

ENGINEERING EXHIBIT

Modification of FM License Replacement Nondirectional Antenna

prepared for

Board of Trustees California State University for San Diego State University

KPBS-FM San Diego, CA

Facility ID 58823

Ch. 208B (89.5 MHz) 26 kW 209 m

Board of Trustees California State University for San Diego State University (“SDSU”) is the licensee of KPBS-FM, Facility ID 58823, Channel 208B, San Diego CA (file number BLED-20120913AAN). *SDSU* herein seeks a License Modification to cover the replacement of the KPBS-FM shared main antenna and changes in the associated transmission line and combiner system.

KPBS-FM’s main facility is licensed to operate at 26 kW effective radiated power (“ERP”) using a non-directional antenna at a height above average terrain (“HAAT”) of 209 meters. The antenna, which is shared with other full-power FM stations, has been replaced in order to accommodate additional FM stations. The antenna project also involved replacement transmission line and modifications to the existing combiner system.

The replacement antenna consists of 12 circularly polarized elements, spaced at intervals of 0.43 wavelength and having 0.8 degrees of electrical beamtilt on KPBS-FM’s frequency (89.5 MHz). The attached Figure 1 provides the antenna manufacturer’s elevation pattern. The maximum ERP is 26 kW and the ERP at the horizontal is 25.59 kW.

Due to minor differences in antenna gain and system losses, the KPBS-FM transmitter power output (“TPO”) was adjusted in order to maintain the authorized ERP. The attached Table 1 provides a summary of the replacement antenna/line system gains and losses, and indicates that the required TPO is 10.5 kW to achieve the maximum ERP of 26 kW.

Upon modification of the combiner system, spurious emissions measurements were conducted by the manufacturer. System performance was verified with respect to occupied bandwidth, harmonic attenuation, and intermodulation products. The manufacturer's measurement report summary is attached separately. The measurements showed that KPBS-FM is in compliance with sections 73.317(b) through 73.317(d) of the FCC's rules, as summarized in the following.

§73.317(b): Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive was found to be attenuated at least 25 dB below the level of the unmodulated carrier.

§73.317(c): Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz was found to be attenuated at least 35 dB below the level of the unmodulated carrier.

§73.317(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz was found to be attenuated at least $43 + 10 \log_{10}(\text{Power, in Watts})$ dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

Human Exposure to Radiofrequency Electromagnetic Field (Environmental)

The KPBS-FM replacement antenna was evaluated for human exposure to RF energy using the procedures outlined in the FCC's OET Bulletin Number 65. The transmitting antenna is a Dielectric model DCRU12DC50T075 consisting of 12 bay levels spaced 0.43 wavelength spacing at KPBS-FM's frequency (89.5 MHz). According to the FCC's "FMModel" software analysis¹ for an EPA Type-5 antenna type, the graph in Figure 2 depicts calculated power density levels attributable to the KPBS-FM facility at locations near the tower at a height of two meters above ground level. The KPBS-FM ERP is increased by four percent (to 27.04 kW) for this analysis to consider the additional power attributable to the KPBS-FM digital operation. That analysis shows that the maximum calculated RF electromagnetic field attributable to KPBS-FM is $5.6 \mu\text{W}/\text{cm}^2$, which is 2.8 percent of the general population/uncontrolled maximum permitted exposure limit. This is below the five percent threshold limit described in §1.1307(b) regarding sites with multiple emitters, categorically excluding the applicant from responsibility for taking any corrective action in the areas where the proposal's contribution is less than five percent.

¹ "Office of Engineering and Technology Announces Updates to FMModel Software," Public Notice, DA 16-340, March 31, 2016. FMModel is available at <https://www.fcc.gov/oet/software/fmmodel>.

For completeness, RF exposure measurements will be conducted to evaluate the total level of RF exposure from all emitters at publicly accessible locations near the transmitter site. As necessary, based on these results and considering all emitters, appropriate exposure abatement procedures will be established and followed in order to comply with the FCC's exposure limits.

The general public will not be exposed to RF levels attributable to the proposal in excess of the FCC's guidelines. RF exposure warning signs will continue to be posted. With respect to worker safety, the applicant will coordinate exposure procedures with all pertinent stations and will reduce power or cease operation as necessary to protect persons having access to the site, tower, or antenna from RF electromagnetic field exposure in excess of FCC guidelines. This exhibit is limited to the evaluation of exposure to RF electromagnetic field.

List of Attachments

Figure 1	Beamtilt Antenna Elevation Pattern
Figure 2	Calculated RF Electromagnetic Field – FCC FMMModel Results
Table 1	Antenna / Line System Gains and Losses

Chesapeake RF Consultants, LLC

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207 Old Dominion Road	Yorktown, VA 23692	703-650-9600

ELEVATION PATTERN

Proposal No. **C-06864-3**

Date **3-Mar-21**

Call Letters **KPBS**

Frequency **89.5 MHz FM**

Antenna Type **DCRU12DC50T075**

RMS Directivity at Main Lobe

6.2 (7.89 dB)

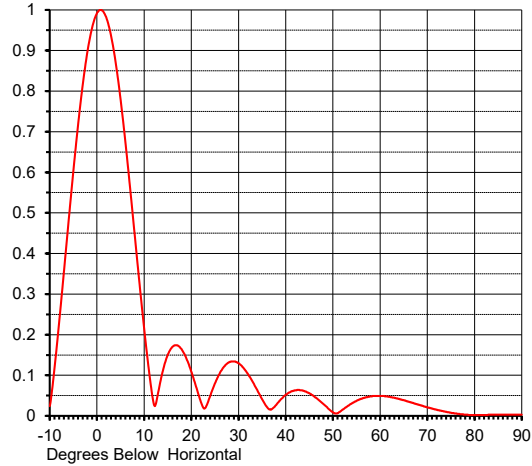
Beam Tilt **0.80 deg**

RMS Directivity at Horizontal

6.1 (7.85 dB)

Pattern Number **12C062080**

Calculated

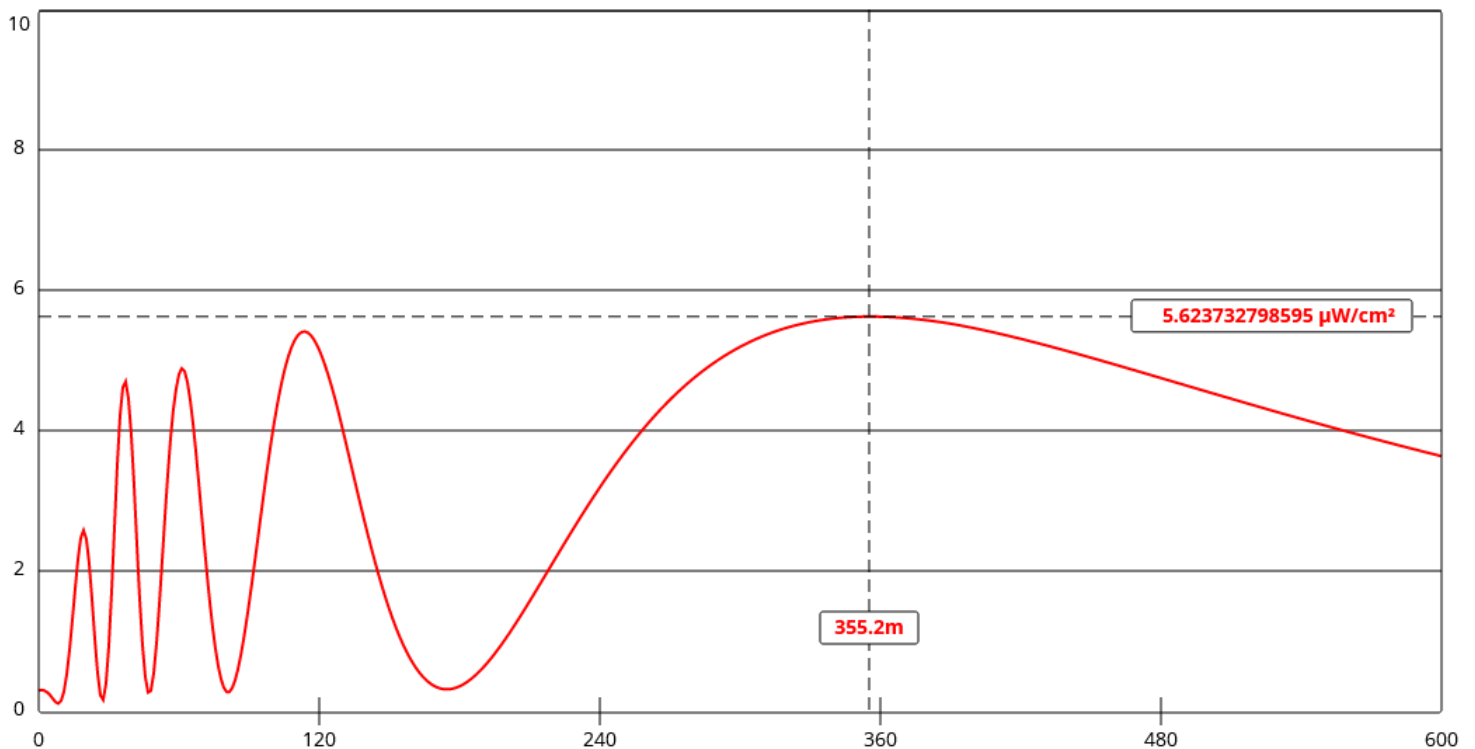


Angle	Field	Angle	Field	Angle	Field	Angle	Field	Angle	Field
-10.0	0.024	10.0	0.216	30.0	0.130	50.0	0.009	70.0	0.021
-9.0	0.116	11.0	0.114	31.0	0.119	51.0	0.007	71.0	0.018
-8.0	0.231	12.0	0.032	32.0	0.103	52.0	0.015	72.0	0.015
-7.0	0.354	13.0	0.059	33.0	0.084	53.0	0.023	73.0	0.012
-6.0	0.480	14.0	0.112	34.0	0.063	54.0	0.031	74.0	0.010
-5.0	0.602	15.0	0.150	35.0	0.041	55.0	0.037	75.0	0.008
-4.0	0.716	16.0	0.170	36.0	0.022	56.0	0.042	76.0	0.006
-3.0	0.816	17.0	0.174	37.0	0.016	57.0	0.046	77.0	0.004
-2.0	0.898	18.0	0.163	38.0	0.027	58.0	0.048	78.0	0.003
-1.0	0.957	19.0	0.140	39.0	0.041	59.0	0.049	79.0	0.002
0.0	0.992	20.0	0.109	40.0	0.052	60.0	0.049	80.0	0.002
1.0	0.999	21.0	0.072	41.0	0.059	61.0	0.048	81.0	0.002
2.0	0.981	22.0	0.035	42.0	0.063	62.0	0.047	82.0	0.002
3.0	0.936	23.0	0.020	43.0	0.063	63.0	0.045	83.0	0.003
4.0	0.868	24.0	0.049	44.0	0.061	64.0	0.042	84.0	0.003
5.0	0.781	25.0	0.080	45.0	0.056	65.0	0.039	85.0	0.003
6.0	0.678	26.0	0.104	46.0	0.048	66.0	0.035	86.0	0.003
7.0	0.565	27.0	0.122	47.0	0.039	67.0	0.032	87.0	0.003
8.0	0.447	28.0	0.132	48.0	0.029	68.0	0.028	88.0	0.003
9.0	0.329	29.0	0.134	49.0	0.018	69.0	0.025	89.0	0.003
								90.0	0.003

Figure 1
Beamtilt Antenna Elevation Pattern
Replacement Antenna
KPBS-FM San Diego, CA
Facility ID 58823
Ch. 208B (89.5 MHz) 26 kW 209 m

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[View Tabular Results +](#)

Channel Selection	Channel 208 (89.5 MHz) ▾		
Antenna Type +	EPA Type 5: Three-Piece or Four-Piece Spiral ▾		
Height (m)	<input type="text" value="36.1"/>	Distance (m)	<input type="text" value="600"/>
ERP-H (W)	<input type="text" value="27040"/>	ERP-V (W)	<input type="text" value="27040"/>
Num of Elements	<input type="text" value="12"/>	Element Spacing (λ)	<input type="text" value="0.43"/>
Num of Points	<input type="text" value="500"/>	<input type="button" value="Apply"/>	



Figure 2
Calculated RF Electromagnetic Field
FCC FMModel Results
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Table 1

Antenna / Line System Gains and Losses

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KPBS-FM San Diego, CA

Modification of License

Replacement Antenna, Line, and Combiner

KPBS-FM License File Number: BLED-20120913AAN

Licensed Maximum Effective Radiated Power: 26.0 kW

Antenna System

Dielectric DCRU12DC50T075 Power Gain: 3.08
12 elements, 0.43 wavelength spacing at 89.5 MHz

Antenna Input Power: 8.44 kW

Line and Other Losses

Transmission Line to Antenna Efficiency: 98.2%
Rigid 6-1/8" (160 ft length)

Transmission Line to Combiner
Segment #1 Efficiency: 94.6%
Helix 2-1/4" (150 ft length)

Transmission Line to Combiner
Segment #2 Efficiency: 99.4%
Rigid 3-1/8" (27 ft length)

Other Losses
Combiner (0.54 dB loss) Efficiency: 88.3%

Transmitter Power Output: 10.35 kW

TPO Rounded per §73.212 10.5 kW