

Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554

MM  
FCC 83-12  
32598

In the Matter of )  
)  
Amendment of Section 73.68 of the ) MM Docket No. 83-16  
Rules to expand the use of toroidal )  
transformers as a method of deriving ) RM-3103  
current samples in directional (AM) )  
antenna systems; and, )  
  
to provide for the use of radio )  
frequency relays in sampling element ) RM-3740  
transmission lines. )

NOTICE OF PROPOSED RULE MAKING

Adopted: January 13, 1983 Released: January 19, 1983

By the Commission:

Introduction

1. The Commission requires AM stations operating with directional coverage patterns to continuously monitor the amplitude and phase of the current delivered to each tower in the array. 1/ The values obtained are used to determine the radiation pattern that must be properly maintained if interference to other stations is to be avoided.

2. Monitoring is accomplished using "pick-up" devices that sample the current flowing into each tower, and coaxial transmission lines that connect the "pick-up" devices to an antenna monitor. 2/ Two types of "pick-up" devices are allowed: "open loops," mounted on the side of each antenna tower, or, in certain circumstances, a current transformer, located at the base of each tower. 3/

1/ Directional patterns are created using two or more transmitting towers. Each tower receives the transmitter's signal (current) at different strengths (amplitudes) and times (phase).

2/ Antenna monitors measure the amplitude and phase of the currents in each tower and are type approved by the Commission to meet certain technical standards.

3/ The term "open loop" is used to describe a small antenna mounted on the side of a radiating tower. The amount of radiation absorbed by it is related to the value of the current in the tower. The current transformer derives its sampling signal from the current present at the base of the tower.

3. If "open loop" sampling antennas are designed, installed and maintained properly, the sample current readings they provide will have a direct relationship to the currents in the various towers and can be used to verify that antenna system directionality is as specified in the station license. If not, an improper radiation pattern may result and cause interference to other stations.

4. Over the last decade, a device known as a toroidal current transformer has gained popularity as a substitute for the traditional "open loop" sampling antenna. These transformers are made by winding a coil of wire around a circular core of ferrite material enclosed in a shielded container. The container minimizes signal pickup from any other nearby antennas. The center conductor of the coaxial cable that feeds the transmitting tower is passed through the center of the toroidal transformer causing a small amount of signal to be transferred to the winding where it is then relayed (by way of still more coaxial cable) to the antenna monitor. Toroidal current transformers require a high antenna base current ("open loops" do not), that may not always be available. They appear to be equal, if not better, in terms of accuracy and reliability than "open loops" because they are installed in the comparatively protected environment of the antenna tuning house at the base of each antenna tower. They are also easier to install and maintain.

#### Background

5. On January 10, 1973, the Commission adopted rules establishing standards for the type approval of AM directional antenna monitors, and established a schedule by which all directional AM stations were required to install approved monitors. 4/ The Report and Order noted that the use of an accurate antenna monitor alone could not guarantee maintenance of the proper radiation pattern because it depended upon the associated antenna sampling system for its indications. If this system were poorly designed, installed or maintained, the sample currents furnished the monitor could be inaccurate. Therefore, in a separate rule making in Docket No. 19692, the Commission proposed standards to govern sampling systems.

6. On February 4, 1976, the Commission adopted a Report and Order in Docket No. 19692 prescribing standards for antenna monitor sampling systems. 5/ The standards applied to all stations issued construction permits after March 18, 1976, for either new or modified directional antenna facilities. Stations constructed prior to that date also could be required to meet the new standards if their monitoring systems were of patently marginal construction, or if unsatisfactory operation could be attributed to deficiencies in their existing monitoring system.

7. The improved performance provided by systems meeting the standards allowed stations to be exempted from certain inspection, monitoring, antenna proof and log keeping requirements. To obtain the exemptions, a

4/ See the Report and Order in Docket No. 18471, (38 FCC 2d 1172).

5/ See the Report and Order in Docket No. 19692 (57 FCC 2d 1085).

description of the sampling system had to be submitted to the Commission for review and approval.

8. Based on the information then available, the specifications for antenna sampling systems included different requirements for towers having uniform cross sections or widths from those having tapered towers, or those exceeding  $110^\circ$  in electrical height. <sup>6/</sup> Towers having non-uniform cross sections or exceeding  $110^\circ$  in height were required to use side mounted fixed sampling loops, whereas towers with uniform cross sections and lesser heights could use current transformers. Even though the Commission recognized the advantages of using toroidal current transformers, there was some concern expressed that due to the high base impedance or capacitance to ground of non-uniform cross section towers and towers of considerable heights, loops could provide a more accurate representation of the actual antenna radiation. Because of the various opinions expressed in the comments and the limited amount of data in the record to support the various opinions, the adopted rules were based on the most conservative engineering judgements. These rules also limited the use of toroidal current transformers.

#### Proposals

9. The Commission has before it a petition for rule making filed on April 4, 1978 (RM-3103) by the Association of Federal Communications Consulting Engineers ("AFCCE") to amend the rules to permit wider use of toroidal current transformers. AFCCE filed comments on its petition on August 11, 1978, urging the Commission to proceed with rule making, and suggesting possible procedures for validating the reliability of the sampling systems recommended. No other comments were received.

10. Another petition concerning antenna sampling systems was filed on July 31, 1980, by Charles P. Crossno. It seeks amendment of §73.68 to permit radio frequency relays in antenna sampling current transmission lines to reduce the amount of coaxial cable normally required. No comments were received on this petition.

#### Discussion

11. AFCCE indicates that there is a consensus among its members that the use of shielded toroidal current transformers can be expanded, based on performance records obtained over the past several years where such coupling units were installed on larger or tapered towers with stable results. AFCCE now asserts that little, if any, accuracy is lost when toroidal current transformers are installed in lieu of conventional sampling loops.

<sup>6/</sup> "Electrical height" is the height of the tower relative to the wavelength of the station's operating frequency expressed in degrees. It may be calculated by multiplying the tower height by  $360^\circ$ , then dividing by the wavelength of the operating frequency, where the height and wavelength are in the same unit of measure.

12. As mentioned previously, a number of factors appear to make the use of toroidal current transformers desirable. Installation is generally simpler and less costly than "open loops". Further, toroidal current sampling transformers have the advantage of being enclosed in the tuning house, protected from the weather, and conveniently located for testing and maintenance.

13. In view of these considerations, AFCCE recommends that the rules be amended to allow the use of toroidal current transformers with antenna towers exceeding 110° in height, provided that the stations can demonstrate stable operation for a one-year period following the installation. Stations would be required to perform an antenna proof of performance, if there was a disturbance in the antenna pattern after changing the sampling system.

14. Although AFCCE originally requested that the Commission amend the rules by a reregulation Order with respect to non-uniform cross section towers under 110° in electrical height, we believe that such changes, together with other changes requested by the petitioner, should be included in this Notice in order that all interested parties may have an opportunity to comment. We recognize that there is still some difference of opinion among experienced radio engineers concerning the reliability of current transformers as sampling devices in some directional antenna systems. We also wish to avoid, if at all possible, a requirement that licensees make a detailed special showing of stability of the sampling system that would have to be reviewed and analyzed by the Commission's staff. We prefer to amend the rules to provide construction specifications which, if followed, would constitute a prima facie showing that the sampling system would have the prerequisite stability. Under the present rules, the licensee would be obligated to make any necessary modifications should the sampling system be unsatisfactory or unstable in any manner.

15. The Commission has examined the AFCCE proposal and we are not convinced that unrestricted use of toroidal transformers should be permitted. Information made available in earlier related proceedings indicates that these devices are not suitable for use in towers above approximately 130° in electrical height. Moreover, the showing proposed by the petitioner would unnecessarily burden the Commission's engineering staff.

16. Accordingly, in lieu of the AFCCE proposal, we propose to expand the use of toroidal current transformers, but only for towers up to 130° in electrical height, including folded unipole type antennas and self-supporting towers having a central common feedpoint for all tower legs, where their proper operation may reasonably be expected. We also propose to require a licensee to certify the stability of the sampling system by meeting required tolerances for a continuous thirty day period. This is the policy currently applied to stations requesting program test authority subsequent to the filing of a license application. Once this stability is attained, a licensee would simply certify this fact to the Commission in an application for approval of the sampling system. No special or detailed showings would be required. If the required stability cannot be achieved, the Commission will consider granting the licensee special temporary authority for operation at variance with the parameters specified in the instrument of authorization until the problem is remedied. Comment is requested on the suitability of this proposed test period and certification procedure.

17. Toroidal current transformers, like sampling loops, are expected to meet the requirement in §73.62 that relative amplitude readings be within 5% of the values specified in the instrument of authorization. Licensees also are reminded that in BC Docket No. 78-28, we have proposed to adopt a tolerance of  $\pm 3^\circ$  in the relative phases of the antenna currents in the elements of non-critical directional arrays. 7/

18. Although not addressed in the AFCCE petition, we have received informal requests for waivers to permit the use of toroidal current transformer sampling devices with the "folded unipole" type of tall antenna tower where the design provides a relatively low impedance at the feed point at the base of the tower. The impedance of such antenna towers may be as stable as that of short towers with similar base impedances. Accordingly, we propose that current transformers be permissible as sampling units for a folded unipole antenna tower of any height, provided the base resistance and reactance do not exceed 70 ohms. We therefore seek comments as to whether the rules should be amended to provide for toroidal current transformers as sampling devices on tall folded unipole type antenna towers, the appropriateness of the proposed condition for such use, and whether the 30 day stability test should apply.

19. With regard to petition RM-3740, there appear to be advantages in using an impedance-matched radio frequency relay to switch sampling current signals from different antenna towers, provided the overall installation satisfies the requirements of §73.68(a)(1). However, a slight variation in cable length may be appropriate to compensate for any effects of the relay itself. Most importantly, the phase readings taken through the relay should be identical with those with the relay system bypassed.

20. The petitioner suggests three safeguards to ensure the accuracy of readings taken through the switching relay. First, the lines extending from the switching point to the antenna monitor should be of identical type and electrical length and exposed to the same environment. [These requirements are derived from the more stringent recommendations contained in §73.63(a)(1).] Second, the antenna monitor should be capable of being installed at the central switching point with no significant difference in observed ratios or phase indications. Lastly, upon installation, individual line impedance measurements should be made at  $\pm 5$  kHz of the station's operating frequency at the antenna monitor end of the two sampling lines for each selected element, and these measurements, along with a schematic of the sampling system, should be filed with the application for station license.

21. The latter two proposals are not included in the rules we are proposing because the same readings in sampling current amplitude may not be obtainable due to reduced sampling line attenuation. Also, to provide for the "field" installation of the antenna monitor, flexible (and therefore braided) cable may be required to make the necessary connections. For some time, we

7/ See Notice of Proposed Rule Making in the Matter of amendment of §73.52 of the Commission's Rules and Regulations with respect to relative phase tolerance for directional AM stations, BC Docket no. 78-28 (43 Fed. Reg. 4647, February 3, 1978).

have sought to minimize the use of such cable in areas of high field strength. Also, we would expect that any impedance-matched radio frequency relay designed for this purpose would be as electrically and physically stable as the coaxial cable connected to it. Any change in readings is likely to make apparent any failure in the sampling system or switching relay. Further, we expect that even if the relay is removed and the individual sampling lines are consecutively "patched in" to the antenna monitor, the difference in the path length and any impedance change will be so minimal that any change in the readings will be negligible. On the matter of sampling line impedance measurement, comments filed earlier in the Docket No. 19692 proceeding indicated that having a good match between the sampling element and the transmission line was not a factor that contributed significantly to overall system stability.

22. Accordingly, we believe that these recommendations of the petitioner are unnecessarily burdensome and without adequate compensatory benefit. They are therefore excluded from the proposed rules set forth in the Appendix. We also see no need for a special showing when an impedance-matched line relay is used in an antenna sampling system in the manner described. Nevertheless, we solicit comments on these issues and may include these or similar requirements in the final rules if the consensus of the comments is that they are necessary.

23. The Commission was questioned in the Docket No. 19692 proceeding as to why it was proposing new rules and technical standards at a time when it was generally seeking to eliminate rules that were meaningless or of questionable need. The National Association of Broadcasters expressed the opinion that the proposed rules could be so described. Responding to this charge in the Report and Order, the Commission agreed that proposing the new rules in the face of its ongoing deregulatory effort posed an apparent philosophical conflict, but that the general tenor of the comments filed in the proceeding suggested that an extensive need for antenna monitoring system upgrading existed. At that time, the Commission noted that many existing sampling systems evidently were installed without proper attention being given to the use of components and construction techniques that contributed to the stability of the system and minimized short and long term environmental effects. It further stated that the licensee's interest in minimizing immediate costs, rather than the engineer's aim toward maximizing long term performance, appeared to have exerted a predominant influence on the system design in many instances. The Commission also pointed out that the contrast between the the heavily built transmission system used to feed power to the antenna, and the light, almost flimsy, construction of the antenna monitoring system was frequently cited in the comments. The questioning of a considerable percentage of stations using directional antennas as to antenna performance and the requirement to take corrective action were attributed, in considerable part, to these circumstances. In light of the above, the Commission concluded that a unique case existed for extending the its regulatory control into the antenna monitoring system performance area.

24. Six years have now passed since the adoption of the Report and Order in Docket No. 19692. At this time, approximately 65% of all directional AM stations have received Commission approval for their sampling systems pursuant to the provisions of §73.68(c). We view this as a significant improvement in overall sampling system quality and we wish to commend those

stations that have participated in the program. However, the number of stations with unapproved systems is still significant. Also, while compliance with directional array technical standards is of considerable importance in preventing interference to the operations of other stations, deviation from authorized parameters generally has a less significant effect on a licensee's individual service area. Therefore, we believe that this aspect of broadcast regulation should be retained. Nevertheless, the necessary rules should be flexible and as least burdensome as possible in order to obtain the desired effect. This has been our goal in formulating the instant proposal.

25. Accordingly, IT IS PROPOSED to amend Part 73 of the Commission's Rules as set forth in the attached Appendix.

26. Authority for the action taken herein is contained in §§4(i) and 303(r) of the Communications Act of 1934, as amended.

27. Pursuant to procedure set forth in §§1.4, 1.415 and 1.419 of the Commission's Rules and Regulations, interested parties may file comments on or before March 21, 1983, and reply comments on or before April 20, 1983. All formal submissions by parties to this proceeding or by persons acting on behalf of such parties must be made in written comments, reply comments or other appropriate pleadings.

28. In accordance with §1.419 of the Commission's Rules and Regulations, an original and five copies of all comments, reply comments, pleadings, briefs or other documents shall be furnished the Commission. Members of the general public who wish to participate informally in this proceeding may submit one copy of their comments, specifying MM Docket Number 83-

29. All filings in this proceeding will be available for examination by interested parties during regular business hours in the Commission's Public Reference Room at its headquarters at 1919 M St., N.W. Washington, D.C.

30. The Commission has determined that §§603 and 604 of the Regulatory Flexibility Act of 1980 (P.L. 96-354) do not apply to this rule making proceeding since this proposal would simply provide for a procedural change allowing greater flexibility in the installation of AM station antenna monitoring systems. The rules herein proposed are completely optional in nature and would not compel licensees to acquire any new equipment, undertake new record-keeping requirements or modify existing practice in any way. Consequently, there would be no adverse economic impact on small businesses (or broadcast licensees), small organizations or small governmental jurisdictions.

31. IT IS ORDERED that the Secretary shall cause a copy of this Notice to be served upon the Chief Counsel for Advocacy of the Small Business Administration and that the Secretary shall also cause a copy of this Notice to be published in the Federal Register.

32. Further information on this proceeding may be obtained by contacting James E. McNally, Jr., Mass Media Bureau (202) 632-9660. However, members of the public should note that from the time a Notice of Proposed Rule

Making is issued until the matter is no longer subject to Commission consideration or court review, ex parte contacts presented to the Commission in proceedings such as this one will be disclosed in the public docket file.

33. An ex parte contact is a message (spoken or written) concerning the merits of a pending rule making other than comments officially filed at the Commission, or oral presentations requested by the Commission. If a member of the public does wish to comment on the merits of this proceeding in this manner, he or she should follow the Commission's procedures governing ex parte contacts in informal rule making. A copy of these procedures is available from the Commission's Consumer Assistance Office, FCC, Washington, D.C. 20554 (202) 632-7000.

FEDERAL COMMUNICATIONS COMMISSION

William J. Tricarico  
Secretary

Attachment: Appendix



A P P E N D I X

It is proposed to revise Part 73 of the Commission's Rules and Regulations as follows:

1. Section 73.68 would be revised as follows:

§73.68 Sampling systems for antenna monitors.

(a) \* \* \* \* \*

(1) All coaxial cable from the sampling elements to the antenna monitor, including cable used in the construction of isolation coils, except short lengths of flexible cable connecting the transmitter house sampling line termination to the monitor, must have a solid outer conductor and have uniform physical and electrical characteristics. The dielectric shall be either predominantly pressurized air or other inert gas, or foamed polyethylene.

(i) All sampling lines for a critical antenna array (i.e., an array for which the station authorization requires the maintenance of phase and current relationships within specified tolerances) must be of the same electrical length, with corresponding lengths of all lines exposed to equivalent environmental conditions.

(ii) For other arrays, lines of differing length may be employed, provided that the difference in length between the longest and the shortest line is not so great that, over the range of temperatures to which the system is exposed, predicted errors in indicated phase difference resulting from such temperature changes will exceed 0.5°.

(iii) A sampling line mounted on a tower must be adequately supported to prevent displacement, and must be protected against physical damage. Where feasible, sampling line sections between each tower base and the transmitter house shall be jacketed and buried: lines run above ground must be firmly supported, and protected against physical damage, with the outer conductor strapped to the station's ground system at such points as found necessary to minimize currents induced by antenna radiation.

(iv) All necessary connections and outdoor cable terminations must be made with waterproof fittings designed for use with the type of cable employed.

(v) For determining the permissible differences in line lengths that may be installed, the total difference between the highest listed normal daily maximum and lowest listed normal daily minimum temperatures as shown for the nearest location shown in the most recent issue of "Local Climatological Data Annual Summaries" shall be used in the calculations. This publication is available from:

National Climatic Center  
National Oceanic and Atmospheric Administration  
Asheville, North Carolina 28801

(vi) The provisions of this subparagraph do not preclude the use of a centrally located impedance-matched radio frequency relay selection device to provide relative sampling currents to the antenna monitor over a single transmission line. However, the reference sampling line and the relative sampling line from the switching point to the antenna monitor must be identical in type and electrical length, and must be exposed to the same environment. The sampling line from each sampling element to the relay must conform to all relevant requirements indicated in this subparagraph.

(2) Except as provided below, sampling elements must be single turn, unshielded loops of extremely rigid construction, with ample, firmly positioned gaps at the open loop end, mounted on towers at a fixed orientation. Loops must be installed to operate at tower potential, provided that for towers less than  $130^\circ$  in electrical height, loops operating at ground potential may be used. Each loop must be mounted on the tower near the point of maximum tower current, but in no case less than 3 meters (10 feet) above ground.

(3) Shielded current transformers may be used in lieu of unshielded loops to extract samples from antenna feed lines at the base of each tower having a uniform cross-section and  $110^\circ$  or less in electrical height.

(4) Shielded current transformers may be used in lieu of unshielded loops to extract samples from the antenna feed line at the base of each tower having a uniform cross-section more than  $110^\circ$  but not greater than  $130^\circ$  in electrical height, self-supporting towers not exceeding  $130^\circ$  in electrical height and having a central common feedpoint for all tower legs, and folded unipole antennas of any height having a base resistance and reactance not exceeding 70 ohms, provided the following conditions are met:

(i) Stability of operation during a test period of 30 continuous days using the current transformers must demonstrate that the antenna monitor sample current ratios do not exceed 5% of those specified on the station authorization.

(ii) Failure to meet the stability requirement specified in (i) above will require that the licensee seek special temporary authority to operate at variance with the terms of the station instrument of authorization until the problem can be corrected.

(iii) A certification by the licensee that the sampling system meets the stability requirement specified in this paragraph must be included in the request for approval of the monitor sampling system together with the information specified in paragraph (c) below.

(iv) The FCC may request the licensee to conduct such other tests, or measurements, or submit additional data it deems necessary to determine the stability of the antenna sampling system.

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