

**APPENDIX D****Final Rules**PART 73 – RADIO BROADCAST SERVICES

The authority for Part 73 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 303, 334, 336.

Amend § 73.61 by revising paragraphs (a) and (b) to read as follows:

§ 73.61 AM directional antenna field strength measurements.

(a) Each AM station using a directional antenna with monitoring point locations specified in the instrument of authorization must make field strength measurements as often as necessary to ensure that the field at each of those points does not exceed the value specified in the station authorization. Additionally, stations not having an approved sampling system must make the measurements once each calendar quarter at intervals not exceeding 120 days. The provision of this paragraph supersedes any schedule specified on a station license issued prior to January 1, 1986. The results of the measurements are to be entered into the station log pursuant to the provisions of § 73.1820.

(b) If the AM license was granted on the basis of field strength measurements performed pursuant to § 73.151(a), partial proof of performance measurements using the procedures described in § 73.154 must be made whenever the licensee has reason to believe that the radiated field may be exceeding the limits for which the station was most recently authorized to operate.

\*\*\*\*\*

Amend § 73.68 by revising paragraph (a) to read as follows, by adding a new paragraph (b), and by redesignating the remaining paragraphs.

§ 73.68 Sampling systems for antenna monitors.

(a) Each AM station permittee authorized to construct a new directional antenna system which will be subject to a proof of performance based on field strength measurements, as described in § 73.151(a) or (b), must install the sampling system in accordance with the following specifications:

(1) Devices used to extract or sample the current and the transmission line connecting the sampling elements to the antenna monitor must provide accurate and stable signals to the monitor (e.g., rigidly mounted and non-rotatable loops and all system components protected from physical and environmental disturbances).

(2) Sampling lines for directional antennas may be of different lengths provided the phase difference of signals at the monitor are less than 0.5 degrees between the shortest and longest cable lengths due to temperature variations to which the system is exposed.

(3) Other configurations of sampling systems may be used upon demonstration of stable operation to the FCC.

(b) An AM station permittee authorized to construct a directional antenna system which will be subject to a proof of performance based on moment method modeling, as described in § 73.151(c), shall install a sampling system conforming to the requirements set forth in that section.

(c) A station having an antenna sampling system constructed according to the specifications given in paragraph (a) of this section may obtain approval of that system by submitting an informal letter request to the FCC in Washington, DC, Attention: Audio Division, Media Bureau. The request for approval,

signed by the licensee or authorized representative, must contain sufficient information to show that the sampling system is in compliance with all requirements of paragraph (a) of this section.

Note to paragraph (c): A public notice dated December 9, 1985 giving additional information on approval of antenna sampling systems is available through the Internet at <http://www.fcc.gov/mb/audio/decdoc/letter/1985-12-09-sample.html>.

(d) In the event that the antenna monitor sampling system is temporarily out of service for repair or replacement, the station may be operated, pending completion of repairs or replacement, for a period not exceeding 120 days without further authority from the FCC if all other operating parameters and the field monitoring point values are within the limits specified on the station authorization.

(e) If the antenna sampling system is modified or components of the sampling system are replaced, the following procedure shall be followed:

(1) Special Temporary Authority (see § 73.1635) shall be requested and obtained from the Commission's Audio Division, Media Bureau in Washington to operate with parameters at variance with licensed values pending issuance of a modified license specifying parameters subsequent to modification or replacement of components.

(2) Immediately prior to modification or replacement of components of the sampling system, and after a verification that all monitoring point values and operating parameters are within the limits or tolerances specified in the rules, the following indications must be recorded for each radiation pattern: Final plate current and plate voltage, common point current, antenna monitor phase and current indications, and the field strength at each monitoring point. Subsequent to these modifications or changes the procedure must be repeated.

(3) If monitoring point field strengths or antenna monitor parameters exceed allowable limits following the replacement or modification of that portion of the sampling system above the base of the towers, a partial proof of performance shall be executed in accordance with § 73.154. The partial proof of performance shall be accompanied by common point impedance measurements made in accordance with § 73.54.

(4) Request for modification of license shall be submitted to the FCC in Washington, DC, within 30 days of the date of sampling system modification or replacement. Such request shall specify the transmitter plate voltage and plate current, common point current, base currents and their ratios, antenna monitor phase and current indications, and all other data obtained pursuant to this paragraph.

(e) If an existing sampling system is found to be patently of marginal construction, or where the performance of a directional antenna is found to be unsatisfactory, and this deficiency reasonably may be attributed, in whole or in part, to inadequacies in the antenna monitoring system, the FCC may require the reconstruction of the sampling system in accordance with requirements specified above.

Amend § 73.151 by revising the introductory paragraph and by adding paragraph (c) to read as follows:

§ 73.151. Directional Antenna Performance Verification

The performance of a directional antenna may be verified either by field strength measurement or by computer modeling and sampling system verification.

\*\*\*\*\*

(c) Computer modeling and sample system verification of modeled parameters to establish operation of a directional antenna consistent with the theoretical pattern. Each element of the directional array shall be modeled by use of a method of moments computer program, using the physical characteristics of each element to establish a model that does not violate any of the internal constraints of the computer program. Only arrays consisting of series-fed elements may have their performance verified by computer modeling and sample system verification.

(1) A matrix of impedance measurements at the base and/or feed point of each element in the array, with all other elements shorted and/or open circuited at their respective measurement locations, shall be made. The physical model of the individual antenna elements used in the computer program may be varied to match the measured impedance matrix, but the actual spacings and orientations of the array elements must be used. Towers may be modeled using individual vertical wires to represent them, or with multiple wires representing their leg and cross-member sections. The resulting model description (consisting of the length, radius, and number of segments of each wire for arrays using vertical wire sections to represent the towers, or the length, end-point coordinates, and radius of each wire used to represent leg and cross-member sections for arrays using detailed tower structure representations) as well as the assumed input feed and base region stray reactances shall be used to generate the drive impedances and sample system parameter values for the operating directional antenna pattern parameters.

(i) For arrays using vertical wires to represent each tower, the radii of cylinders shall be no less than 80 percent and no more than 150 percent of the radius of a circle with a circumference equal to the sum of the widths of the tower sides.

(ii) For arrays using multiple wires to represent leg and cross-member sections, the individual legs of the tower may be modeled at their actual diameters with appropriate interconnecting segments representing cross-members at regular intervals.

(iii) No less than one segment for each 10 electrical degrees of the tower's physical height shall be used for each element in the array.

(iv) Base calculations shall be made for a reference point at ground level or within one electrical degree elevation of the actual feed point.

(v) For uniform cross-section towers represented by vertical wires, each wire used for a given tower shall be between 75 to 125 percent of the physical length represented.

(vi) For self-supporting towers, stepped-radius wire sections may be employed to simulate the physical tower's taper, or the tower may be modeled with individual wire sections representing the legs and cross members.

(vii) The lumped series inductance of the feed system between the output port of each antenna tuning unit and the associated tower shall be no greater than 10  $\mu\text{H}$  unless a measured value from the measurement point to the tower base with its insulator short circuited is used.

(viii) The shunt capacitance used to model base region effects shall be no greater than 250 pF unless the measured or manufacturer's stated capacitance for each device other than the base insulator is used. The total capacitance of such devices shall be limited such that in no case will their total capacitive reactance be less than five times the magnitude of the tower base operating impedance without their effects being considered.

(ix) The orientation and distances among the individual antenna towers in the array shall be confirmed by a post-construction certification by a land surveyor (or, where permitted by local regulation, by an engineer) licensed or registered in the state or territory where the antenna system is located.

(2)(i) The computer model, once verified by comparison with the measured base impedance matrix data, shall be used to determine the appropriate antenna monitor parameters. The moment method modeled parameters shall be established by using the verified moment method model to produce tower current distributions that, when numerically integrated and normalized to the reference tower, are identical to the specified field parameters of the theoretical directional antenna pattern. The samples used to drive the antenna monitor may be current transformers or voltage sampling devices at the outputs of the antenna matching networks or sampling loops located on the towers. If sample loops are used, they shall be located at the elevation where the current in the tower would be at a minimum if the tower were detuned in the horizontal plane, as determined by the moment method model parameters used to determine the antenna monitor parameters. Sample loops may be employed only when the towers are identical in cross-sectional structure, including both leg and cross member characteristics; if the towers are of unequal

height, the sample loops shall be mounted identically with respect to tower cross members at the appropriate elevations above the base insulator. If the tower height used in the model is other than the physical height of the tower, the sampling loop shall be located at a height that is the same fraction of the total tower height as the minimum in tower current with the tower detuned in the model. Sample lines from the sensing element to the antenna monitor must be equal in both length (within one electrical degree) and characteristic impedance (within two ohms), as established by impedance measurements, including at the open-circuit resonant frequency closest to carrier frequency to establish length, at frequencies corresponding to odd multiples of 1/8 wavelength immediately above and below the open circuit resonant frequency closest to carrier frequency, while open circuited, to establish characteristic impedance, and at carrier frequency or, if necessary, at nearby frequencies where the magnitude of the measured impedance is no greater than 200 ohms with the sampling devices connected. Samples may be obtained from current transformers at the output of the antenna coupling and matching equipment for base-fed towers whose actual electrical height is 120 degrees or less, or greater than 190 electrical degrees. Samples may be obtained from base voltage sampling devices at the output of the antenna coupling and matching equipment for base-fed towers whose actual electrical height is greater than 105 degrees. Samples obtained from sample loops located as described above can be used for any height of tower. For towers using base current or base voltage sampling derived at the output of the antenna coupling and matching equipment, the sampling devices shall be disconnected and calibrated by measuring their outputs with a common reference signal (a current through them or a voltage across them, as appropriate) and the calibration must agree within the manufacturer's specifications. A complete description of the sampling system, including the results of the measurements described in this paragraph, shall be submitted with the application for license.

(ii) Proper adjustment of an antenna pattern shall be determined by correlation between the measured antenna monitor sample indications and the parameters calculated by the method of moments program, and by correlation between the measured matrix impedances for each tower and those calculated by the method of moments program. The antenna monitor sample indications must be initially adjusted to agree with the moment method model within +/- 5 percent for the field ratio and +/- 3 degrees in phase. The measured matrix impedances must agree with the moment method model within +/- 2 ohms and +/- 4 percent for resistance and reactance.

(3) Reference field strength measurement locations shall be established in directions of pattern minima and maxima. On each radial corresponding to a pattern minimum or maximum, there shall be at least three measurement locations. The field strength shall be measured at each reference location at the time of the proof of performance. The license application shall include the measured field strength values at each reference point, along with a description of each measurement location, including GPS coordinates and datum reference.

Add § 73.155 to read as follows:

#### § 73.155 Periodic Directional Antenna Performance Recertification

A station licensed with a directional antenna pattern pursuant to a proof of performance using moment method modeling and internal array parameters as described in § 73.151(c) shall recertify the performance of that directional antenna pattern at least once within every 24 month period.

(a) Measurements shall be made to verify the continuing integrity of the antenna monitor sampling system.

(1) For towers using base current or base voltage sampling derived at the output of the antenna coupling and matching equipment, the sampling devices shall be disconnected and calibrated by measuring their outputs with a common reference signal (a current through them or a voltage across them, as appropriate) and the calibration must agree with the manufacturer's specifications.

(2) For towers using base current or base voltage sampling derived at the output of the antenna coupling and matching equipment, sampling line measurements shall be made to verify the open-circuit resonant frequency closest to carrier frequency, to establish length, and also at frequencies corresponding to odd

multiples of 1/8 wavelength immediately above and below the open-circuit resonant frequency closest to carrier frequency, while open circuited, to verify their characteristic impedance. The frequencies measured must be the same as were measured in the most recent proof of performance and must demonstrate that the sampling lines continue to meet the requirements of § 73.151(c) with regard to their length and characteristic impedance.

(3) For towers having sampling loops, measurements shall be made at carrier frequency or, if necessary, at nearby frequencies where the magnitude of the measured impedance is no greater than 200 ohms with the sampling loops connected. The frequencies measured must be the same as were measured in the most recent proof of performance and the measured impedances must agree within +/- 2 ohms and +/- 4 percent resistance and reactance of the proof values.

(b) Field strength measurements shall be made at the reference field strength measurement locations that were established by the most recent proof of performance. If locations have become inaccessible or their readings contaminated by localized electromagnetic environmental changes, new locations that meet the requirements of the moment method proof of performance rules in § 73.151(c)(3) shall be established to replace them.

(c) The results of the periodic directional antenna performance recertification measurements shall be retained in the station's public inspection file.