

ENGINEERING EXHIBIT

Application for License

prepared for

WGBH Educational Foundation

WCAI(FM) Woods Hole, MA
Facility ID 8566
Ch. 211B1 (90.1 MHz) 12.5 kW 74 m

WGBH Educational Foundation (“*WEF*”) is the licensee of WCAI(FM), Facility ID 8566, Woods Hole, MA. *WEF* has completed construction of the facility modification as authorized in its construction permit (“CP,” file number BPED-20130809ABZ). The CP authorizes an increase in effective radiated power (“ERP”) to 12.5 kW with circular polarization and use of a different directional antenna pattern

A new directional antenna is specified in the CP. Upon review of this application by Commission staff, *WEF* requests full program test authority and subsequent issuance of a license to cover the construction. Until full program test authority is granted, *WEF* will operate the WCAI facility at 50 percent of the authorized ERP under the automatic program test authority provisions of §73.1620(a)(2). This statement and associated exhibits are provided to comply with the various special operating conditions on the CP and with §73.316(c)(2) of the Commission’s rules.

CP Conditions 1 through 5 (Directional Antenna)

The directional antenna is a side mounted Dielectric model DCRH4E50P. Dielectric performed range testing of a 4.4:1 scale model of the antenna for pattern measurement.

The antenna manufacturer’s proof-of-performance data and related exhibits as specified in Condition 1 of the CP are supplied as Attachment 1 to this statement. Based on the method specified in §73.316(c)(2)(ix)(A) and azimuths spaced every ten degrees (see attached Table 1) the calculated RMS of the measured composite pattern is 0.809, which is 86.2 percent of the RMS of the authorized pattern (0.939). Thus, the Commission’s minimum 85 percent RMS requirement is met.

The installation engineer's and surveyor's statements are supplied as Attachments 2 and 3, respectively. These items will satisfy Conditions 2 and 3, respectively.

Pursuant to §73.316(c)(2)(ix)(B), a map is supplied as Figure 1, which depicts the WCAI 60 dBμ (principal community) contour resulting from the measured composite pattern and the boundaries of Woods Hole, the station's principal community. The principal community of Woods Hole is encompassed by the as-built WCAI 60 dBμ coverage contour as predicted by the standard method of §73.313, thus satisfying Condition 4 on the CP and §73.316(c)(2)(ix)(B).

The measured data demonstrates compliance with Condition 5, which specifies the maximum ERP of 12.5 kW ERP and principal minimum limits as shown below.

Maximum ERP: 12.5 kW

Azimuth (°T)	FCC Limit ERP (kW)	Maximum Measured Relative Field	Maximum Actual ERP (kW)
40	2.400	0.286	1.022

The attached Table 2 supplies a summary of the antenna gain and transmission line loss data, and shows that the required transmitter power output is 4.7 kW to achieve 12.5 kW ERP.

Regarding the requirements of §73.316(c)(2)(iv) - (vi) of the Commission's Rules, a representative of the applicant advised the undersigned that:

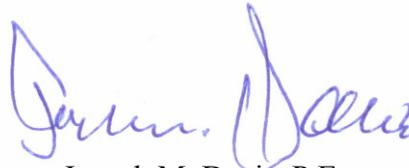
1. The antenna is side-mounted on a particular type of antenna tower in accordance with specific instructions provided by the antenna manufacturer;
2. The directional antenna is not mounted on the top of an antenna tower which includes a top-mounted platform larger than the nominal cross-sectional area of the tower in the horizontal plane; and
3. No other antenna of any type is mounted on the same tower level as the directional antenna, and no antenna of any type is mounted within the horizontal or vertical distance specified by the antenna manufacturer as being necessary for proper directional operation.

CP Condition 6: RF Exposure

The directional antenna is a Dielectric model DCRH4E50P antenna consisting of four elements at half-wavelength spacing. This is the specific antenna described in Condition 6 of the CP, thus satisfying that condition.

Certification

The undersigned hereby certifies that the foregoing statement and associated attachments were prepared by him or under his direction, and that they are true and correct to the best of his knowledge and belief.



Joseph M. Davis, P.E.
December 20, 2013

Chesapeake RF Consultants, LLC
207 Old Dominion Road
Yorktown, VA 23692
703-650-9600

List of Attachments

Table 1	Directional Antenna RMS Compliance
Table 2	Antenna / Line System Gains and Losses
Figure 1	Principal Community Coverage
Attachment 1	Directional Antenna – Manufacturer’s Report
Attachment 2	Engineer’s Statement of Installation
Attachment 3	Surveyor’s Statement

Table 1

Directional Antenna RMS Compliance

prepared for

WGBH Educational Foundation

WCAI(FM) Woods Hole, MA



Construction Permit File Number: BPED-20130809ABZ

Azimuth (°T)	Construction Permit Envelope Rel Field	----- Measured Pattern -----		
		Horizontal Polarization Rel Field	Vertical Polarization Rel Field	H & V Composite Rel Field
0	0.933	0.629	0.486	0.629
10	0.741	0.467	0.339	0.467
20	0.589	0.306	0.243	0.306
30	0.479	0.233	0.211	0.233
40	0.437	0.286	0.182	0.286
50	0.550	0.297	0.182	0.297
60	0.692	0.305	0.202	0.305
70	0.871	0.252	0.274	0.274
80	1.000	0.158	0.385	0.385
90	1.000	0.219	0.546	0.546
100	1.000	0.448	0.725	0.725
110	1.000	0.643	0.868	0.868
120	1.000	0.734	0.965	0.965
130	1.000	0.768	0.990	0.990
140	1.000	0.668	0.999	0.999
150	1.000	0.595	0.993	0.993
160	1.000	0.541	0.990	0.990
170	1.000	0.589	0.953	0.953
180	1.000	0.724	0.929	0.929
190	1.000	0.809	0.909	0.909
200	1.000	0.861	0.897	0.897
210	1.000	0.919	0.907	0.919
220	1.000	0.977	0.914	0.977
230	1.000	0.981	0.910	0.981
240	1.000	1.000	0.926	1.000
250	1.000	0.986	0.924	0.986
260	1.000	0.937	0.904	0.937
270	1.000	0.872	0.910	0.910
280	1.000	0.799	0.903	0.903
290	1.000	0.723	0.909	0.909
300	1.000	0.669	0.952	0.952
310	1.000	0.552	0.935	0.935
320	1.000	0.554	0.907	0.907
330	1.000	0.668	0.828	0.828
340	1.000	0.732	0.731	0.732
350	1.000	0.724	0.618	0.724
RMS:	0.939			0.809

86.16%
of envelope

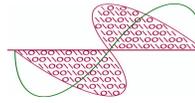


Table 2

Antenna / Line System Gains and Losses

prepared for

WGBH Educational Foundation

WCAI(FM) Woods Hole, MA

Construction Permit File Number: BPED-20130809ABZ

Authorized Effective Radiated Power: 12.50 kW

Antenna System

Dielectric DCRH4E50P

Max Power Gain: 2.89

Antenna Input Power: 4.325 kW

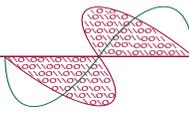
Line and Other Losses

Transmission Line Efficiency: 92.8%
Andrew HJ7-50A, length 167 ft

Other Losses
--- None ---

Transmitter Power Output: 4.661 kW

Rounded per §73.212: 4.7 kW

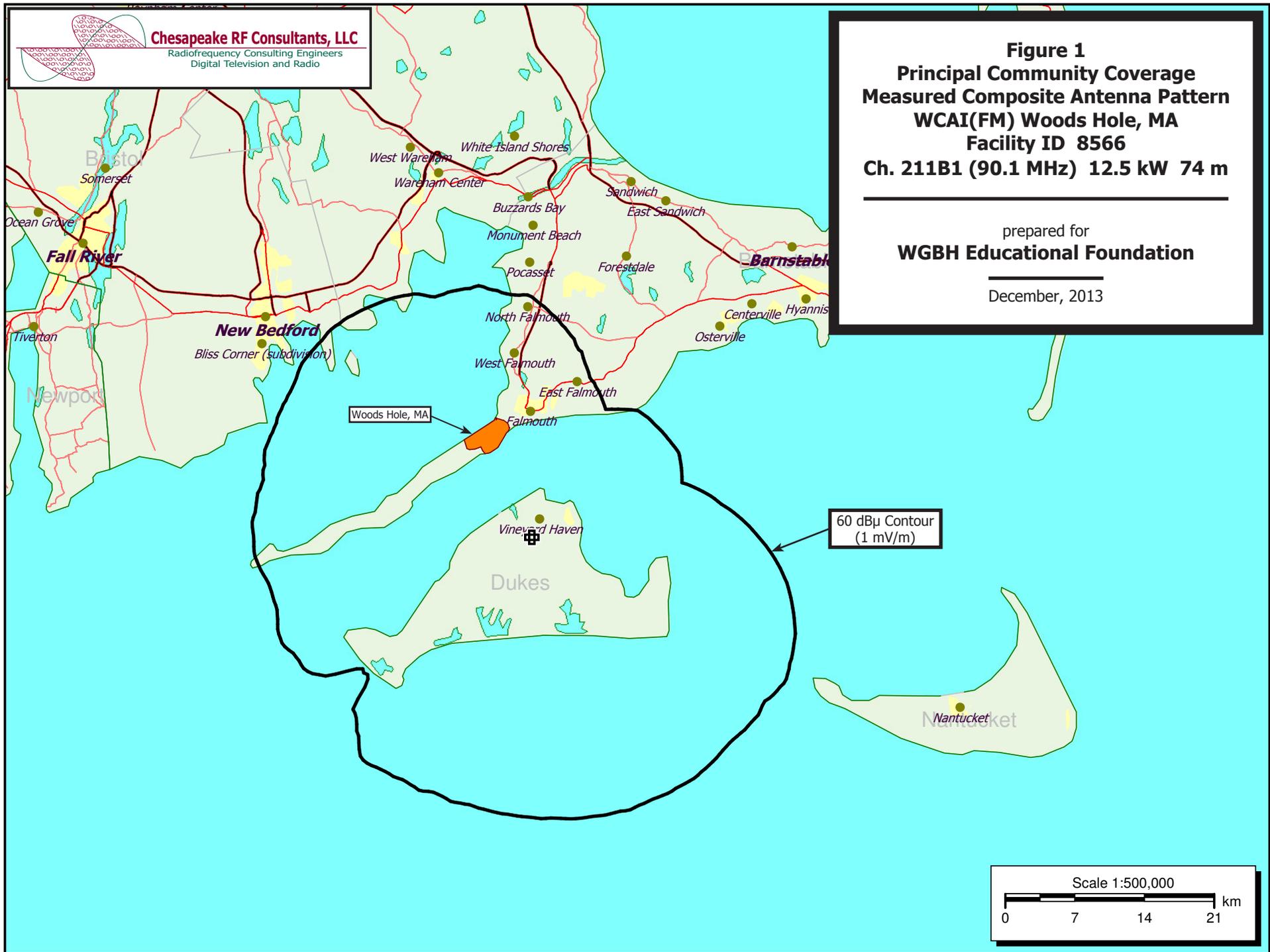


Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio

Figure 1
Principal Community Coverage
Measured Composite Antenna Pattern
WCAI(FM) Woods Hole, MA
Facility ID 8566
Ch. 211B1 (90.1 MHz) 12.5 kW 74 m

prepared for
WGBH Educational Foundation

December, 2013





Proposal Number	C-05187
Date	12/16/2013
Call Letters	WCAI
Location	Woods Hole, MA
Customer	WGBH Educational
Antenna Type	DCRH
Frequency	90.1
Drawing #	22

PATTERN CERTIFICATION

TABLE OF CONTENTS

Narrative Pattern Certification

FM Azimuth Pattern Approval

Azimuth Patterns of Horizontal and Vertically Polarized Planes

Tabulation of Measured Horizontal and Vertically Polarized Planes

Composite Pattern of Horizontal and Vertically Polarized Planes

Tabulation of Composite Pattern

Gain Summary

Rectangular Plot of Vertical Plane Pattern

Sketch of Scale Model Test



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Antenna Type	DCRH
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Drawing #	22

PATTERN CERTIFICATION

Method of Measurement

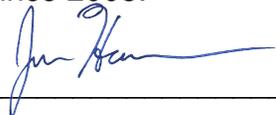
The azimuth pattern for WCAI, Dielectric Document Sketch #22, was measured in the following manner.

A single 4.4 to 1 scale model "DCRH" bay radiator was mounted on a similarly scaled model of the tower according to information provided to Dielectric by the customer; refer to Dielectric Document Sketch #22. The antenna under test, all parasitics, all known tower appurtenances, and the tower section were rotated through 360 degrees while receiving a signal at the appropriate frequency from a linear cavity-backed source antenna. Both the horizontal and vertical polarization azimuth patterns were measured in an anechoic test range.

The transmit and scale model antennas are mounted at identical elevations and at opposite ends of the chamber. A Hewlett Packard model 8753ET network analyzer was used to supply the RF signal to the source antenna at 4.4 times the fundamental FM frequency and to receive the signal intercepted by the antenna under test. The received signal was converted to a relative level, referenced to the source. This level was stored on a computer acting as the master controller. The computer controls the measurement system via IEEE-488 control bus through a GPIB card.

Statement of Qualifications

Jon Hanson is an Electrical Engineer here at Dielectric. He received a BS in Electrical Engineering from the North Dakota State University in 2004. He has 6 years experience in RF antenna engineering and has been employed by Dielectric Communications since 2008.

Signed by:  _____

Date: 2013-Dec-16



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Antenna Type	DCRH
Frequency	90.1
Drawing #	22

FM AZIMUTH PATTERN APPROVAL

The azimuth pattern of the horizontal polarization and vertical polarization as supplied by Dielectric in the document labeled "Pattern 22", is acknowledged as acceptable. We understand that Dielectric does not guarantee or predict signal strength in any particular location.

(Customer's name)

By: _____
(Name typed or printed)

Title: _____

(Signature)



Proposal Number C-05187
Date 12/16/2013
Call Letters WCAI
Location Woods Hole, MA
Customer WGBH Educational
Antenna Type DCRH
Frequency 90.1
Drawing # 22

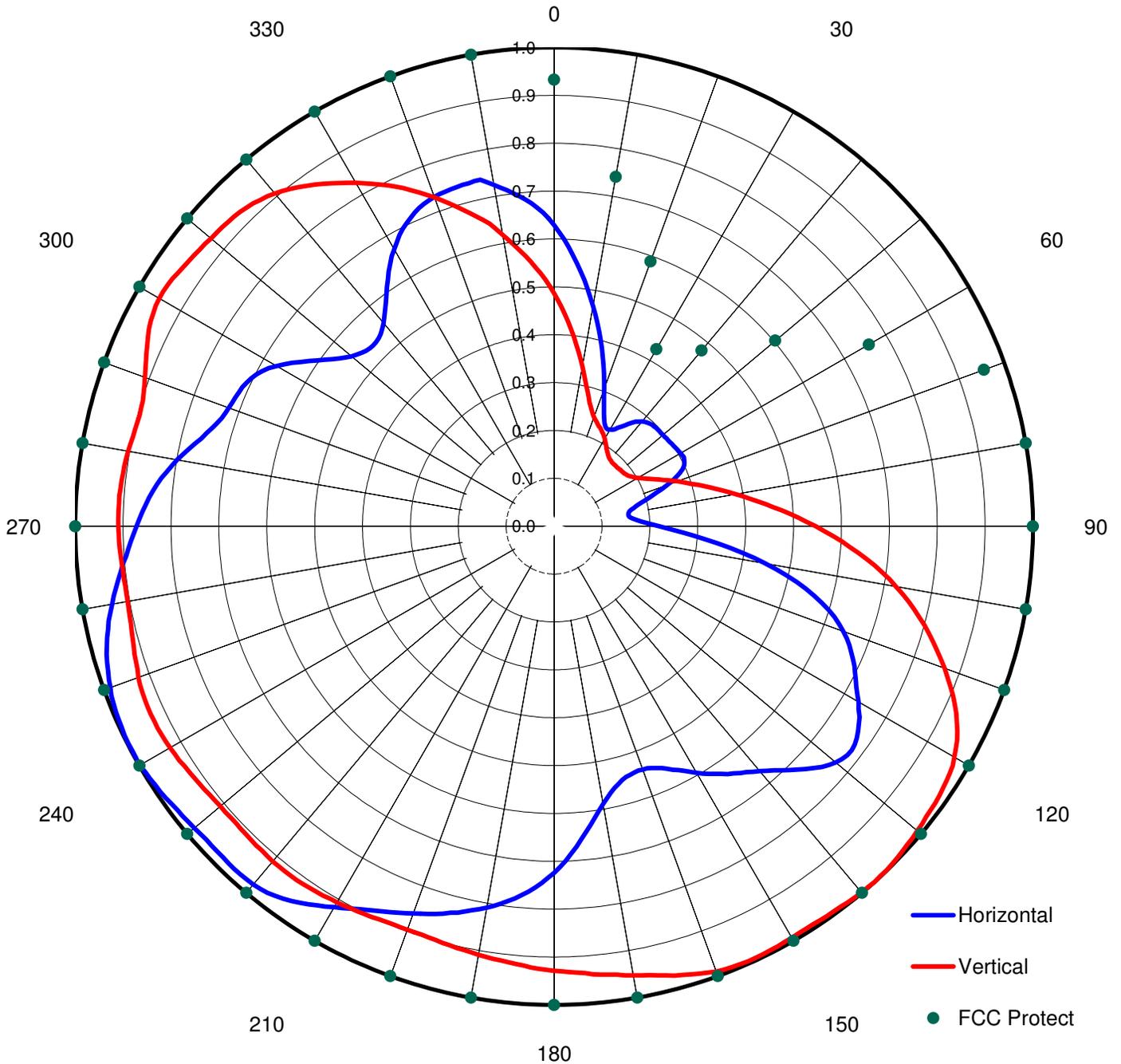
AZIMUTH PATTERN

85.7% Ccov 46.1% Hrms - 53.9% Vrms

Gain 2.20 (3.43 dB) HPOL
1.61 (2.08 dB) VPOL

Calculated / Measured

Measured





Proposal Number **C-05187**
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 Call Letters **WCAI**
 Location **Woods Hole, MA**
 Customer **WGBH Educational**
 Antenna Type **DCRH**
 Frequency **90.1**
 Drawing # **22**

TABULATION OF HORIZONTAL AZIMUTH PATTERN

Angle	Field	dBk	ERP kW
	0.629	6.942	4.946
10	0.467	4.355	2.726
20	0.306	0.684	1.170
30	0.233	-1.684	0.679
40	0.286	0.096	1.022
50	0.297	0.424	1.103
60	0.305	0.655	1.163
70	0.252	-1.003	0.794
80	0.158	-5.058	0.312
90	0.219	-2.222	0.600
100	0.448	3.995	2.509
110	0.643	7.133	5.168
120	0.734	8.283	6.734
130	0.768	8.676	7.373
140	0.668	7.465	5.578
150	0.595	6.459	4.425
160	0.541	5.633	3.659
170	0.589	6.371	4.337
180	0.724	8.164	6.552
190	0.809	9.128	8.181
200	0.861	9.669	9.267
210	0.919	10.235	10.557
220	0.977	10.767	11.932
230	0.981	10.802	12.030
240	1.000	10.969	12.500
250	0.986	10.847	12.152
260	0.937	10.404	10.975
270	0.872	9.779	9.505
280	0.799	9.020	7.980
290	0.723	8.152	6.534
300	0.669	7.478	5.595
310	0.552	5.808	3.809
320	0.554	5.839	3.836
330	0.668	7.465	5.578
340	0.732	8.259	6.698
350	0.724	8.164	6.552



Proposal Number **C-05187**
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 Call Letters **WCAI**
 Location **Woods Hole, MA**
 Customer **WGBH Educational**
 Antenna Type **DCRH**
 Frequency **90.1**
 Drawing # **22**

TABULATION OF VERTICAL AZIMUTH PATTERN

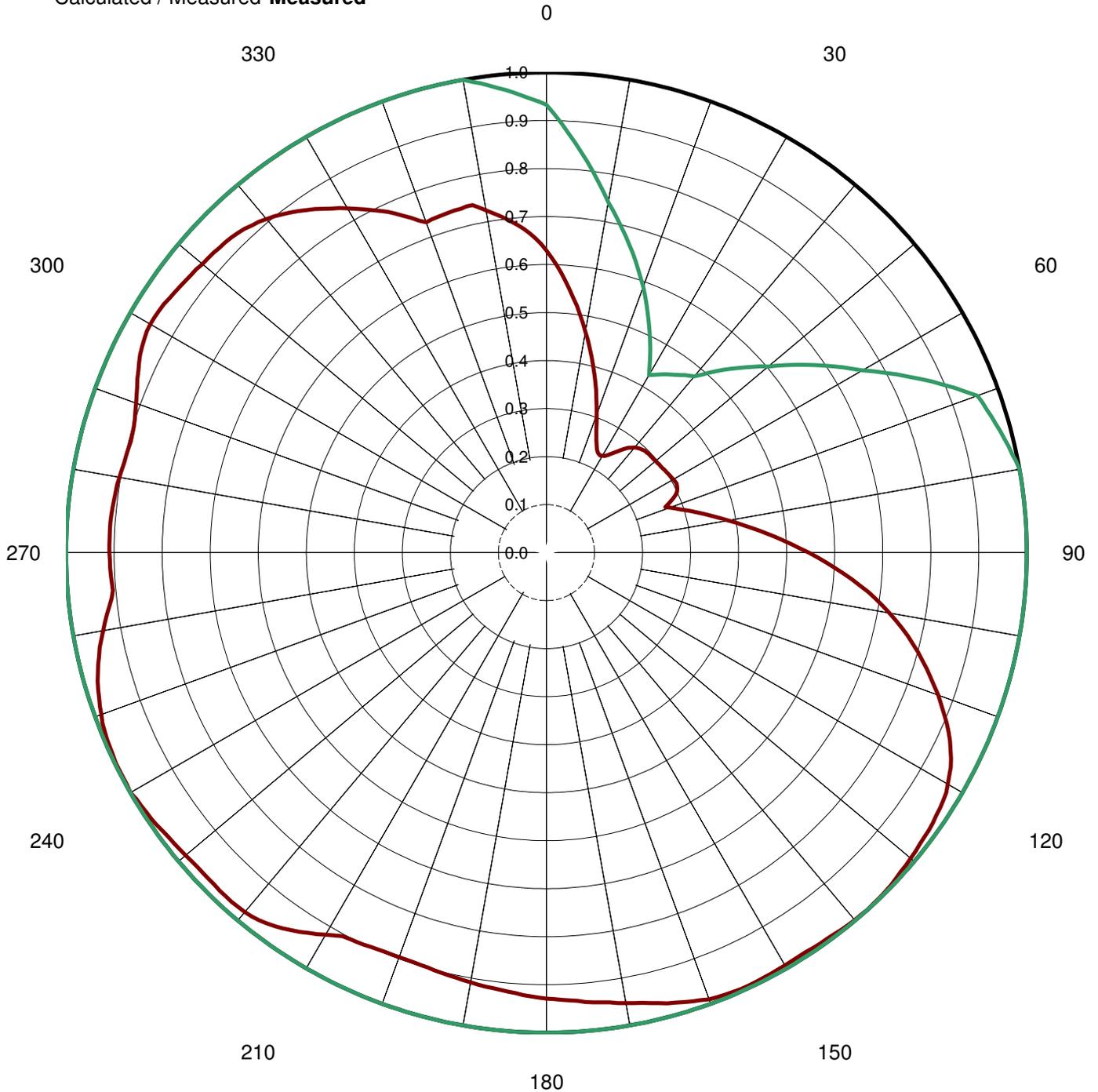
Angle	Field	dBk	ERP kW
	0.486	4.702	2.952
10	0.339	1.573	1.437
20	0.243	-1.319	0.738
30	0.211	-2.545	0.557
40	0.182	-3.829	0.414
50	0.182	-3.829	0.414
60	0.202	-2.924	0.510
70	0.274	-0.276	0.938
80	0.385	2.678	1.853
90	0.546	5.713	3.726
100	0.725	8.176	6.570
110	0.868	9.739	9.418
120	0.965	10.660	11.640
130	0.990	10.882	12.251
140	0.999	10.960	12.475
150	0.993	10.908	12.326
160	0.990	10.882	12.251
170	0.953	10.551	11.353
180	0.929	10.329	10.788
190	0.909	10.140	10.329
200	0.897	10.025	10.058
210	0.907	10.121	10.283
220	0.914	10.188	10.442
230	0.910	10.150	10.351
240	0.926	10.301	10.718
250	0.924	10.283	10.672
260	0.904	10.092	10.215
270	0.910	10.150	10.351
280	0.903	10.083	10.193
290	0.909	10.140	10.329
300	0.952	10.542	11.329
310	0.935	10.385	10.928
320	0.907	10.121	10.283
330	0.828	9.330	8.570
340	0.731	8.247	6.680
350	0.618	6.789	4.774



Proposal Number C-05187
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Call Letters WCAI
Location Woods Hole, MA
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Frequency 90.1
Drawing # 22

COMPOSITE AZIMUTH PATTERN

Calculated / Measured **Measured**





Proposal Number **C-05187**
 Date **12/16/2013**
 Call Letters **WCAI**
 Location **Woods Hole, MA**
 Customer **WGBH Educational**
 Antenna Type **DCRH**
 Frequency **90.1**
 Drawing # **22**

TABULATION OF COMPOSITE AZIMUTH PATTERN

Angle	Field	dBk	Power kW	Input Power
	0.629	6.942	4.946	12.500
10	0.467	4.355	2.726	12.500
20	0.306	0.684	1.170	12.500
30	0.233	-1.684	0.679	12.500
40	0.286	0.096	1.022	12.500
50	0.297	0.424	1.103	12.500
60	0.305	0.655	1.163	12.500
70	0.274	-0.276	0.938	12.500
80	0.385	2.678	1.853	12.500
90	0.546	5.713	3.726	12.500
100	0.725	8.176	6.570	12.500
110	0.868	9.739	9.418	12.500
120	0.965	10.660	11.640	12.500
130	0.990	10.882	12.251	12.500
140	0.999	10.960	12.475	12.500
150	0.993	10.908	12.326	12.500
160	0.990	10.882	12.251	12.500
170	0.953	10.551	11.353	12.500
180	0.929	10.329	10.788	12.500
190	0.909	10.140	10.329	12.500
200	0.897	10.025	10.058	12.500
210	0.919	10.235	10.557	12.500
220	0.977	10.767	11.932	12.500
230	0.981	10.802	12.030	12.500
240	1.000	10.969	12.500	12.500
250	0.986	10.847	12.152	12.500
260	0.937	10.404	10.975	12.500
270	0.910	10.150	10.351	12.500
280	0.903	10.083	10.193	12.500
290	0.909	10.140	10.329	12.500
300	0.952	10.542	11.329	12.500
310	0.935	10.385	10.928	12.500
320	0.907	10.121	10.283	12.500
330	0.828	9.330	8.570	12.500
340	0.732	8.259	6.698	12.500
350	0.724	8.164	6.552	12.500



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Antenna Type	DCRH
Frequency	90.1
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CUSTOMER GAIN SUMMARY

Azimuth Pattern Gain of Horizontal Polarization	2.20 (3.43 dB)
Elevation Pattern Gain Per Polarization	1.32 (1.19 dB)
Peak Gain of Horizontal Polarization	2.89 (4.62 dB)

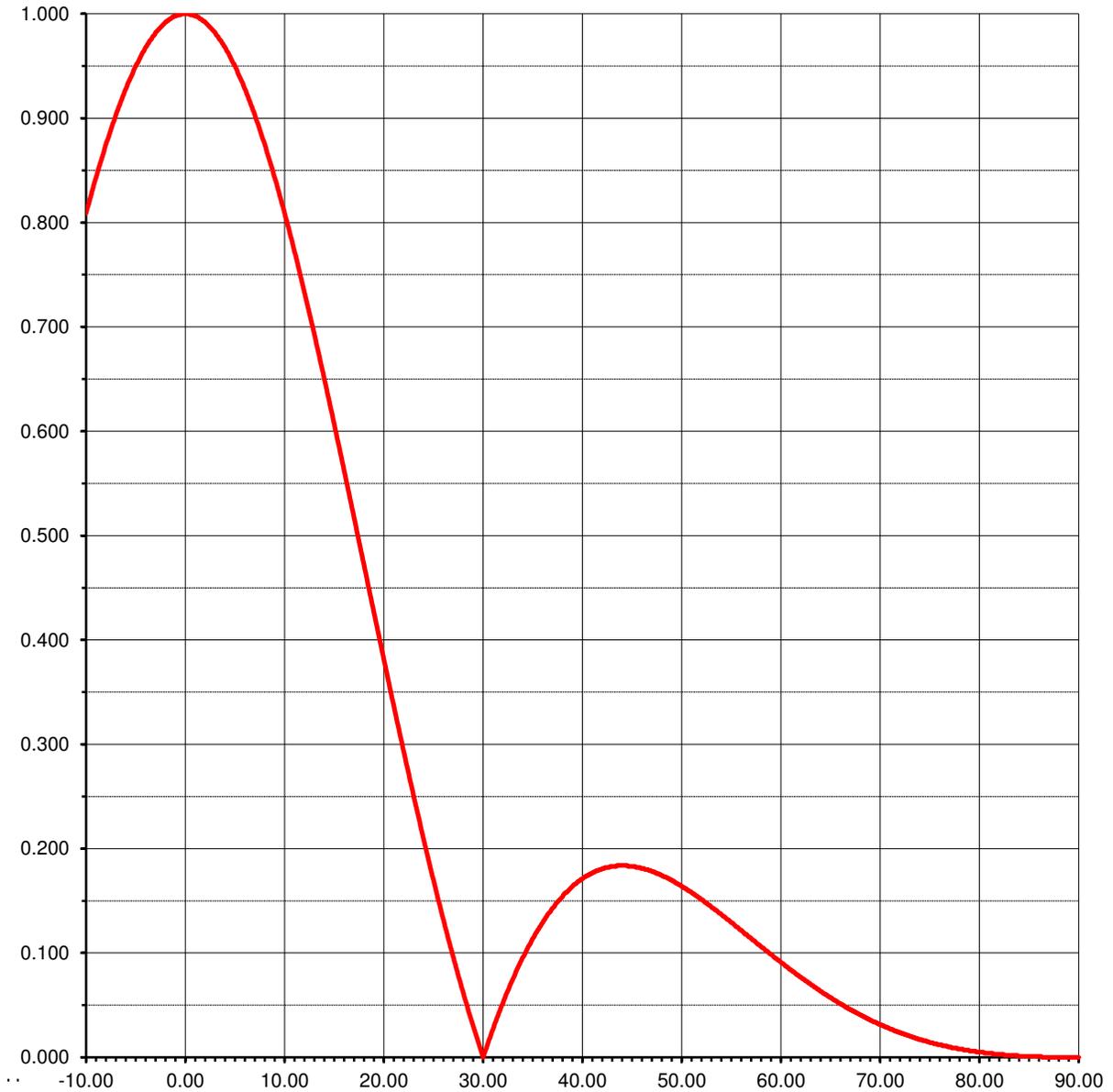


Proposal Number **C-05187**
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Antenna Type **DCRH**
Frequency **90.1**
Drawing # **22**

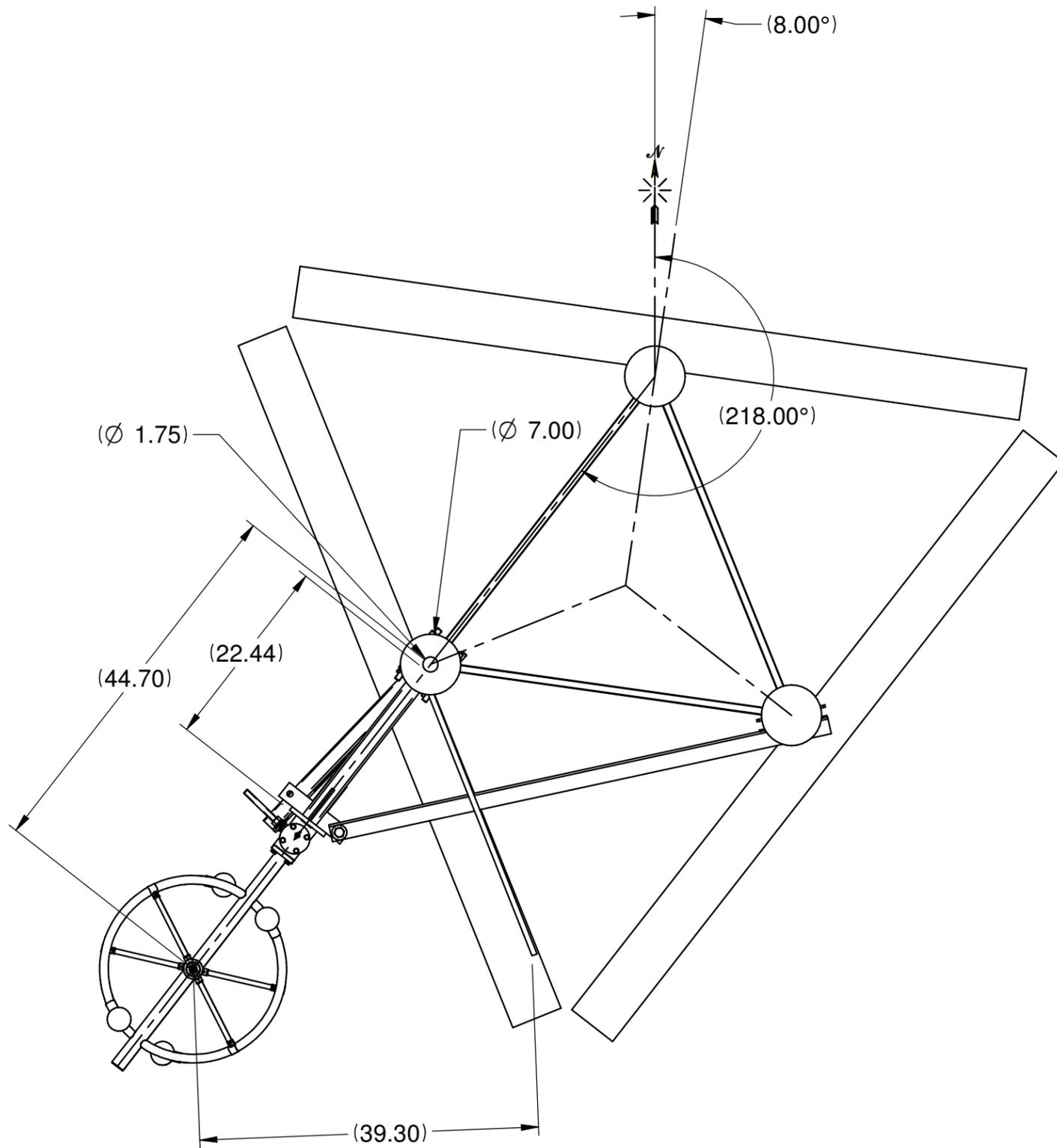
ELEVATION PATTERN

RMS Gain at Main Lobe **1.32 (1.19 dB)**
Per Polarization
Calculated / Measured **Calculated**

Beam Tilt
Frequency **90.1 MHz**



REV:	SHEET	REVISION NOTE CAD MAINTAINED. CHANGES SHALL BE INCORPORATED BY THE DESIGN ACTIVITY.	ECO	DATE APPR
A		PRODUCTION RELEASE		



STATUS:	CONCEPTUAL	DIMENSIONAL TOLERANCES (UNLESS OTHERWISE NOTED) DECIMAL DIMENSIONS 3 PLACE DIMENSIONS ±.005 2 PLACE DIMENSIONS ±.02 FRACTIONAL DIMENSIONS 0"-6" ±1/32" ABOVE 6" UP TO 12" ±1/16" ABOVE 12" UP TO 48" ±1/8" ABOVE 48" ±1/4" ANGULAR DIMENSIONS ±1/2° REFERENCE DIMENSIONS ARE NOT FOR MANUFACTURING OR INSPECTION																
PART NO: / MATERIAL NO:																		
SAP DOCUMENT NO:	10000009325		TITLE: INSTALLATION DCRH4E50P WCAI 90.1 FM PROJECT C-05187 SO 3077819															
MATERIAL:			GAGE CODE: B 08441 DRAWING NO: 016A53600															
FINISH:	N/A	ANGLE PROJECTION 	2:47:32 PM															
	REFER TO D8110 FOR PLATING REFER TO D17800 FOR PAINT	<table border="1"> <thead> <tr> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DESIGNED BY rcmason</td> <td>1/21/2013</td> </tr> <tr> <td>DETAIL BY rcmason</td> <td>12/16/2013</td> </tr> <tr> <td>CHKD. BY</td> <td></td> </tr> <tr> <td>ENG. 1 APPR.</td> <td></td> </tr> <tr> <td>ENG. 2 APPR.</td> <td></td> </tr> <tr> <td>MANUFACT.</td> <td></td> </tr> </tbody> </table>	NAME	DATE	DESIGNED BY rcmason	1/21/2013	DETAIL BY rcmason	12/16/2013	CHKD. BY		ENG. 1 APPR.		ENG. 2 APPR.		MANUFACT.		SHEET: 1 OF 1	
NAME	DATE																	
DESIGNED BY rcmason	1/21/2013																	
DETAIL BY rcmason	12/16/2013																	
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MANUFACT.																		

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UNLESS OTHERWISE SPECIFIED
 MANUFACTURING TOLERANCE AND PROCEDURES MUST BE IN ACCORDANCE WITH D78691. ALL ALUMINUM, COPPER, AND BRASS WELDING MUST COMPLY WITH A-62700, SECT. XIV "PRODUCTION WELDING PROCEDURES". STRUCTURAL STEEL WELDING MUST COMPLY WITH "AWS 1.1 CURRENT REVISION".

December 4, 2013

RE: Dielectric DCRH4E50P WCAI 90.1 FM

To Whom It May Concern,

On November 15, 2013 I was present for all aspects associated with assembly and installation of a Dielectric DCRH4E50P four-bay directional antenna for WCAI-FM.

The experienced broadcast antenna installer and I verified orientation of antenna components according to Dielectric antenna installation drawing number 016A53600.

A surveyor from Schofield, Barbini & Hoehn, Inc. independently verified antenna bearing relative the tower.

I have been employed by the WGBH Educational Foundation as Transmitter Engineer since 1999.

Please contact me for any additional information needed.

Sincerely,



Dennis J. Correia, Engineer
WGBH Radio Stations
1 Guest Street
Boston, MA 02135
dennis_correia@wgbh.org

 **Schofield, Barbini & Hoehn Inc.**
Land Surveying ⊕ Civil Engineering

12 Surveyor's Lane, Box 339
Vineyard Haven, Mass.
508-693-2781
www.sbhinc.net
dhoehn@sbhinc.net

Thomas M. Devlin
Operations Manager, WGBH Radio
1 Guest Street
Boston, MA 02135

December 17, 2013
MV 8045

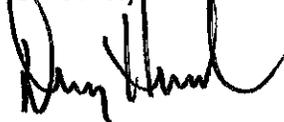
Re: Directional Antenna Layout, WCAI, Vineyard Haven, MA

Dear Tom:

On Friday November 15, 2013, Schofield, Barbini & Hoehn, Inc. took survey readings on the above referenced antenna. Based on these readings, we found that the antenna was installed at a directional azimuth of 218 degrees from true north.

If you have any questions, please feel free to contact Chris Alley of my office.

Sincerely,



Douglas R. Hoehn
Professional Land Surveyor

