Exhibit 24

Technical Description and Narrative
WMFO Directional Antenna Replacement

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I. Introduction

This exhibit was prepared to support the filing of form 302-FM for Tufts University, licensee of FM station WMFO. This exhibit provides detail on the installation of a new directional array for station WMFO pursuant to answering questions #14 and #15 on form 302-FM.

WMFO is a non-commercial, class A station operating with an effective radiated power of 125 watts on channel 218 (91.5 MHz). The licensed directional pattern for WMFO was originally established in 1982. This pattern was derived using a specialized corner reflector antenna manufactured by Telrex Labs. Due to age, this original antenna degraded to the point where further operation was impossible and replacement was required. Telrex Labs no longer manufactures a similar corner reflector so a new antenna type was located to replicate the existing coverage as closely as possible.

II. Replacement Antenna System

In the replacement of the WMFO directional antenna, the guidelines of section 73.1690 of the Commission's Rules were considered. The location of the antenna remains the same as licensed and no change in the height of the center of radiation is proposed. Additionally, the replacement antenna was selected to provide a pattern that would remain within the existing licensed pattern for all azimuths and also provide a minimum of 85% of the current coverage. The antenna selected was a Kathrein model K53 32 187 CP.

The Kathrein K53 series antennas are panels comprised of dual horizontal and vertical dipole elements mounted on a square reflector. The reflector is designed to minimize the effects of the mounting structure on the radiated pattern of the individual panel elements. As such, the K53 provides a repeatable and controlled pattern for both the vertical and horizontal planes. Each K53 generates a field pattern shape with a narrow beam width similar to the corner reflector design, due to the dual dipole elements. By using a 90 degree phased cable harness, circular polarization is achieved. Power is split equally to the vertical and horizontal dipole elements.

The relative field values for the licensed WMFO directional array are shown below in Tables 1 and 2 for horizontal and vertical polarization respectively. The relative field values for the proposed Kathrein K53 32 187 antenna is shown below in Tables 3 and 4 for horizontal and vertical polarization respectively. In both cases the patterns have been normalized to show the peak power lobe oriented to achieve a maximum field gain at 90 degrees from true north per existing authorization. Polar plots showing the radiation pattern are included in Exhibit B, the manufacturer's antenna test results.

Table 1: Licensed WMFO Relative Field Values

H- Polarization

Deg	Relative Field	Deg	Relative Field	Deg	Relative Field
0	0.285	120	0.735	240	0.195
10	0.260	130	0.590	250	0.170
20	0.290	140	0.460	260	0.145
30	0.355	150	0.360	270	0.110
40	0.460	160	0.290	280	0.145
50	0.610	170	0.260	290	0.170
60	0.735	180	0.280	300	0.195
70	0.885	190	0.320	310	0.220
80	0.968	200	0.295	320	0.250
90	1.000	210	0.291	330	0.288
100	0.968	220	0.250	340	0.300
110	0.885	230	0.220	350	0.320

Table 2: Licensed WMFO Relative Field Values

V- Polarization

Deg	Relative Field	Deg	Relative Field	Deg	Relative Field
0	0.285	120	0.735	240	0.195
10	0.260	130	0..590	250	0.170
20	0.290	140	0.460	260	0.145
30	0.355	150	0.360	270	0.110
40	0.460	160	0.290	280	0.145
50	0.610	170	0.260	290	0.170
60	0.735	180	0.280	300	0.195
70	0.885	190	0.320	310	0.220
80	0.968	200	0.295	320	0.250
90	1.000	210	0.291	330	0.288
100	0.968	220	0.250	340	0.300
110	0.885	230	0.220	350	0.320

Table 3: Proposed Relative Field Values with Kathrein K53 32 187 Antenna
H-Polarization

Deg	Relative Field	Deg	Relative Field	Deg	Relative Field
0	0.036	120	0.750	240	0.078
10	0.064	130	0.600	250	0.071
20	0.157	140	0.449	260	0.078
30	0.271	150	0.314	270	0.093
40	0.414	160	0.178	280	0.078
50	0.578	170	0.047	290	0.057
60	0.736	180	0.045	300	0.050
70	0.871	190	0.100	310	0.086
80	0.964	200	0.156	320	0.107
90	1.000	210	0.178	330	0.121
100	0.971	220	0.171	340	0.107
110	0.885	230	0.135	350	0.078

Table 4: Proposed Relative Field Values with Kathrein K53 32 187 Antenna
V-Polarization

Deg	Relative Field	Deg	Relative Field	Deg	Relative Field
0	0.057	120	0.703	240	0.093
10	0.071	130	0.550	250	0.086
20	0.121	140	0.393	260	0.114
30	0.207	150	0.271	270	0.128
40	0.350	160	0.186	280	0.131
50	0.514	170	0.136	290	0.114
60	0.693	180	0.107	300	0.093
70	0.850	190	0.107	310	0.078
80	0.951	200	0.102	320	0.071
90	1.000	210	0.114	330	0.071
100	0.960	220	0.112	340	0.064
110	0.857	230	0.103	350	0.064

As can be seen from the tables above, the proposed antenna provides a close correspondence to the licensed pattern. In the major lobe of the Kathrein antenna the field strength exceeds the licensed pattern by minor amounts on the 100, 120, and 130 degree azimuths for the horizontal plane pattern. However, these differences are less than 2% of the licensed field strength along these azimuths and should be considered within the measurement error of the test range.

III. Pattern Study

Per the requirements of section 73.1690 a pattern study was completed by Kathrein Incorporated. The pattern study used a mounting structure equivalent to the existing WMFO tower (36 foot tall Rohn 25 tower, triangular with 12" face). Please see Exhibit B for the complete pattern study and description of measurement procedures. The relative field values in Tables 3 and 4 above are taken from this field measurement data. Antenna peak RMS gain was calculated from pattern study data using a custom spreadsheet program.

IV. Antenna Installation

Installation of the Kathrein K53 87 32 CP antenna was undertaken to carefully maintain the licensed pattern. The center of radiation was placed at the same height as the previous antenna. Orientation of the antenna was confirmed by a licensed surveyor, Medford Engineering and Survey. Antenna is oriented with the main lobe in the easterly direction per the station authorization. Please see Exhibit C for the surveyor certification.

No other antennas or platforms are mounted on the tower structure. Non-conductive guy lines were employed to prevent pattern distortion from the range measurement values.

V. Coverage Area

The replacement antenna must provide a minimum of 85% of the licensed coverage area. Coverage area was calculated using the RMS formula as specified in section 73.316 of the Commission's Rules regarding directional FM antennas.

Using this formula, the coverage area was found to be 92% of the licensed coverage area for horizontal polarization. For the vertical polarization, the coverage area was found to be 88% of the licensed coverage area.

The coverage area of the proposed antenna meets or exceeds the 85% coverage required by section 73.1690.

VI. Technical Operating Parameters

Antenna RMS maximum gain:	7.45 dB
Transmission line loss (50 feet LDF5-50A):	-0.20 dB
Power divider:	-3.00 dB
Insertion losses:	-0.50 dB
Total gain:	3.75 dB
Effective Radiated Power (H and V)	125.00 watts
Transmitter Power Output	52.71 watts
Antenna Center of Radiation HAAT	41 meters (no change)
Antenna Center of Radiation HAAT	70 meters (no change)

VII. Conclusion

This engineering exhibit is to support the replacement of an FM directional array for station WMFO. This replacement was necessitated by the deterioration of the original antenna that dates from 1982 and which likely no longer met the original pattern guidelines. The proposed Kathrein K53 antenna meets the guidelines of section 73.1690 for replacement of an FM directional array. Mounting of the new antenna was done according to the guidelines of Section 73.1690.

The peak RMS gain for the new antenna is slightly higher than previously licensed. The new value for Transmitter Power Output should be 53 watts.

VIII. Certification

I hereby certify that all the statements made in this exhibit are true to the best of my knowledge. Furthermore, the antenna installation and pattern measurements were made according to the Commission's Rules.

I am an SBE member and currently hold certification for Professional Broadcast Engineer in good standing.

Michael LeClair

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