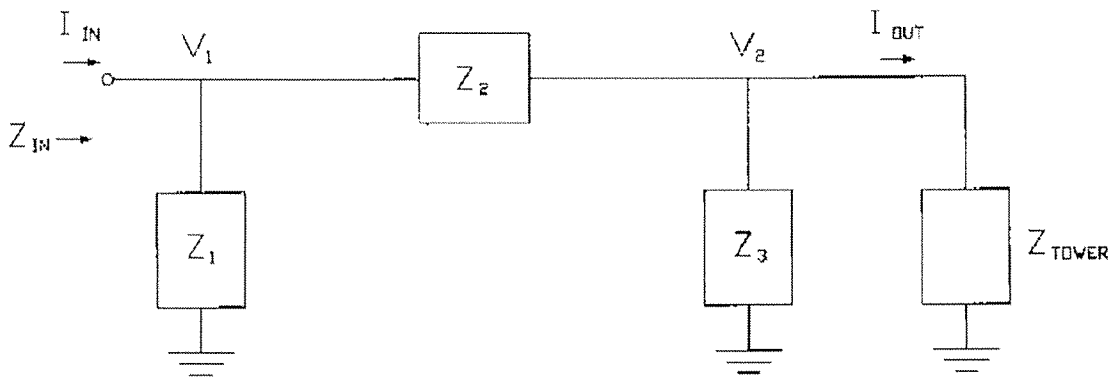
FIGURE 10
WBKK CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS
AUGUST, 2012
CONTINUED

WBKK TOWER 2 (OTHERS OPEN)

```
FREQUENCY :   820.00 kHz
     ATU SHUNT IMPEDANCE     (R,X) :    0.00, -6500.00 OHMS
     TOWER FEED IMPEDANCE    (R,X) :    0.00,    23.90 OHMS
     TOWER SHUNT IMPEDANCE   (R,X) :    0.00,-12939.40 OHMS
     TOWER IMPEDANCE         (R,X) :   49.95,    57.56 OHMS
```

NODE	TO	NODE	IMPEDANCE R	(OHMS) X
1		GROUND	0.00	-6500.00
2		GROUND	50.40	57.62
1		2	0.00	23.90

NODE	VOLTAGE MAGNITUDE	PHASE
1	100.00	0.00
2	79.87	-9.45

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	51.68	82.15	97.06	57.83
INPUT CURRENT (AMPS) :	0.55	-0.87	1.03	-57.83
OUTPUT CURRENT (AMPS) :	0.55	-0.89	1.05	-58.50

```
INPUT/OUTPUT CURRENT RATIO =  0.9831
INPUT/OUTPUT PHASE         =  0.67 DEGREES
```

FIGURE 10
WBKK CIRCUIT ANALYSIS FOR INDIVIDUAL TOWERS
AUGUST, 2012
CONTINUED

WBKK TOWER 3 (OTHERS OPEN)

FREQUENCY : 820.00 kHz
```
    ATU SHUNT IMPEDANCE    (R,X) :    0.00,  2900.00 OHMS
    TOWER FEED IMPEDANCE   (R,X) :    0.00,    14.20 OHMS
    TOWER SHUNT IMPEDANCE  (R,X) :    0.00,-12939.40 OHMS
    TOWER IMPEDANCE        (R,X) :   52.29,    60.75 OHMS
```

NODE	TO	NODE	IMPEDANCE R	(OHMS) X
1		GROUND	0.00	2900.00
2		GROUND	52.78	60.82
1		2	0.00	14.20

	VOLTAGE	
NODE	MAGNITUDE	PHASE
1	100.00	0.00
2	87.79	-5.82

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	50.14	74.02	89.40	55.89
INPUT CURRENT (AMPS) :	0.63	-0.93	1.12	-55.89
OUTPUT CURRENT (AMPS) :	0.63	-0.90	1.10	-55.10

```
INPUT/OUTPUT CURRENT RATIO =  1.0212
INPUT/OUTPUT PHASE         = -0.78 DEGREES
```

FIGURE 11
WBKK CIRCUIT ANALYSIS FOR DIRECTIONAL DAY MODE
AUGUST, 2012

WBKK TOWER 1 DA:

```
FREQUENCY :   820.00 kHz
ATU SHUNT IMPEDANCE    (R,X) :    0.00,   2900.00 OHMS
TOWER FEED IMPEDANCE   (R,X) :    0.00,     22.70 OHMS
TOWER SHUNT IMPEDANCE  (R,X) :    0.00, -12939.40 OHMS
TOWER IMPEDANCE        (R,X) :   23.43,     43.60 OHMS
```

			IMPEDANCE (OHMS)	
NODE	TO	NODE	R	X
1		GROUND	0.00	2900.00
2		GROUND	23.59	43.70
1		2	0.00	22.70

	VOLTAGE	
NODE	MAGNITUDE	PHASE
1	775.86	73.00
2	546.79	64.20

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	22.54	65.10	68.89	70.90
INPUT CURRENT (AMPS) :	11.25	0.41	11.26	2.10
OUTPUT CURRENT (AMPS) :	11.04	0.47	11.05	2.45

```
INPUT/OUTPUT CURRENT RATIO =   1.0195
INPUT/OUTPUT PHASE         =  -0.35 DEGREES
```

WBKK TOWER 2 DA:

```
FREQUENCY :   820.00 kHz
ATU SHUNT IMPEDANCE     (R,X) :    0.00,  -6500.00 OHMS
TOWER FEED IMPEDANCE    (R,X) :    0.00,     23.90 OHMS
TOWER SHUNT IMPEDANCE   (R,X) :    0.00,-12939.40 OHMS
TOWER IMPEDANCE         (R,X) :   40.45,     86.47 OHMS
```

			IMPEDANCE (OHMS)	
NODE	TO	NODE	R	X
1		GROUND	0.00	-6500.00
2		GROUND	41.00	86.92
1		2	0.00	23.90

	VOLTAGE	
NODE	MAGNITUDE	PHASE
1	1512.81	-49.25
2	1230.42	305.80

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	42.43	112.47	120.21	69.33
INPUT CURRENT (AMPS) :	-6.02	-11.05	12.58	-118.58
OUTPUT CURRENT (AMPS) :	-6.27	-11.26	12.89	-119.13

```
INPUT/OUTPUT CURRENT RATIO =  0.9764
INPUT/OUTPUT PHASE         =  0.55 DEGREES
```

WBKK TOWER 3 DA:

```
FREQUENCY :  820.00 kHz
     ATU SHUNT IMPEDANCE      (R,X) :    0.00,  2900.00 OHMS
     TOWER FEED IMPEDANCE     (R,X) :    0.00,    14.20 OHMS
     TOWER SHUNT IMPEDANCE    (R,X) :    0.00,-12939.40 OHMS
     TOWER IMPEDANCE          (R,X) :   25.86,   226.47 OHMS
```

			IMPEDANCE (OHMS)	
NODE	TO	NODE	R	X
1		GROUND	0.00	2900.00
2		GROUND	26.79	230.45
1		2	0.00	14.20

	VOLTAGE	
NODE	MAGNITUDE	PHASE
1	975.80	-159.52
2	919.85	200.10

	REAL	IMAGINARY	MAGNITUDE	PHASE
INPUT IMPEDANCE (OHMS) :	22.78	225.81	226.96	84.24
INPUT CURRENT (AMPS) :	-1.90	3.86	4.30	116.24
OUTPUT CURRENT (AMPS) :	-1.81	3.61	4.04	116.61

```
INPUT/OUTPUT CURRENT RATIO =  1.0654
INPUT/OUTPUT PHASE         = -0.37 DEGREES
```

FIGURE 12
WBKK REFERENCE FIELD INTENSITY MEASUREMENTS
AUGUST, 2012

RADIAL 20° TRUE:

Point	Distance (Km)	Coordinates (NAD27)	Date	Time	Field (mV/m)	Point Description
1	9.50	N 47° 28' 18.2" W 95° 02' 02.7"	08/09/2012	1511	108.00	Balsam Ridge Rd, 80' N of #281 Sign
2	10.90	N 47° 29' 02.3" W 95° 01' 39.5"	08/09/2012	1518	88.0	Trengrove Rd., 0.2 mile W of #191 Sign
3	14.40	N 49° 30' 48.0" W 95° 00' 45.5"	08/09/2012	1527	51.0	Hwy 2 & Scribner Rd.

RADIAL 189° TRUE:

Point	Distance (Km)	Coordinates (NAD27)	Date	Time	Field (mV/m)	Point Description
1	2.57	N 47° 22' 07.4" W 95° 04' 58.7"	08/09/2012	1412	42.8	490 St., #13580 Sign
2	4.20	N 47° 21' 15.0" W 95° 05' 12.1"	08/09/2012	1417	19.5	County #9, 100' E of Creek
3	5.84	N 47° 20' 22.5" W 95° 05' 23.2"	08/09/2012	1433	12.7	470 St., 200' W of #13294 Sign

RADIO 211° TRUE:

Point	Distance (Km)	Coordinates (NAD27)	Date	Time	Field (mV/m)	Point Description
1	2.93	N 47° 22' 08.2" W 95° 05' 51.9"	08/09/2012	1408	29.0	129 Ave. & 490 St.
2	5.75	N 47° 20' 49.8" W 95° 07' 01.3"	08/09/2012	1424	14.5	County #9, 60' E of #11934 Sign
3	5.98	N 47° 20' 43.7" W 95° 07' 07.9"	08/09/2012	1427	13.0	County #97, 500' S of County #9

FIGURE 13 WBKK CERTIFIED ARRAY GEOMETRY SURVEY

NORTHERN ENGINEERING

& CONSULTING, INC.

August 2, 2012

To whom it may concern:

In the fall of 2010, Ed De La Hunt hired our firm to locate the #1 base at the Wilton site and to stake base #2 and base #3. On Nov. 11, 2010, we staked base #2 at North 20 degrees East (True) at 268.2 feet from #1 and staked base #3 at North 20 degrees East(True) at 567.8 feet from #1.

In July of 2012, he hired us to verify their location. On July 13, 2012, we located the bases again and found them to well within the 1.5 electrical degree tolerance.

Below please find the latitude and longitude of Base #2 and Base #3, first as was staked and second as were located on July 13.

Base #2	Staked	47 degrees 23'29.45007"	95 degrees 04'40.79060"
	Located	47 degrees 23'29.44936"	95 degrees 04'40.78283"

Base #3	Staked	47 degrees 23'32.22836"	95 degrees 04'39.30033"
	Located	47 degrees 23'32.22807"	95 degrees 04'39.29864"

Sincerely,

NORTHERN ENGINEERING & CONSULTING, INC.

Terry L. Freeman

Professional Land Surveyor, MN License #21367