2017 Biennial Recertification of Sampling System

KRMG

Tulsa, Oklahoma

3/22/2017

Radio Station KRMG, Tulsa, Oklahoma, operates with a directional antenna facility, which was licensed pursuant to the moment method modeling provisions of 47 C.F.R. §73.151(c). The license was granted on March 31, 2015.

The recertification measurements of the sampling system are tabulated below. The results of these measurements show that the sample system continues to meet the requirements of 47 C.F.R. §73.151(c).

The sampling system consists of Delta Electronics TCT-1 current transformers installed at the output of each antenna tuning unit. Samples from the current transformers are fed to the antenna monitor via equal lengths of Andrew 3/8 inch foam-dielectric coaxial transmission lines. The antenna monitor is a Potomac Instruments Type 1901.

Impedance measurements were made of the antenna sampling system using an Array Solutions PowerAIM-120 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 450 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 (kHz)	Sample Line Calculated Electrical Length At 740 kHz (deg.)
1	815.9	408.1
2	815.3	408.4
3	815.6	408.3
4	815.6	408.3
5	815.6	408.3
6	815.5	408.3

This table shows that 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 Frequency (kHz)	+45 Deg. Measured Impedance (ohms)	- 45 Deg. Offset Frequency (kHz)	-45 Deg. Measured Impedance (ohms)	Calculated Characteristic Impedance (ohms)
1	897.5	16.39 + j50.88	734.3	10.88 –j45.24	49.9
2	896.8	15.73 +j49.39	733.8	11.44 –j45.98	49.6
3	897.2	16.88 +j47.52	734.0	12.27 –j47.14	49.6
4	897.2	15.53 +J49.57	734.0	11.41 –J46.51	49.8
5	897.2	14.99 +j48.73	734.0	11.76 –j47.18	49.8
6	897.1	16.52 +46.58	734.0	12.54 –j48.15	49.6

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

The calibration of the Delta TCT-1 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 six current transformers and the inputs of the antenna monitor. The Potomac 1901 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.	Serial No.	Ratio	Phase (deg.)
1	18250	1.000	0.0
2	18271	reference	reference
3	18252	1.000	0.0
4	18253	1.000	0.0
5	18254	1.000	0.0
6	18255	1.000	0.0

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	48.5	+0.6
2	48.3	+0.6
3	48.7	+0.5
4	48.8	+0.6
5	48.8	+0.5
6	48.6	+0.5

Reference Field Intensity Measurements

Reference field strength measurements were originally made on October 28 and 29, 2014, at three locations along each of the major lobe and null radials of each pattern. Those points were re-measured in March, 2017. The measured field strengths and descriptions and NAD-27 GPS coordinates for the reference measurement points are shown are the attached Appendix A.

D. Stanley Tacker
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March 22, 2017

Appendix A

DAYTIME

Radial 22.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	6.13	36° 07' 53.26"	96° 15' 35.01"	3/21/2017	10:20	20.4	Highway 51 west of Keystone School
2	13.84	36° 11' 43.79"	96° 13' 36.49"	3/21/2017	10:27	7.2	Hollandia Rd west of CR 1200
3	18.89	36° 14' 14.77"	96° 12' 18.84"	3/21/2017	10:36	5.6	Prue Rd north of Chickasaw Rd

Radial 73.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	15.44	36° 06' 20.99"	96° 07' 1.05"	3/21/2017	10:03	176	1/10th mi N of E 41st St on Hwy 97.
2	25.47	36° 07' 16.65"	96° 00' 25.82"	3/21/2017	9:48	68	In Goodwill parking lot on Southwest Blvd.
3	39.69	36° 08' 42.20"	95° 51' 5.18"	3/21/2017	9:32	46	On I-44 at junction of I-44 & S Garnett Rd.

Radial 135°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	14.2	35° 59' 24.52"	96° 10' 27.71"	3/21/2017	14:25	13	194m E of Dixieland Rd on Hwy 66.
2	23.31	35° 55' 55.59"	96° 06' 10.82"	3/21/2017	14:55	2.7	15940 Willow Lane.
3	32.83	35° 52' 17.00"	96° 01' 42.64"	3/21/2017	15:23	2.5	402.5m E of N 3920 Rd on W 201st St S.

Radial 205°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	11.3	35° 59' 18.33"	96° 20' 19.81"	3/21/2017	13:09	3.4	337.3m E of 8th St on Hwy 33.
2	21.27	35° 54' 11.12"	96° 23' 16.07"	3/21/2017	13:30	2	256.7m N of W 181st St S on Hwy 48
3	32.17	35° 49' 5.61"	96° 26' 11.03"	3/21/2017	13:54	1	1.94km W of 3705 Rd on Hwy 66.

Radial 260.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	9.23	36° 04' 0.67"	96° 23' 13.61"	3/21/2017	12:36	380	7.09km N of Hwy 33 on Hwy 48.
2	15.72	36° 03' 25.80"	96° 27' 29.95"	3/21/2017	12:15	180	6.0km N of Hwy 33 on S 417th Ave. W.
3	27.16	36° 02' 24.00"	96° 35' 1.41"	3/21/2017	12:04	96	5.86km N of Hwy 33 on Hwy 99.

Radial 317.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	3.66	36° 06' 17.26"	96° 18' 47.98"	3/21/2017	10:57	100	41st St South west of 289th W. Ave
2	11.25	36° 09' 18.34"	96° 22' 13.70"	3/21/2017	11:05	34.8	Old Highway 51 west of Fox Run Rd
3	20.64	36° 13' 2.11"	96° 26' 28.55"	3/21/2017	11:37	13	County Barn Rd west of House Creek Rd

NIGHTTIME

Radial 9°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	5.64	36° 07' 50.31"	96° 16' 33.56"	3/19/2017	10:13	13	Hwy 51 by Hwy 151 entrance ramp
2	20.87	36° 15' 57.20"	96° 14' 57.56"	3/19/2017	15:10	5.5	Prue Road east of CR 1475
3	26.66	36° 19' 2.27"	96° 14' 21.01"	3/19/2017	15:17	2	CR 1475 south of creek

Radial 39°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	6.04	36° 07' 21.95"	96° 14' 36.92"	3/19/2017	10:03	13.4	225th W. Ave north of W. 42nd St. South
2	7.64	36° 08' 2.16"	96° 13' 56.64"	3/19/2017	10:08	6.4	Hwy 51 west of 213th W. Ave
3	14.5	36° 10' 54.88"	96° 11' 3.41"	3/19/2017	15:12	3.4	Shell Creek Road east of 177th E. Ave

Radial 56°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	4.57	36° 06' 12.61"	96° 14' 37.27"	3/19/2017	10.:01	24	225th W. Ave north of W. 31st St South
2	11.3	36° 08' 14.14"	96° 10' 53.60"	3/19/2017	9:45	14	Hwy 51 w. of S. 169th W. Ave
3	15.69	36° 09' 33.50"	96° 08' 27.46"	3/19/2017	14:59	6.5	Willow St, east side

Radial 96.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	24.83	36° 03' 18.56"	95° 00' 41.44"	3/19/2017	14:27	74	7550 S. Union Ave
2	31.72	36° 02' 52.71"	95° 56' 7.27"	3/19/2017	14:10	60	7835 S. Louisville Ave
3	38.87	36° 02' 25.80"	95° 51' 22.90"	3/19/2017	13:56	38	S of junction of S. 107th E. Ave and E. 84th Pl at Thomas Jefferson Elementary

Radial 139°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	13.56	35° 59' 18.46"	96° 11' 13.20"	3/19/2017	12:35	9	On Hwy 66 next to gas station.
2	22.94	35° 55' 28.95"	96° 07' 7.59"	3/19/2017	12:55	2.5	At junction of 165th and S 113th Ave. W.
3	34.76	35° 50' 39.78"	96° 01' 58.82"	3/19/2017	13:30	0.7	On N 190 Road, N of junction of N 190 Road and Hectorville Road.

Radial 156.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	11.18	35° 59' 18.23"	96° 14' 10.49"	3/19/2017	12:26	4.6	676.7m E of S 225th Ave W on Hwy 33.
2	20.01	35° 54' 56.16"	96° 11' 49.79"	3/19/2017	12:15	3.6	On W 171st St S at S 184th West Ave.
3	35.92	35° 47' 3.59"	96° 07' 36.80"	3/19/2017	11:56	1.4	On Grimes Road, E of junction of Grimes Road & N 135 Road.

Radial 198.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	10.98	35° 59' 12.78"	96° 19' 28.12"	3/19/2017	11:09	10	970m E of 8th St on Hwy 33.
2	21.05	35° 54' 3.78"	96° 21' 35.34"	3/19/2017	11:32	4	175.2m W of S 327th West Ave on Hwy 66.
3	27.89	35° 50' 33.63"	96° 23' 1.66"	3/19/2017	11:45	3.5	35m E of RR tracks on Refinery Rd.

Radial 246.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	9.92	36° 02' 41.65"	96° 23' 12.89"	3/19/2017	10:40	265	4.65m N of Hwy 33 on Hwy 48.
2	18.69	36° 00' 47.91"	96° 28' 34.58"	3/19/2017	10:59	110	1.16 N of Hwy 33 on S 433rd Ave. W.
3	29.25	35° 58' 30.64"	96° 35' 1.35"	3/19/2017	11:05	66	1.3km S of Hwy 33 on Hwy 16.

Radial 277.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	9.19	36° 05' 28.86"	96° 23' 13.81"	3/19/2017	10:26	13	Hwy 48 north of W. 51st St South
2	14.03	36° 05' 49.18"	96° 26' 25.95"	3/19/2017	10:34	5	South 401st W Ave north of W 51st South
3	26.21	36° 06' 40.01"	96° 34' 29.90"	3/19/2017	15:45	2.4	Hwy 99 north of W 41st St South

Radial 305°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	9.82	36° 07' 52.41"	96° 22' 31.24"	3/19/2017	10:21	5.6	Hwy 51 east of Old Hwy 48
2	12.46	36° 08' 41.39"	96° 23' 58.03"	3/19/2017	16:12	2.7	Highway 48 south of West 11th St South
3	21.42	36° 11' 27.45"	96° 28' 52.39"	3/19/2017	16:20	1.6	Airport Rd north of Benight Rd

Radial 337.5°

Point #	Dist. km	Latitude	Longitude	Date	Time	Field mVm	Point Description
1	5.88	36° 07' 45.81"	96° 18' 38.98"	3/19/2017	10:15	6.6	Hwy 51 east of Pelican Pl
2	27.39	36° 18' 29.00"	96° 24' 9.45"	3/19/2017	15:27	4	CR 1705 north of Prue Rd
3	31.97	36° 20' 46.15"	96° 25' 20.03"	3/19/2017	15:39	3.1	Hwy 99 west of CR 1807