FCC 80-538
28119

Before the
Federal Communications Commission
Washington, D. C. 20554

In the Matter of	)	
	)	
Amendment of the Rules governing the conversion of radiation patterns for AM Broadcast stations	)))	Docket No. 21473

NOTICE OF PROPOSED RULEMAKING

Adopted: September 10, 1980; Released: September 26, 1980

By the Commission:

1. In 1971, we adopted new rules governing the design of radiation patterns for AM broadcast stations with directional antennas. Report and Order in Docket No. 16222 27 FCC 2d 77, 20 RR 2d 1745 (1971). Our amended Rules define the mathematical formula to be used in computing the radiation patterns, which are called "standard patterns." However, the Rules (Sections 73.150 and 73.152) apply only to applicants for new stations or for major changes, although applicants for minor changes can voluntarily use the new method of computing the patterns. Because the Rules apply only to stations authorized since 1971, most of the AM station patterns are under the old system. These stations have measured patterns which describe the pattern with which they are actually operating. They also have theoretical patterns which describe how the station would operate under ideal circumstances. Because no circumstances are ideal, of course, the theoretical patterns generally have MEOV (Maximum Expected Operating Values) which attempt to estimate the maximum expected deviations from the ideal. Because the MEOV were assigned based on the experience and educated guesses of the station's consulting engineer, there is no easy way to define the MEOV with a formula. Similarly, there is no easy way to define a measured pattern with a formula. Prior to the advent of automation in processing the applications for AM broadcast stations, all of the required engineering studies were performed manually, both by the applicant's consulting engineer and by the Commission engineers. The use of theoretical patterns with MEOV and measured patterns was a logical approach under those circumstances. However, in the past several years, more and more of the AM engineering studies have become automated. To take advantage of the efficiency of automation, we have been searching for ways to automate application processing without losing effectiveness. One approach is to convert all of the existing AM stations still using non-standard patterns to standard patterns since the standard pattern formula can easily be (and, in fact, has been) computerized. Accordingly, we issued the Notice of Inquiry, 66 FCC 2d 901 (1977), in this proceeding to begin discussion of the possibility of converting the remaining stations to standard patterns.

2. As extended, the time for filing comments was July 24, 1978, and

the time for filing reply comments was August 25, 1978. Comments were filed by the following parties:

J. G. Rountree
Hammett & Edison, Inc.
R. A. Jones
David C. Williams
Clear Channel Broadcasting Service (CCBS)
Association of Federal Communications Consulting Engineers (AFCCE)
Association for Broadcast Engineering Standards, Inc. (ABES)

No reply comments were filed. We have analyzed the comments, considering that the consultants were speaking for themselves rather than for their clients, and have found them to be extremely helpful. Rather than discuss the comments at this point, we find it more appropriate to begin discussion of the entire matter, bringing in the related comments as we proceed.

3. While our first concern in the Notice of Inquiry was whether we should convert, ABES has raised an issue which is even more basic: What are our goals, our policy objectives? Our primary objective in this proceeding is to increase the speed at which AM engineering studies are conducted. The potential means of achieving this end is increased automation of these studies. These studies involve individual applications as well as individual notifications from foreign countries. Also, we must conduct general studies for policy reasons; these include preparations for negotiations which may lead to new international agreements. For example, preparation is now underway for the Second Session of the Region 2 MF Broadcasting Conference, which may lead to an agreement by all or most countries in the Western Hemisphere concerning the AM Broadcast Band. Because of the voluminous nature of these general studies (perhaps involving all existing stations), it is simply not feasible to perform the studies manually. Although we have already automated a substantial portion of the engineering processing, we find that further automation requires conversion to computerized patterns. ABES has correctly surmised that this is our goal and has directed its comments accordingly.

4. We now reach the question of the type of computer pattern to which we should convert. Our Notice focused on the standard pattern with augmentation. We have also considered other possibilities, such as digitizing existing measured patterns, but have rejected them as not going far enough towards total automation. For instance, digitizing measured patterns would require re-digitizing each time a new measured pattern is filed. In addition, if we were to use a digitized pattern, we would be faced with the problem of developing a method to determine the radiation to use at various vertical angles when the only radiation we have is in the horizontal plane. At present, we use engineering judgment, which varies from case to case. However, an automated method cannot depend on "engineering judgment" but must have a pre-defined means of determining the appropriate value of vertical radiation from the horizontal radiation. We would also have a problem from an international standpoint if we were to use a digitized pattern. We thus concentrate on conversion to standard patterns. All of the commenting parties, except Mr. Jones, agreed that

conversion was desirable. Their rationale was along the same lines as ours: it would aid computerization with the resulting improvements in speed. On the other hand, Mr. Jones believes that the savings in time would not be significant, and, without a savings in time, the reason for conversion disappears. Mr. Jones states that he determined that it required less than two hours to manually adjust a nighttime computer channel study to account for the measured patterns. This small amount of time per application, coupled with the relatively few nighttime applications which are filed, leads Mr. Jones to conclude that the small benefit is not enough to justify the possibly substantial cost of conversion. However, we find that it is not unusual for a complicated nighttime allocation study to take a substantial amount of a staff engineer's time. We estimate that this could be cut significantly if adjustments for measured patterns were not needed. Moreover, although at the time we issued the Notice our daytime allocation studies were almost completely unautomated, we have since purchased a computer system which automates the calculating and plotting of groundwave contours. In the short time that this system has been in use, we have found significant improvements in the processing time for daytime studies. While not all of the increases in speed are attributable to the use of standard patterns rather than measured patterns, we have been able to achieve more of an improvement with those applications with standard patterns than with applications using non-standard patterns. Clearly, we have found that there are significant improvements which obtain with the standard pattern; we expect that consulting engineers would find similar improvements. Moreover, in many of the general studies which we will be required to make in preparations for negotiations, we also find that it is simply not possible to manually perform the required studies, simply because of the volume of work to be accomplished in a short time. Accordingly, we conclude that conversion to the standard pattern is necessary to assist in alleviating our current AM backlog, to aid us in forestalling the possibility of future backlogs, and to assist in preparation for future international conferences and general rulemakings.

5. In paragraph 5 of the Notice, we discussed whether we should convert all of the theoretical patterns to standard patterns or just the nighttime patterns. We pointed out that the determinations of presunrise power, as well as daytime allocations studies, would be made with standard patterns, if we converted the daytime patterns. However, since relatively few of the stations with presunrise service authorizations operate with directional antennas, there would be little overall effect on presunrise operation. None of the commenting parties discussed whether only some of the patterns should be converted to standard patterns. We infer that this represents a consensus that all patterns should be converted. We agree, particularly now that we are able to automate daytime studies in addition to the nighttime studies.

6. Because we performed our own study on a Class III channel at night (930 kHz; see the Appendix to the Notice), but did not have sufficient resources to perform a sample study on one of our clear channels, we specifically asked for comments on the effects that a conversion would have on the nighttime service areas of Class I stations. CCBS noted that most of the Class II stations (which operate co-channel with the Class I stations) were not authorized with standard patterns and would not be able to provide the requisite nighttime protection to the 0.5 mV/m-50 percent skywave

service areas of Class I stations if they were required to utilize a standard pattern. In general, this is because the standard pattern will not allow for the high degree of suppression to which many Class II stations have been restricted. While CCBS is very much in favor of the use of standard patterns for new stations, it is concerned that conversion of existing stations would result in the depiction of "interference" to the skywave service areas of Class I stations. Recognizing that that this "interference" would be on paper only (because no actual adjustments to the stations' directional antenna systems would be made), CCBS is nonetheless concerned that we would be opening the door for eventual creation of actual interference, presumably by a station which adjusts its pattern sometime in the future to conform to the standard pattern. Therefore, CCBS suggests that Class II stations should convert to standard patterns which provide actual protection to the skywave service areas of Class I stations. ABES also believes that any conversion must be of a nature such that a Class I-A station will not become something less.

7. The issue raised by CCBS is a complex issue. At this stage, we are not sure of the magnitude of the problem postulated by CCBS. Neither CCBS nor any other party has submitted studies showing the extent to which there may be a paper infringement of Class I secondary service areas; in addition, the Commission does not have the resources, given our current backlogs, to make such a study. Accordingly, we will propose two solutions:

a. Convert the Class I and II stations without regard to whether there is a theoretical increase in "interference," or

b. In those cases where the standard pattern radiation exceeds the MEOV and the measured radiation in the direction towards a Class I station's skywave service area, require the Class II station to convert to a different standard pattern which would not increase the radiation beyond that now authorized. This might be accomplished by use of a lower Q, in accordance with the requirements outlined in paragraph 40 of our Report and Order in Docket No. 16222, 27 FCC 2d 77, 20 RR 2d 1745 (1971), concerning the showings required to establish that the operation with the lower Q is susceptible to practical achievement. Another alternative is to allow "negative augmentation" under Section 73.152(a)(2) of the Rules. In this manner, we would permit specification of augmented values of radiation which are less than the standard pattern values (although not less than the measured values). The formula in Section 73.152(a)(2) could be used without change if we consider that "J" in the current formula can be an imaginary number. To avoid the need to think of "J" being imaginary (because "j" represents the square root of -1, among other reasons), we are proposing to redefine "J" so that it will always be real. We also propose to use a different letter to avoid confusion with the "J" in the present Rules. We note that we are suggesting this alternative only for use in conversion, not for the use of future applicants wishing to avoid interference problems.

We will await analysis of the comments to be filed in response to this Notice before selecting the course to follow.

8. In addition to the question concerning the Class I stations discussed in the preceeding paragraphs, we have a similar question concerning the Class II and III stations. As noted earlier, there will be shifts in the predicted interference levels and service areas for these stations. But these changes will also be only on paper and not in practice, although there may be future changes which would not be permissable under pre-conversion circumstances. The situation with the Class II and III stations is somewhat different than with the Class I stations. As indicated above, the Notice included an Appendix which showed the results of conversion of the nighttime stations on 930 kHz. In most cases on 930 kHz, there would be changes in the nighttime RSS of less than one decibel (dB), as we switch from the use of measured patterns to standard patterns. If we compare theoretical (rather than measured) patterns to standard patterns, we find that there would be changes of less than 0.5 dB on 930 kHz. And, since all stations are authorized to operate with at least their theoretical radiations, there would be changes in the authorized RSS of less than 0.5 dB in all cases. Such a small change (even if it occurred in fact rather than on paper) would be imperceptable. Because of the small changes, we believe that it would be unnecessary, as well as undesirable, to permit the use of a lower Q or "negative augmentation" in the situations involving only Class II and III stations.

9. In its comments, AFCCE favors conversion to the standard pattern, but prefers to avoid even a nominal change in the nighttime limitations which comprise a station's RSS. To avoid such a change, AFCCE proposes that the Commission compute the RSS and maximum permissable limitation for each station under the present procedures, publish a list of these values, and include these values on the stations' licenses. Stations would be given six months to challenge these values; if there were no challenge or at the conclusion of actions concerning the challenge, these values would become final, to be used in future allocations. If it is not possible to issue all of these values immediately, AFCCE suggests working by frequency or by groups of frequencies.

10. We have given a great deal of thought to this portion of the AFCCE proposal and have concluded that it is not desirable. First, if we follow this approach, we would not have to convert existing stations to standard patterns. Currently, all applicants for new stations or for major changes are required to use standard patterns. If we knew the RSS and the maximum permissable limitations for each station, our studies would be easy, and we would only have to require that applicants for minor changes also submit standard patterns to achieve complete automation of nighttime studies. However, we must convert to a computerized pattern so that we can perform the studies necessary for international conference preparation. A more fundamental problem with AFCCE's approach is that it is not dynamic; it does not recognize changes that would occur on the channel. For instance, a station may change frequency, thereby dropping out of the RSS, but AFCCE's approach would be unable to deal with this possibility (absent recalculating the RSS using measured patterns, the very thing which we are trying to eliminate in this proceeding). We feel that freezing things as they are is not consistent with the dynamics of broadcasting, both from a domestic and international standpoint. Accordingly, we must reject AFCCE's suggestion. In view of the fact that the levels of authorized RSS appear to change by no more than 0.5 dB, and considering that no suitable alternative

approaches have been suggested, we conclude that we should actually recompute the predicted levels of interference and service areas for each study.

11. We now move to an issue that affects only certain Class III stations. As discussed in the Notice, the changes in the nighttime RSS which would result from conversion could possibly convert a Class III-A station into a Class III-B station, or vice-versa, if the RSS moves above or below 2.5 mV/m. Notice, supra, at n. 3. A Class III-A station may have its RSS raised no higher than 2.5 mV/m while a Class III-B station may have its RSS raised no higher than 4.0 mV/m. (A station with an RSS higher than 2.5 mV/m or 4.0 mV/m, depending on its class, is protected against any increases in the RSS.) For Class III stations with a nighttime power of one kilowatt, the determination of whether it is a Class III-A or Class III-B station depends on whether its RSS is above or below 2.5 mV/m. Since a change in the permissable level of interference from 2.5 mV/m to 4.0 mV/m is much greater than the 0.5 dB we would otherwise experience, we were concerned that this would be a barrier to conversion. In his comments, Mr. Williams suggested that we determine which Class III stations are Class III-A stations under the present measured pattern system, and continue to define these individual stations as Class III-A stations after the conversion even if the RSS rises above 2.5 mV/m. This proposal has some of the same infirmities as the AFCCE proposal discussed above, although Mr. Williams' alternative would require calculations only for Class III stations with a nighttime power of one kilowatt rather than for all nighttime Class II and III stations. After due consideration, we believe that the most direct solution is to simply change the definition of Class III-A and Class III-B stations so that all Class III stations with a nighttime power of one kilowatt are Class III-A stations. This would provide a benefit to those Class III-B stations whose RSS is between 2.5 mV/m and 4.0 mV/m (without affecting any other stations) since they would receive protection to their actual RSS service contours rather than remaining vulnerable to applicants which might raise the RSS to as high as 4.0 mV/m. Because of the simplicity, we will propose changing the definition rather than following Mr. Williams' approach.

12. In paragraph 19 of the Notice, we discussed the possibility of converting to the metric system at the same time that we convert to standard patterns. We noted that our present allocation scheme mixes metric and traditional British units. (For example, we have millivolts per meter at one mile.) Since we have already announced our intention to convert to the metric system, FCC 76-737 (August 3, 1976), the only question is whether we should combine the metric conversion with the standard pattern conversion. Our initial inclination was to combine the two conversions simply to avoid the necessity of two separate conversions, and we requested comments. All of the parties who commented on the potential metric conversion were in favor of the concept, although there were reservations. Mr. Jones, for instance, indicated his belief that it was unnecessary to convert our radiation patterns from millivolts per meter at one mile to millivolts per meter at one kilometer; he saw nothing wrong with a simple relabeling (as opposed to redrawing) of the patterns to show the radiation in millivolts per meter at 1.6 kilometers. All of the commenting parties were uniformly opposed to the use of radians rather than degrees in describing the directional antenna parameters; indeed, it is rare when we

see such uniformity in comments filed in any proceeding. Hammett & Edison referred to the suggestion to use radians as "ludicrous." Since degrees are acceptable under *Metric Practice*, ANSI Z210.1-1976, ASTM E 380-76, IEEE Std. 268-1976, we conclude that the continued use of degrees in describing the parameters would be best. As for the description of radiation patterns, however, we believe it would be best to describe the inverse distance fields at a distance of one kilometer, rather than one mile (or 1.6 km). Since the *Notice* was issued, we have become involved in negotiations which may lead to an AM broadcast agreement covering the entire western hemisphere. The daytime and nighttime propagation curves in the preliminary agreements have specified the radiation in decibels above one microvolt per meter (dBu), as we do in FM and TV. Since we believe that our domestic rules should conform to international agreements if possible and appropriate, we find it necessary to consider whether the new metric standard patterns should be plotted in millivolts per meter or dBu. We do not now express a preference and will wait until the *Report and Order* before making our choice. Comments on these points are specifically solicited. As for the conversion of our groundwave and skywave propagation curves to the metric system, we agree with Hammett & Edison that conversion of those curves need not be a part of this proceeding. Accordingly, we will no longer consider the propagation curve conversion in this Docket. While it may be slightly difficult to work with the new metric standard patterns and the old propagation curves, we are confident that there will be no problems with conversions to and from the metric system for the short period in which the curves will be out of sync with the patterns.

13. As discussed in paragraph 7 of the *Notice*, we must take account of those cases where currently authorized measured patterns and/or MEOV exceed the would-be standard pattern. In those cases, we suggested that use of the modified standard pattern (augmented pattern; see Section 73.152) would be appropriate. Since the augmentation resulting in the modified standard pattern is unique to the station, each will have to be done on a case-by-case basis. There are numerous patterns to be converted, approximately 2000 when the separate day and night patterns are considered. We also wish to perform the conversion with as little disruption as possible to both the Commission staff and prospective applicants. Because of our current backlog situation and filing deadlines for the Second Session of the Region 2 MF Broadcasting Conference, we wish the conversion to proceed as quickly as possible so that we might take advantage of the use of the standard pattern. On the other hand, because of our limited staff, we cannot absorb the workload and continue to process the pending applications at our present rate. For these reasons, it is important to examine the details to ensure that we select the most efficient and effective method of conversion.

14. One of the first things to be considered is the order of conversion. In the *Notice*, we proposed two alternatives:

a) Submission of the new standard pattern with the license renewal application, with the Commission staff or a contractor verifying the patterns. This approach has been used in the past; for instance, the TV stations submitted new coverage maps with their renewal applications in conjunction with the adoption of revised propagation curves. And we are in the process of having

Class D noncommercial educational FM stations submit applications to change frequency with their renewal applications.

b) Conversion frequency by frequency, with work on a new frequency not beginning until work on the previous frequency is finished.

The commenting parties generally favored conversion over the renewal cycle, primarily because such an approach worked well with the TV coverage contours, and because a station will be more motivated to convert while its renewal application is pending. Mr. Williams preferred conversion by state rather than by frequency, with a lottery determining which states come first. He prefers this to a frequency-by-frequency conversion to avoid the possibility of mutually exclusive situations which may develop if all stations on a frequency converted at once. Since we are simply making a conversion on paper, we will, by administative fiat, have no mutually exclusive situations in the U.S. However, there is the possibility of such situations arising with foreign stations. For instance, the conversion of two stations to standard patterns could, considered individually, raise the RSS of a foreign station to a permissable value, but, considered together, would raise the RSS to an impermissable value. We also have the possibility of a reduction in radiation from a station which is the dominant limit in the RSS of a foreign station, thereby reducing the foreign station's RSS. Because of the lower RSS, the converted standard pattern of a second domestic station may be unacceptable. These considerations come into play only when we consider notifying the standard patterns to foreign countries. Since we do not necessarily have to notify the standard patterns to foreign countries at the same time that we adopt them domestically, although we prefer the one-pattern approach, the order of the conversion should not be dictated by the need to notify to foreign countries.

15. As many are aware, we are preparing for the Second Session of the Region 2 MF Broadcasting Conference to be held in November and December 1981. As indicated in paragraph 3, above, we must conduct many studies during our preparation. It may be that the preparations will require that we convert to standard patterns, at least for international purposes. If that should occur, then we would not be afforded the luxury of converting domestically but not internationally. Therefore, our conversion may, in fact, have to consider the effect on the stations in foreign countries in addition to the domestic effect. ABES has expressed some concern over the possibility that some U.S. stations may be required to adjust parameters during such an international conversion. Since this question is in a state of flux at this time, we are simply keeping it in mind as we consider the order of conversion.

16. At the time we adopted the Notice, we were leaning in favor of conversion by frequency, primarily because it would be less disruptive. By publishing the schedule of conversion, we could give notice to applicants of specific dates on which their applications would have to consider the results of conversion; applications filed before those dates would be able to ignore the results of conversion. While it is of course possible to publish dates for states to convert (whether in order by renewal cycle or in some other order), the allocation studies remain restricted to certain frequencies. Preparing an allocation study with a few changes on the

frequency occuring quite often would, we believe, create more of an uncertainty than more numerous changes at one time. Recognizing our concern, and disliking our suggestion of a freeze or mini-freezes, Hammett & Edison suggests that applicants could simply amend to compensate for the changes. Despite the comments favoring conversion over the renewal cycle, and the apparent feeling that such a conversion would not be sufficiently disruptive to favor conversion by frequency, we are tentatively concluding that we should convert by frequency. We base this conclusion primarily on the international considerations which are involved.

17. We now move on to the discussion of how the standard pattern will be derived. As noted above, modified standard patterns may be required to take into account the measured patterns and the MEOV. The question of arriving at an appropriate augmentation of the standard pattern to achieve the modified standard pattern remains elusive. We could have each licensee and permittee recalculate and replot its patterns, and submit them to the Commission for verification. The workload would be spread over the licensees and permittees rather than concentrated on the Commission or a contractor. In addition, the individual station is uniquely aware of the particular circumstances of the station. It could, for instance, devote more effort to augmentation of one of two apparently similar portions of its pattern because the station has had previous problems in one area but not in the other. If Commission staff or a contractor performed the conversion, these two areas might receive equal attention. On the other hand, the augmentation would not be uniformly applied, as it would be if the Commission or a single contractor performed the conversion. With either approach, however, it will be necessary to adopt some guidelines concerning the use of augmentation. And, if the guidelines are sufficient, it is possible that uniformity could be achieved even with each licensee and permittee performing the work for its station. AFCCE, ABES, Hammett & Edison, and, we infer, Mr. Williams favor each licensee and permittee performing the conversion, with the Commission staff verifying the submitted information. Mr. Jones suggests that we ask licensees and permittees to voluntarily submit standard patterns. For those which are not submitted, he suggests that either the Commission or a contractor perform the conversion. Mr. Rountree believes that the beneficiaries of the conversion should pay the cost. Under his analysis, the Commission would be the major beneficiary, with improved efficiency. However, he doubts that the conversion would contribute to a meaningful reduction in the cost of government, and, as a taxpayer, protests. At the time of the Notice, we were quite open-minded about the various alternatives. However, in view of the changes since the time the Notice was issued, we now find that a speedy conversion is essential. Since we lack the staff to perform the conversion or to verify conversion by licensees and permittees, we see no choice but to use a contractor. We emphasize that we reach this decision based primarily on the time frame associated with each of the possibilities, and not on their relative merits.

18. We now discuss possible guidelines for using augmentation. It is first appropriate to review the difference between a standard pattern concept and the previous two-pattern concept. Under the traditional approach, the determination of interference (and lack thereof) was based on the measured pattern of existing stations, except in the case of an application. The MEOV specified in an application was used in computing

interference. Coverage was determined using theoretical values for applications, and measured values for existing stations. Once the application was granted, the MEOV was used only as the upper bounds for adjustment of the directional array. With its use of only one pattern, the standard pattern approach combines the two different philosophies inherent in the traditional method. The standard pattern is used to determine the extent of interference and coverage, as well as defining an upper bound on the adjustment of the directional antenna. It has two conflicting roles: it must attempt to show, reasonably well, the extent of interference and coverage; and it must also allow a reasonable tolerance for adjustment of the array. We do not want to permit the use of any augmentation simply because it encompasses existing MEOV since many MEOV are substantially beyond what would ever be achieved. Using an unrealistically high augmentation would not only inflate the depiction of coverage, but would also raise the apparent level of interference on a channel, thereby allowing greater levels of interference from new stations both foreign and domestic. On the other hand, we don't necessarily wish to restrict the augmentation to the measured value (in those cases where the MEOV is greater than the measured value, and the measured radiation is greater than the standard pattern radiation) because the additional leeway may be needed in the future for minor readjustments.

19. In paragraph 17 of the Notice, we suggested that we limit the augmentation so that the RMS of the measured pattern is no less than 85 percent of the RMS of the augmented pattern, as required by Section 73.151(a) of the Rules. AFCCE proposes that we ignore the MEOV in deriving the standard pattern, but that the MEOV (both on the theoretical pattern and on the construction permit) would continue to be valid. Thus, a station would be restricted in future adjustments of the directional antenna to a value below the standard pattern radiation if the MEOV is below the standard pattern. Although AFCCE was silent about the converse, the logical extension of this approach is that stations would be able to retain their MEOV in areas where the MEOV exceeds the standard pattern radiation. The AFCCE approach is very attractive, although it does have the infirmity of requiring two patterns. Of course, only one of the two patterns (the standard pattern) need be used for interference and coverage calculations. Hammett & Edison would restrict the use of augmentation to those areas where the measured patterns show a need, with unrealistic MEOV deleted.

20. We advance another proposal: permit augmentation to encompass MEOV which are below a certain percentage (say, ten percent) of the RMS even if they might appear to be unreasonable, but permit augmentation to encompass MEOV of higher values only if the MEOV are reasonable. In this manner, we would allow sufficient latitude for adjustment in the nulls (where most adjustments are needed) and still avoid unrealistic MEOV. Adoption of this latter proposal would be a step towards defining a more precise method of assigning augmentation, thereby possibly permitting a contractor to arrive at augmentations with some assurance of uniformity and fairness. In the guidelines proposed in Appendix I, we present two formulas to determine the maximum allowable portion of the MEOV which would be retained in the form of augmentation. The first formula attempts to allow retention of more MEOV in the null areas than in the main lobes of the patterns. The determination of whether the area of concern is a null depends on the ratio of the measured radiation to the RMS. As written, as the measured radiation

approaches zero (a true null), the allowable retention of the MEOV increases to ten percent of the RMS. As the radiation increases, less of the MEOV is retained so that -- when the measured value equals the RMS -- only five percent of the RMS may be added to the measured value. And, when the measured value is twice the RMS (or greater), no MEOV beyond the measured value is permitted. The second formula looks only at the reasonableness of the MEOV. The more excessive the MEOV, the less that is retained. If the tolerance (the MEOV minus the measured radiation) is low, a higher percentage of the tolerance is retained than if the tolerance is high. Using the proposed formula, as the tolerance approaches zero, the full tolerance is retained. As the tolerance increases to the point where the MEOV is twice the measured value, only one-half of the tolerance is retained. And if the MEOV is three times (or more) the measured value, none of the tolerance is retained. The maximum allowable portion of the MEOV which could be retained is the greater of the two values. Our preliminary studies show that the first formula is predominant in null areas while the second formula is predominant in the major lobes of the patterns. We are not wedded to the specific numbers in the formulas, or even the formulas. However, we do wish to follow the general philosophy of limiting excessive radiation while still allowing adequate room for adjustment.

21. As an alternative, we suggest a modification of the AFCCE approach: Retain the MEOV in those cases where they exceed standard pattern values, thereby allowing the station to adjust to the MEOV or standard pattern, whichever is greater. Retention of the MEOV would last for a given time (perhaps until 1985), at which time the MEOV would evaporate. During this grace period, stations could voluntarily apply for augmentation, not exceeding the MEOV, to allow retention beyond 1985, for instance. Since the augmentations would not exceed the authorized MEOV, allocations studies by the applicant and the Commission staff would not be required. After the initial conversion, which would consider the present measured patterns, stations submiting measurement data showing radiation in excess of the standard pattern, although within the MEOV, would be required to reduce radiation or submit a minor change application to add augmentation to cover the measured radiation. We would still include restrictions to limit the use of unreasonable augmentation. We set out in Appendix I a list of proposed (sometimes conflicting) guidelines to be used, regardless of whether the conversion is by the licensee, the Commission, or a contractor. As indicated in paragraph 15, above, we may have to convert to standard patterns for international purposes as well as for domestic reasons. If this should occur, we would not be able to have a grace period in which each station could apply to add augmentation to retain the MEOV. In this event, the conversion would have to include the MEOV as well as measured radiation, as outlined in paragraph 20, above. At this stage, although we cannot be sure, it appears as though a full conversion will be required.

22. In paragraph 12 of the <u>Notice</u> we discussed the so-called "problem" cases, and solicited suggestions on the possible means of solving these problems. The first area in which problems are likely to arise is when we notify the new standard patterns to foreign countries. As mentioned previously, the radiation values on the standard pattern will often be higher than the notified values, particularly in the null areas. AFCCE, the only party commenting on this subject, suggested that there was no immediate need to notify the new standard patterns to foreign countries

since, under its proposal, no station would be allowed to increase radiation over that now authorized, even if the standard pattern values are higher than what is now authorized. AFCCE foresees notification only when (and if) other countries choose to adopt similar procedures. As we indicated in our Further Notice of Proposed Rulemaking in Docket No. 16222, 34 FR 18942 at para. 66 (1969), one of the aims in adopting the standard pattern was to achieve a single-pattern system. Indeed, failure to adopt a standard pattern for all stations for use in the international arena would preclude automated studies of both routine notifications from foreign countries and the general studies which are necessary as we prepare for the Second Session of the Region 2 MF Broadcasting Conference. Accordingly, we conclude that there is a need to convert to standard patterns for international purposes as well as for purely domestic use. As mentioned in paragraph 22 of the Notice, we have held discussions with Canada concerning the possibility of a joint conversion to standard patterns. Some, or perhaps all, of the problems discussed above would be alleviated or even eliminated by a joint conversion since Canada and the United States are the two countries in Region 2 with the most stations with directional antennas. We are continuing to pursue this possibility.

23. Another problem arises when the pattern generated from the authorized parameters is not the same as the actually authorized pattern. Many such situations exist, most of which were generated during the 1940 "NARBA shift" when changes in frequency were made without taking into account the effect of the changes on the electrical height and spacing of the existing towers. In paragraph 14 of the Notice, we suggested the use of the actual field ratios and phasings, but recomputing the electrical height and spacing for the new frequency. The standard pattern would then be computed from these values. AFCCE suggests that any of the theoretical parameters could be modified to generate a theoretical pattern which is a closer match. Mr. Jones simply states his agreement that the "NARBA shift" problems should be corrected at this time. In view of the lack of opposition to our original proposal, we will include it in the guidelines for conversion in Appendix I. However, we are also asking for comments on the AFCCE proposal that the theoretical parameters such as field ratio and relative phasing also be modified, if necessary. The comments should consider that a contractor may be performing the conversion, and should analyze the desirability of delegating the authority to make such modifications to a contractor. We also ask for comments on whether providing for such modifications would require a significant increase in the cost of conversion.

24. The present standard pattern rules require an assumed loss resistance of at least one ohm per tower at the current loop (or base if the tower is less than 90 electrical degrees in height). Many of the existing theoretical patterns, however, have an RMS greater than that which would be computed using an assumed loss of one ohm. In the Notice, we asked whether we should allow the use of the larger RMS or whether we should require that the standard pattern be generated with an RMS no larger than the one-ohm-loss RMS. Hammett & Edison suggest that the standard pattern be based on the theoretical RMS, except where the theoretical pattern size is larger than can actually be generated with any reasonable loss resistance. Noting that they have encountered measured patterns with excessive RMS with some elderly directional antennas, Hammett & Edison recommend abandoning

the measured pattern in these cases and using a calculated standard pattern with no less than one ohm loss per tower. AFCCE suggests using a one ohm loss pattern only in those cases where the measured RMS exceeds the one-ohm-loss RMS by ten percent or more. AFCCE agrees with the Hammett & Edison comment that some of the existing measured patterns, particularly from proofs of performance made many years ago, show unrealistically high RMS values, and states that the general experience of its members is that remeasurement using presently acceptable procedures results in the conclusion that the pattern RMS was exaggerated.

25. We have conducted a study of many stations, including the nighttime operations of all of the U.S. Class I-B stations and those on 930 kHz, to determine the existing RMS situation. Our calculations of the equivalent loss resistance were based on the theoretical, not measured RMS, although we have also tabulated the measured RMS for comparison. The results are shown in Appendix II. As can be seen, there are several cases where the theoretical RMS is based on an unreasonably low equivalent loss resistance; indeed, in many cases the loss resistance is negative, indicating that more power is radiated than was supplied. Based on this study and the comments by Hammett & Edison and AFCCE, we conclude that it will, in some cases, be necessary to use an RMS which is less than presently authorized in arriving at a standard pattern. In making our proposal, we are also considering that Section 73.51(b) allows the antenna input power to be 8 percent greater than the nominal power for stations with 5 kilowatts or less, and 5.3 percent greater than the nominal power for stations with powers in excess of 5 kilowatts. While Sections 73.51(b)(3) and 73.51(c) make provision for reduction in power as necessary to limit the radiated fields to the authorized values, we believe that we should not reduce presently authorized values below what is permitted by Section 73.51. Accordingly, we will propose in the conversion guidelines in Appendix I that the theoretical RMS be no greater than 3.9 percent more (equivalent to 8 percent more power) than the no loss or one-ohm-loss RMS for stations with nominal powers of five kilowatts or less, and no greater than 2.6 percent more (equivalent to 5.3 percent more power) than the no loss or one-ohm-loss RMS for stations with nominal powers above five kilowatts. We request comments on whether we should use the no loss RMS or the one-ohm-loss RMS. In this manner, we hope to achieve a limitation on unrealistic RMS values while, at the same time, allowing reasonable values resulting from antenna installations with better than average efficiency.

26. As can be seen from Appendix II, there were a few stations whose RMS we were unable to analyze because we did not have sufficient information about their sectionalized antennas. This brings us to the question of how to deal with these cases. Usually, the situation arises with stations that were authorized many years ago, at a time when we did not require all of the information that we now require for top-loaded and sectionalized towers. In some cases, we were supplied only with graphical information regarding the antenna characteristics. While manual processing of the applications was not impeded with graphical information, the automation of the processing is hindered without available formulas describing the vertical radiation characteristics, or, in some cases, the parameters necessary to utilize known formulas. In yet other cases, we do not have even graphical information. Since calculation of the vertical radiation characteristics (as opposed to interpolation from graphs)

requires this information, we suggested in paragraph 16 of the Notice that the burden of deriving the appropriate formula or supplying the necessary parameters be placed on the licensee or permittee. In addition, to compute the RMS based on an assumed loss resistance pursuant to the method outlined in Appendix B of the Report and Order in Docket No. 20645, supra, it is necessary to have the formula to compute the loop current. And, again, we suggested that the burden of supplying this information be placed on the licensee or permittee. In many cases, the "burden" will be minimal because we will already have the formula, and will need only the actual values for the variables in the formula. Other cases, somewhat fewer in number, will require derivation of formulas in addition to supplying the actual values for the variables.

27. In his comments, Mr. Jones opposes the suggestion that licensees or permittees be required to supply formulas for top-loaded and sectionalized towers. His experience, he states, shows that the measured results do not agree with the predictions. Therefore, he suggests the use of assumed uniform current distribution for all towers, with 10 percent elongation for top-loading. He would, however, give licensees and permittees the option of submitting additional studies which show otherwise. Hammett & Edison, on the other hand, believes it is reasonable for the licensee or permittee to be responsible for deriving the appropriate formulas, citing the case of KOTZ, Kotzebue, Alaska, in which the firm developed computerized methods to determine the three-dimensional radiation pattern for a top-loaded "Tee" antenna. AFCCE agrees that this information should be available, but does not express a preference as to where it should originate. In addition, it would be acceptable to AFCCE if it were either in formula or tabular form. Mr. Williams comments that the licensees using such antennas should be required to provide the appropriate information.

28. With regard to Mr. Jones' comments, we note that we have consistently held that there is no effective method of determining the actual vertical radiation characteristics of an array other than inference from the horizontal pattern. Capital Cities Broadcasting Corp., 20 FCC 2d 768 (1969); 49 FCC 2d 626 (1974), supplemented in 51 FCC 2d 649 (1975), affirmed sub nom, WBEN, Inc. v. Federal Communications Commission, 175 U.S. App. D.C. 363, 535 F. 2d 1325, 37 RR 2d 675 (1976). While Mr. Jones may be correct in his assertion that the vertical radiation characteristics for top-loaded towers differ from what is predicted, we have no reliable information to confirm or dispute this. However, we do need a method, for administrative purposes if no other, to compute the vertical radiation characteristics for top-loaded and sectionalized towers. And we believe that the use of formulas which are designed for this purpose will more closely approximate reality than simpler approaches such as the addition of ten percent to the physical height of a top-loaded tower. To assist in this, we are proposing to modify the Rules to include the formulas for vertical radiation characteristics, $f(\theta)$, for top-loaded and some sectionalized towers, in addition to the formula already included for the more customary towers. Appendix III includes the corresponding formulas for loop current. Over the past few months, Commission staff have been making informal requests of licensees with sectionalized towers to supply this information on a voluntary basis since it is necessary that we have sufficient information to make interference calculations preparatory to the

Second Session of the Region 2 MF Broadcasting Conference. We are now directing the staff to begin solicitation of the necessary information on a more formal basis. Because of the time constraints, we cannot wait until issuance of a Report and Order before beginning the compilation of these data. We note that acquiring these data at an earlier time will simplify the conversion to standard patterns.

29. In the Notice, we indicated that a part of the conversion to standard patterns would involve the replotting of approximately 2000 patterns, including all necessary stacked and vertical sections. After checking for accuracy, they might be notified to foreign countries in accordance with our international agreements. AFCCE questions whether we should continue our requirement concerning the plotted patterns, in particular the 5-degree through 60-degree stacked sections. Noting that the patterns served a useful purpose when MEOV were specified, AFCCE suggests that the plots are seldom needed with standard patterns because of the widespread use of computers. Hammett & Edison, while not discussing whether we should continue to require the plotted patterns, notes that it is now relatively easy to plot them with computerized curve plotters; several consultants have such plotters. From a purely domestic point of view, we see no need to continue the requirement to submit the stacked sections. AFCCE suggests that the need for the plots could be eliminated by specifying sufficient information on the construction permit and license so that the pattern could be computed; at the moment, we do not specify everything that is needed to compute a standard pattern. In addition, AFCCE would have us specify a radiation value at a particular azimuth and elevation angle so that correct entry of the parameters (into a computer program to calculate radiation, for instance) could be verified. A factor which we did not consider earlier is the cost of replotting all of the vertical and stacked sections. The cost estimates supplied to us are substantial in the aggregate, and they were made in 1978. Because we see no need for the stacked sections for our domestic use, and because of the substantial cost in replotting the patterns, we intend to pursue the question of whether they are needed for international purposes. We hope to be able to answer that question in the Report and Order. However, although we believe that it is necessary to continue the requirement of a plotted horizontal plane pattern (if for no other reason than to see what the pattern looks like), we propose to delay the replotting until we know whether the Second Session of the Region 2 MF Broadcasting Conference has voted to change the channel spacing from 10 kHz to 9 kHz. If we do shift to 9 kHz spacing, we will not replot the patterns until after the necessary frequency changes are made. Hammett & Edison suggest the adoption of a required format for the plotted patterns, including the tower layout, etc.

30. To this point, all of our discussion has been related solely to directional antennas. However, the majority of antennas are non-directional, and, if we are to further automate our processing, it is necessary to consider the means of dealing with measurement data for non-directional stations which show that the station is, in fact, directional. In paragraph 18 of the Notice, we suggested that we ignore measurement data in determining the radiation from non-directional stations, using only the predicted radiation. (Measurement data would still be used to determine the conductivity.) AFCCE agrees with this suggestion, while Hammett & Edison suggests that a standard pattern be developed for

those cases where the measured radiation departs from circular by more than 10 percent, or some other reasonably restrictive value. We assume that generation of the standard pattern would use augmentation (either positive or negative) in the arcs where the departure from circular occurs. Because of its simplicity, we tend to favor the approach we originally suggested. However, because of the potential impact (as noted above, there are more non-directional operations than directional operations) and because of the dearth of comments, we will withhold a final decision pending further analysis. We specifically solicit comments on this issue.

31. In the Notice we were concerned with patterns generated with parameters of unrealizable precision. While not making specific proposals, we suggested limiting the precision to no greater than can be obtained with available equipment. Mr. Williams applauds us for this stand, and would extend the limitation on the number of significant figures to actual interference calculations such as computations of nighttime RSS. AFCCE would take it one step farther, its goal being a license which contains sufficient information to reproduce the standard pattern accurately and completely. Therefore, in addition to restrictions on the field ratio and phasing, as we proposed, AFCCE would also include restrictions on precision for spacing, orientation, and height. AFCCE did not mention other parameters, such as the theoretical RMS (used to determine pattern size) and the augmentation parameters. We agree that there should be restrictions on the precision used in specifying the parameters. Indeed, we suggest that there is a rebuttable presumption of instability of a directional antenna array if its parameters must be specified to greater precision. The exact values we propose are outlined in the proposed Rules. In two areas we are deviating from the AFCCE proposal. We see no reason to require that the field ratio of the tower with the highest field be specified as 1.00. Also, we see no need to require that the spacing and orientation be specified from a common reference point. In a parallelogram array, for example, a simpler description results from describing the sides of the parallelogram; we would apply the limitations on precision to the descriptions of the sides of the parallelogram.

32. In the Notice we were concerned with the means of enforcing the conversion effort if we left it to the individual stations to supply the standard patterns. Several of the parties commented that the best way to ensure compliance would be to withhold license renewal in the same manner used when TV broadcast stations had to submit new service contours. However, in view of our disposition to have a contractor perform the conversion, we now see no need for concern, except with regard to the supplying of information for top-loaded and sectionalized towers. We believe that these situations can be handled by withholding license renewal.

33. We have previously discussed our desire to convert to standard patterns on an international as well as domestic basis. We are continuing our discussions in this area with Canada and hope to be able to perform a joint conversion.

34. ABES expressed concern in its comments that we might do more in this proceeding than simply redescribe the existing situation. ABES was especially concerned that redesign, modifications, and new proofs of

performance not be required. At this stage, we believe it is appropriate to recapitulate those few areas in which we are proposing to do more than redescribe an array. They are:

(a) Restrict the RMS of those stations with excessively high values of RMS.

(b) Restrict the MEOV in those arcs where the MEOV are excessively high.

(c) Correct the parameters where the existing parameters are simply wrong.

(d) Modify the theoretical parameters, if necessary, to achieve a calculated theoretical pattern which more closely approximates the plotted theoretical pattern.

35. One final area deserves discussion. It does not relate to the conversion process, but it does relate to augmented patterns. We therefore feel that it is appropriate to include it in this proceeding. The present Section 73.152 restricts the use of augmentation to those cases where, after construction and adjustment of a directional antenna, augmentation is necessary to encompass measured values that exceed the standard pattern values. Should this occur, the station is authorized limited program test authority at reduced power. The station must file an application for modification of construction permit; then we must process and grant the application. The permittee then is authorized to operate with full facilities. Our experience has shown that such cases are sufficiently numerous that we should consider whether to loosen the restriction on proposing augmentation at the initial construction permit stage. (Currently, augmentation at the construction permit stage is limited to a few cases, such as the case of a DA-D station proposing to become a DA-1 station, where the need for augmentation is already known with certainty.) We must keep in mind that we do not want to return to the situation which developed with MEOV that were excessive; that concern is even more important now that the augmented pattern will be used for future allocation studies, not just the initial application, as was the case with MEOV. Accordingly, we are proposing an amendment to permit augmentation at the construction permit stage upon a sufficient showing that it is needed. We have made some initial proposals concerning the showing, and solicit comments on these and other proposals for such a showing.

36. Accordingly, IT IS PROPOSED TO AMEND Part 73 of the Commission's Rules and Regulations as set forth in attached Appendix IV.

37. Authority for the actions taken herein is contained in Sections 4(i), and 303(a), (b), (f), (g), and (r) of the Communications Act of 1934, as amended.

38. Pursuant to procedures set out in Sections 1.4, 1.415, and 1.419 of the Commission's Rules and Regulations, interested parties may file comments on or before November 17, 1980 and reply comments on or before December 2, 1980 . Because of the time constraints imposed by international considerations, we do <u>not</u> intend to

grant extensions of time to file comments and reply comments. All submissions by parties to this proceeding or persons acting on behalf of such parties must be made in written comments, reply comments, or other appropriate pleadings.

39. In accordance with Section 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 the proceeding may submit one copy of their comments, specifying Docket No. 21473.

40. All filings made 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, 1919 M Street, NW, Washington, DC.

41. For further information concerning this proceeding, contact John Boursy, Broadcast Bureau, (202) 632-6485. However, members of the public should note that from the time a Notice of Proposed Rulemaking 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.

42. 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 the proceeding in this manner, he or she should follow the Commission's procedures governing *ex parte* contacts in informal rule making. A summary of these procedures is available from the Commission's Consumer Assistance Office, FCC, Washington, DC 20554 (202-632-7000).

FEDERAL COMMUNICATIONS COMMISSION

William J. Tricarico
Secretary

Attachments: Appendices

APPENDIX I

The following guidelines are to be applied in converting AM broadcast stations to standard patterns.

[Note: Areas in which we have not reached even a preliminary decision are enclosed within square brackets.]

1. Existing standard and augmented patterns.

   A. Convert to metric system using existing parameters.

   [B. Replot horizontal plane patterns.]

2. Other existing patterns.

   A. Check parameters such as spacing and height to ensure that they are correct for the authorized frequency. If incorrect, use the physical spacing and height to compute the proper electrical height for the authorized frequency.

   B. Compute the equivalent loss resistance, using the authorized theoretical RMS. If the equivalent loss resistance is less than one ohm per tower, adjust the theoretical RMS so that it is no greater than 3.9 percent more than the [one-ohm-loss] [no loss] RMS if the nominal power is less than or equal to five kilowatts, and no greater than 2.6 percent more than the [one-ohm-loss] [no loss] RMS if the nominal power is greater than five kilowatts.

   C. Compute the standard pattern using the theoretical RMS (as modified by B, if appropriate) to determine the pattern size. The normal Q shall be used in computing the standard pattern.

   D. Examine the measured pattern, the plotted theoretical pattern with MEOV, and the appropriate construction permit to determine the arcs in which the measured radiation and/or MEOV exceeds the standard pattern, as computed in C, above. In these arcs, augmentation shall be applied as follows:

      (1) The augmented value shall be as great as the measured value at each azimuth, insofar as possible. It is more important that the augmentation cover the measured values on the azimuths at which proof of performance measurements were made; it is less important that the augmentation cover the values on the measured pattern which are the result of "smoothing in" between measured radials.

      (2) In arcs where the MEOV exceeds the measured and/or standard pattern values, the augmented values shall be no greater than the MEOV at any azimuth.

      (3) In arcs where the MEOV exceeds the measured and/or

standard pattern values, the maximum possible value of the existing MEOV which can retained at each azimuth is the greater of the following two values, subject to the condition in (2), above:

RAD1 = (RMS)[(-0.05)(Meas/RMS)+0.1] + Meas

where RMS is the measured pattern RMS, and Meas is the measured radiation at the desired azimuth.

RAD2 = (MEOV-Meas)[1.0-(MEOV-Meas)/(2 Meas)] + Meas

where MEOV is the MEOV at the desired azimuth, and Meas is the measured radiation at the desired azimuth.

Note: In each case, if the part in square brackets is less than zero, use zero.

(4) Normally, the augmentation shall not extend beyond the arcs of existing MEOV. However, in those cases where the only MEOV at an azimuth is a value specified on a construction permit, or where the MEOV specified on the construction permit is greater than the MEOV shown on the pattern, the MEOV on the construction permit can be used in (3), above, with a span of 10 degrees.

(5) Augmentation shall be used as sparingly as possible.

(6) The measured pattern RMS shall not fall below 85 percent of the augmented pattern RMS.

[E. For stations which meet all of the following criteria:

(1) Class I or II station operating at night.
(2) Co-channel with a U.S. Class I station.
(3) Has arcs in the direction of the 0.5 mV/m-50 percent skywave contour of the Class I station.

Then, the standard pattern of the Class I or II station shall be adjusted by use of either a lower Q or "negative augmentation" (or both) to reduce the standard pattern radiation to a value no greater than the MEOV or the measured radiation. In accomplishing this, it may be necessary to repeat steps C and D.]

[F. For non-Class IV stations operating at night, which have arcs in the direction of the protected service area of a non-U.S. Class I station, or in the direction of the site (plus and minus five degrees) of a non-U.S. non-Class I station, in which the standard pattern radiation exceeds the notified pattern radiation:

Then, the standard pattern of the non-Class IV station shall be adjusted by use of either a lower Q or "negative augmentation" (or both) to reduce the standard pattern radiation to a value no greater than the notified radiation. In accomplishing this, it may be necessary to repeat steps C, D, and E.]

G. Convert the standard pattern, as augmented, to the metric system.

[H. Replot the horizontal plane pattern.]

3. Pending applications.

The processing of pending applications will be stopped, individually, while each is converted. The method of conversion will be as though the application were an existing operation. After its conversion, each application will be processed using the converted pattern. If interference develops (using the converted pattern) that did not exist prior to conversion, the application will be granted with the converted pattern, notwithstanding the interference.

4. Precision of parameters.

Converted patterns which do not need adjustment of basic parameters (pursuant to 2(A) above, for example) will continue using these parameters, even if the precision is in excess of the specified precision in Sections 73.150(b)(6) and 73.152(b)(5).

If the existing parameters must be adjusted or if new parameters must be assigned (adding augmentation, for example), the new and/or adjusted parameters shall have no greater precision than outlined in Sections 73.150(b)(6) and 73.152(b)(5).

APPENDIX II

This Appendix lists the theoretical RMS, measured RMS, one-ohm-loss RMS, and equivalent loss resistance (for the theoretical RMS) for the nighttime operations of U.S. Class I-B stations and for the nighttime operations on 930 kHz. Stations which already have standard patterns are not listed. Neither are non-directional stations.

Call	Location	Freq.	1 ohm loss RMS	Meas. RMS	Theo. RMS	Equiv. Loss
KAAY	Little Rock, AR	1090	1736	1626	1630	8.46
KPMC	Bakersfield, CA	1560	758	743	765	-0.03
KFBK	Sacramento, CA	1530	Sectionalized (insufficient data)			
KGO	San Francisco, CA	810	1546	1615	1540	1.16
WTIC	Hartford, CT	1080	1704	1720	1660	6.17
WTOP	Washington, DC	1500	1691	?	1630	10.79
KXEL	Waterloo, IA	1540	1664	1840	1700	-2.52
WCFL	Chicago, IL	1000	1629	1580	1600	4.17
WOWO	Ft. Wayne, IN	1190	1640	1700	1730	-10.81
KWKH	Shreveport, LA	1130	1756	1820	1650	14.20
WBAL	Baltimore, MD	1090	1811	1638	1654	16.48
KSTP	St. Paul, MN	Sectionalized				
KFAB	Omaha, NE	1110	1624	1835	1770	-18.52
WBT	Charlotte, NC	1110	1573	1658	1590	-1.32
WKBW	Buffalo, NY	1520	1738	1770	1725	2.55
WOR	New York, NY	710	1666	1600	1590	10.23
WNEW	New York, NY	1130	1456	1490	1485	-1.89
WQXR	New York, NY	1560	1656	1630	1592	7.24
WCKY	Cincinnati, OH	1530	1727	1634	1600	13.11
KOMA	Oklahoma City, OK	1520	1708	1772	1634	7.81
KVOO	Tulsa, OK	1170	1761	1650	1600	20.06
KEX	Portland, OR	1190	1750	1732	1655	10.06
KYW	Philadelphia, PA	1060	1605	1593	1590	2.64
WLAC	Nashville, TN	1510	1592	1600	1600	0.64
KRLD	Dallas, TX	1080	1706	1850	1800	-8.85
WRVA	Richmond, VA	1140	1632	1678	1600	3.85
KIRO	Seattle, WA	710	1407	1365	1407	1.00
KOMO	Seattle, WA	1000	1771	1800	1745	2.11
KGA	Spokane, WA	1510	1586	1589	1573	2.76
WWVA	Wheeling, WV	1170	1638	1650	1600	6.06
KHJ	Los Angeles, CA	930	453	479	480	-2.73
KIUP	Durango, CO	930	179	178	180	0.64
WJAX	Jacksonville, FL	930	472	471	470	1.35
WKXY	Sarasota, FL	930	136	127.5	126.5	2.45
WMGR	Bainbridge, GA	930	136	126.3	125.4	2.48
KSEI	Pocatello, ID	930	424	440	436	-0.87

WTAD	Quincy, IL	930	202	201	175	12.47
WKCT	Bowling Green, KY	930	127	121	120.3	3.73
WFMD	Frederick, MD	930	212	177	221	0.12
WBCK	Battle Creek, MI	930	205	191	191	2.93
WSLI	Jackson, MS	930	475	469	452	2.05
KWOC	Poplar Bluff, MO	930	133	126	126	3.84
WWNH	Rochester, NH	930	399	393	393	2.14
WPAT	Paterson, NJ	930	485	530	545	+8.67
WBEN	Buffalo, NY	930	531	527	517	5.38
WSOC	Charlotte, NC	930	204	219	220	+0.51
WITN	Washington, NC	930	203	210	215	+0.30
WEOL	Elyria, OH	930	217	204.1	202	1.87
WKY	Oklahoma City, OK	930	477	583	600	+28.29
KAGI	Grants Pass, OR	930	194	199	190	1.87
KSDN	Aberdeen, SD	930	211	198	195	2.46
KCCW	Terrell Hills, TX	930	191	210	196	+0.99
WGNT	Huntington, WV	930	205	187.5	190	2.04

APPENDIX III

In this Appendix, the equations for the no-loss loop current for top-loaded and sectionalized towers are given. The "loop current" is the current at the point where the current in the tower is the maximum, and is used in determining whether the theoretical RMS for a standard pattern is too high.

The equation for the loop current for a normal (i.e., non-top-loaded, non-sectionalized) tower was given in Appendix B to the Report and Order in Docket No. 20645, 60 FCC 2d 927, 37 RR 2d 649 (1976), and will not be repeated here.

For a top-loaded tower:

$$I_i = \frac{K F_i}{(C2)(\cos B_i - \cos G_i)}$$

For a sectionalized tower:

$$I_i = \frac{K F_i \sin (180 - \Delta_i)}{(C2)\{\cos B_i - \cos G_i - \sin B_i \cos[D_i - \cos \Delta_i]\}}$$

where:

I_i = the no-loss loop current in amperes of the i^{th} tower;

K = the no-loss multiplying constant, as computed pursuant to Appendix B to the Report and Order in Docket No. 20645, supra;

F_i = the field ratio for the i^{th} tower;

$C2$ = 37.256479; this was derived in Constants for Directional Antenna Computer Program, 43 FCC 2d 544, 28RR 2d 959 (1973);

B_i (for a top-loaded tower) = the difference between the apparent height (based on current distribution) and the actual height of the i^{th} tower;

B_i (for sectionalized tower) = the difference between the apparent height (based on current distribution) of the lower section and the actual height of the lower section of the i^{th} tower;

G_i (for a top-loaded tower) = the apparent height (based on current distribution) of the i^{th} tower;

G_i (for a sectionalized tower) = the apparent height (based on current distribution) of the lower section of the i^{th} tower;

D_i = the difference between the apparent height (based on current distribution) of the entire tower and the actual height of the entire tower, for the i^{th} tower; this will be zero if the top section is not top-loaded;

Δ_i = the difference between the apparent height (based on current distribution) of the entire tower, and the actual height of the lower section, for the i^{th} tower; this will be equal to the height of the upper section if the upper section is not top-loaded.

NOTE: A diagram showing B_i and G_i for the top-loaded towers appears as Figure 1 to proposed Section 73.160 in Appendix IV. A diagram showing B_i, G_i, and D_i for sectionalized towers appears as Figure 2 to proposed Section 73.160 in Appendix IV.

APPENDIX IV

[Note: Areas in which we have not reached even a preliminary decision are enclosed within square brackets.]

1. Section 73.21(b)(1)(ii) is proposed to be modified to read as follows:

Section 73.21 Classes of AM Broadcast Channels and Stations.
(a) * * *
(b) * * *
(1) * * *
(i) * * *
(ii) Class III-B station. A Class III-B station is a Class III station which operates with a nighttime nominal power of 500 watts, and a daytime nominal power no less than 500 watts and no greater than 5 kilowatts. The service area of a Class III-B station is subject to interference in accordance with Section 73.182.
(c) * * *

2. THE FOLLOWING AMENDMENTS TO SECTION 73.150 ARE PROPOSED:
A. The Note to Section 73.150(a) is proposed to be modified to read as follows:

(a) * * *

Note: Applications for new stations and for changes (both minor and major) in existing stations must use a standard pattern. [Those stations which had non-standard patterns until the conversion to standard patterns in Docket No. 21473 continue to retain any maximum expected operating values (MEOV) which exceed the standard pattern until January 1, 1985. These MEOV are not to be used in computing interference and service; they are to be used only in determining the allowable adjustment of a directional antenna system, and as a basis for augmentation pursuant to Section 73.152(a)(1) of the Rules.]

B. The portion of Section 73.150(b)(1)(i) which currently begins:

"$f_i(\theta)$ represents the vertical plane * * *"

and concludes

"See also Section 73.190, Figure 5."

is proposed to be replaced by the following:

$f_i(\theta)$ represents the vertical plane radiation characteristic of the i^{th} antenna. This value depends on the tower height, as well as whether the tower is top-loaded or sectionalized. The various formulas for computing $f_i(\theta)$ are given in Section 73.160.

C. Section 73.150(b)(1) is proposed to be modified to redescribe Eq. 3, Eq. 4, and Eq. 5 as Eq. 2, Eq. 3, and Eq. 4, respectively.

D. Section 73.150(b)(6) is proposed to be redefined as Section 73.150(b)(7), and a new Section 73.150(b)(6) is proposed to be added as follows:

Section 73.150 * * *
(a) * * *
(b) * * *

* * *

(6) The values used in specifying the parameters which describe the array must be specified to no greater precision than can be achieved with available monitoring equipment. Use of greater precision raises a rebuttable presumption of instability of the array. Following are acceptable values of precison; greater precison may be used only upon showing that the monitoring equipment to be installed gives accurate readings with the specified precision.

(i) Field Ratio: 3 significant figures.

(ii) Phasing: to the nearest 0.1 degree.

(iii) Orientation (with respect to a common point in the array, or with respect to another tower): to the nearest 0.1 degree.

(iv) Spacing (with respect to a common point in the array, or with respect to another tower): to the nearest 0.1 degree.

(v) Electrical Height (for all parameters listed in Section 73.160): to the nearest 0.1 degree.

(vi) Theoretical RMS (to determine pattern size): [4 significant figures] [to the nearest 0.1 dBu]

(vii) Additional requirements relating to modified standard patterns appear in Section 73.152(b)(5).

3. Section 73.152 is proposed to be modified to read as follows:

Section 73.152 Modification of Directional Antenna Data

(a) If, after construction and final adjustment of a directional antenna, a measured inverse distance field in any direction exceeds the field shown on the standard radiation pattern for the pertinent mode of directional operation, an application shall be filed, specifying a modified standard radiation pattern and/or such changes as may be required in operating parameters so that all measured effective fields will be contained within the modified standard radiation pattern.

(b) Normally, a modified standard pattern is not acceptable at the initial construction permit stage. However, in certain cases, where it can be shown that modification is necessary, a modified standard pattern will be acceptable at the initial construction permit stage. Following is a non-inclusive list of items to be considered in determining whether a modification is acceptable at the initial construction permit stage:

(1) When the proposed pattern is essentially the same as an existing pattern at the same antenna site. (e.g., A DA-D station proposing to become a DA-1 station.)

(2) Excessive reradiating structures, which should be shown on a plat of the antenna site and surrounding area.

(3) Other environmental factors; they should be fully described.

(4) Judgment and experience of the engineer preparing the engineering portion of the application. This must be supported with a full discussion of the pertinent factors.

(c) The following general principles shall govern the situations in subsections (a) and (b) in this Section:

(1) Where an excessive measured field in any direction will result in objectionable interference to another station (and which would not be computed if the standard pattern field in that direction were employed), the license application shall specify the level at which the input power to the antenna shall be limited to maintain the measured field at a value not in excess of that shown on the standard pattern, and shall specify the common point current corresponding to this power level. This value of common point current will be specified on the license for that station.

(2) Where any excessive measured field does not result in objectionable interference to another station, a modification of construction permit application shall be submitted with a modified standard pattern encompassing all measured fields. The modified standard pattern shall supersede the previously submitted standard radiation pattern for that station in the pertinent mode of directional operation. Following are the possible methods of creating a modified standard pattern:

(i) The modified pattern may be computed by making the entire pattern larger than the original pattern (i.e., have a higher RMS value) if the measured fields systematically exceed the confines of the original pattern. The larger pattern shall be computed by using a larger multiplying constant, k, in the theoretical pattern equation (Eq. 1) in Section 73.150(b)(1).

(ii) Where the measured field exceeds the pattern in discrete directions, but objectionable interference does not result, the pattern may be expanded over sectors including these directions. When this "augmentation" is desired, it shall be achieved by application of the following equation:

$$E(\phi,\theta)_{aug} = \sqrt{\{E(\phi,\theta)_{std}\}^2 + A\{g(\theta)\ \cos(180\ \frac{D_A}{S})\}^2}$$

where:

$E(\phi,\theta)_{std}$ is the standard pattern field at some particular azimuth and elevation angle, before augmentation, computed pursuant to Eq. 2, Section 73.150(b)(1)(i).

$E(\phi,\theta)_{aug}$ is the field in the direction specified above, after augmentation.

$A = E(\phi',0)^2_{aug} - E(\phi',0)^2_{std}$ in which ϕ' is the central azimuth of augmentation. $E(\phi',0)_{std}$ and $E(\phi',0)_{aug}$ are the fields in the horizontal plane at the central azimuth of augmentation.

Note: A must be positive, except during the process of converting non-standard patterns to standard patterns pursuant to the Report and Order in Docket No. 21473. During the conversion process, A may be negative if appropriate.

$g(\theta)$ is defined in Section 73.150(b)(1)(i).

S is the angular range, or "span", over which augmentation is applied. The span is centered on the central azimuth of augmentation. At the limits of the span, the augmented pattern merges into the unaugmented pattern. Spans may overlap.

D_A is the absolute horizontal angle between the azimuth at which the augmented pattern value is being computed and the central azimuth of augmentation. (D_A cannot exceed 1/2 S).

In the case where there are spans which overlap, the above formula shall be applied repeatedly, once for each augmentation, in ascending order of central azimuth of augmentation, beginning with zero degrees representing true North.

(iii) A combination of (i) and (ii), above, with (i) being applied before (ii) is applied.

(3) A Modified Standard Pattern shall be specifically labeled as such, and shall be plotted in accordance with the requirements of subparagraph (2) of paragraph (b) of Section 73.150. The effective (RMS) field intensity in the horizontal plane of $E(\phi,\theta)_{std}$, $E(\phi,\theta)_{th}$, and the root sum square (RSS) value of the inverse fields of the array elements (derived from the equation for $E(\phi,\theta)_{th}$), shall be tabulated on the page on which the horizontal plane pattern is plotted. Where sector augmentation has been employed in designing the modified pattern, the direction of maximum augmentation (i.e., the central azimuth of augmentation) shall be indicated on the horizontal plane pattern for each augmented sector, and the limits of each sector shall also be shown. Field values within an augmented sector, computed prior to

augmentation, shall be depicted by a broken line.

(4) There shall be submitted, for each modified standard pattern, complete tabulations of final computed data used in plotting the pattern. In addition, for each augmented sector, the central azimuth of augmentation, span, and radiation at the central azimuth of augmentation ($E(\phi,\theta)_{aug}$) shall be tabulated.

(5) The parameters used in computing the modified standard pattern shall be specified with realistic precision. Following is a list of the maximum acceptable precision:

(i) Central Azimuth of Augmentation: to the nearest 0.1 degree.

(ii) Span: to the nearest 0.1 degree.

(iii) Radiation at Central Azimuth of Augmentation: [4 significant figures] [to the nearest 0.1 dBu]

4. A new Section 73.160 is proposed to be added as follows:

Section 73.160 Vertical plane radiation characteristics, $f(\theta)$.

(a) The vertical plane radiation characteristics show how much field is being radiated at a given vertical angle, with respect to the horizontal plane. The vertical angle, represented as θ, is 0 degrees in the horizontal plane, and 90 degrees when perpendicular to the horizontal plane. The vertical plane radiation characteristic is referred to as $f(\theta)$. The generic formula for $f(\theta)$ is:

$$f(\theta) = E(\theta)/E(0)$$

where:

$E(\theta)$ is the radiation from the tower at angle θ.
$E(0)$ is the radiation from the tower in the horizontal plane.

(b) Listed below are formulas for $f(\theta)$ for several common towers.

(1) For a typical tower, which is not top-loaded or sectionalized, the following formula shall be used:

$$f(\theta) = \frac{\cos(G \sin\theta) - \cos G}{(1 - \cos G)\cos\theta}$$

where G is the electrical height of the tower, not including the base insulator and pier. (In the case of a folded unipole tower, the entire radiating structure's electrical height is used.)

(2) For a top-loaded tower, the following formula shall be used:

$$f(\theta) = \frac{\cos B \cos (A \sin \theta) - \sin \theta \sin B \sin (A \sin \theta) - \cos (A+B)}{\cos \theta \, (\cos B - \cos (A+B))}$$

where:

A is the physical height of the tower, in electrical degrees.

B is the difference, in electrical degrees, between the apparent electrical height (G, based on current distribution) and the actual physical height.

G is the apparent electrical height: the sum of A and B; A + B.

See Figure 1 of this Section.

(3) For a sectionalized tower, the following formula shall be used:

$$f(\theta) = \frac{\{\sin \Delta \, [\cos B \cos (A \sin \theta) - \cos G] + \sin B \, [\cos D \cos (C \sin \theta) - \sin \theta \sin D \sin (C \sin \theta) - \cos \Delta \cos (A \sin \theta)]\}}{\cos \theta \, [\sin \Delta \, (\cos B - \cos G) + \sin B \, (\cos D - \cos \Delta)]}$$

where:

A is the physical height, in electrical degrees, of the lower section of the tower.

B is the apparent electrical height (based on current distribution) of the lower section of the tower.

C is the physical height of the entire tower, in electrical degrees.

D is the difference between the apparent electrical height of the tower (based on current distribution of the upper section) and the physical height of the entire tower. D will be zero if the sectionalized tower is not top-loaded.

G is the sum of A and B; A + B.

H is the sum of C and D; C + D.

Δ is the difference between H and A; H - A.

See Figure 2 of this Section.

(c) One of the above f(θ) formulas <u>must</u> be used in computing radiation in the vertical plane, unless the applicant submits a special formula for a particular type of antenna. If a special formula is submitted, it must be accompanied by a complete derivation and sample calculations.

Submission of values for $f(\theta)$ only in a tabular or graphical format (i.e., without a formula) is not acceptable.

5. Section 73.182(a)(3)(ii) is proposed to be modified to read as follows:

(a) * * *

(1) * * *

(2) * * *

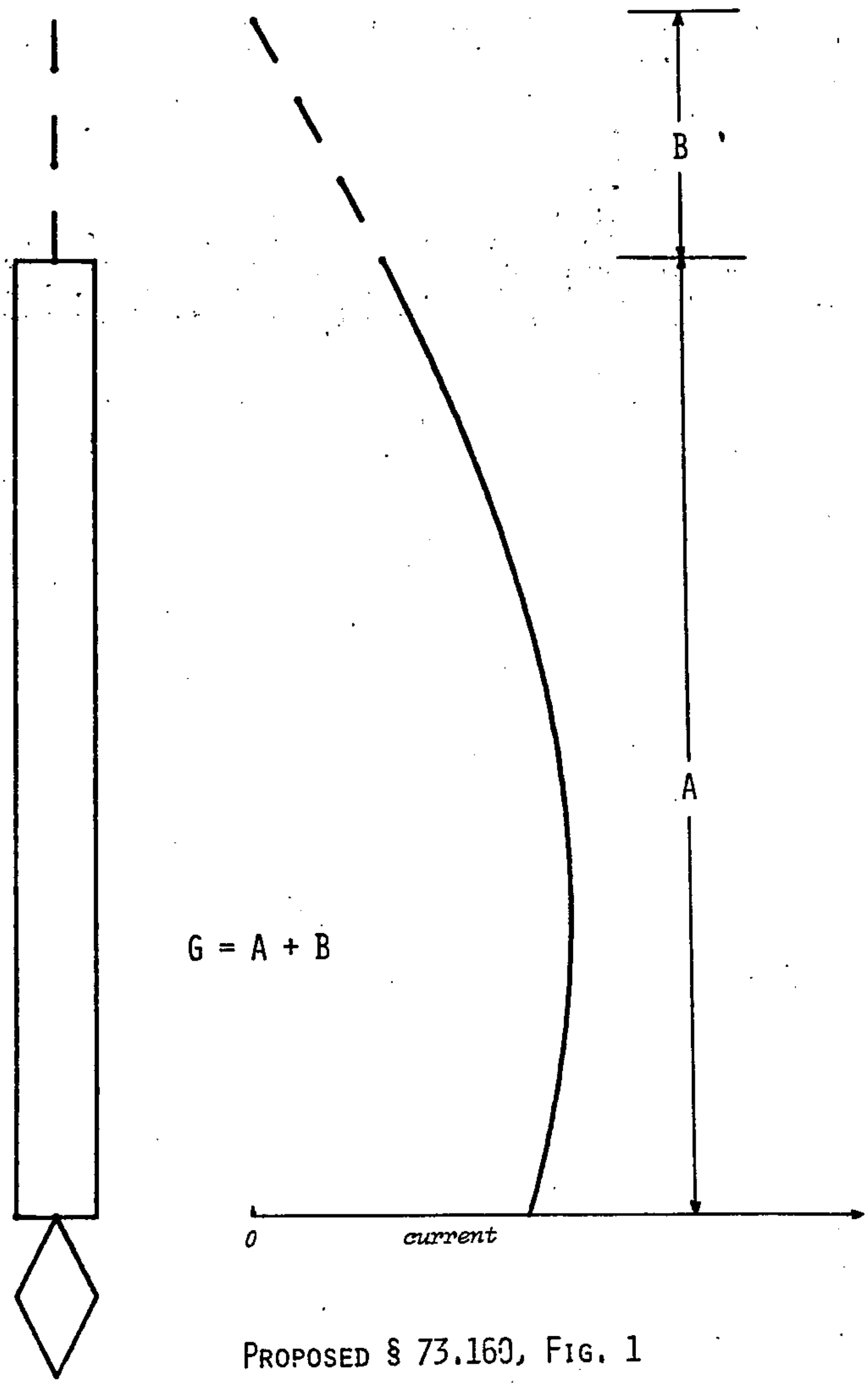
(3) * * *

(i) * * *

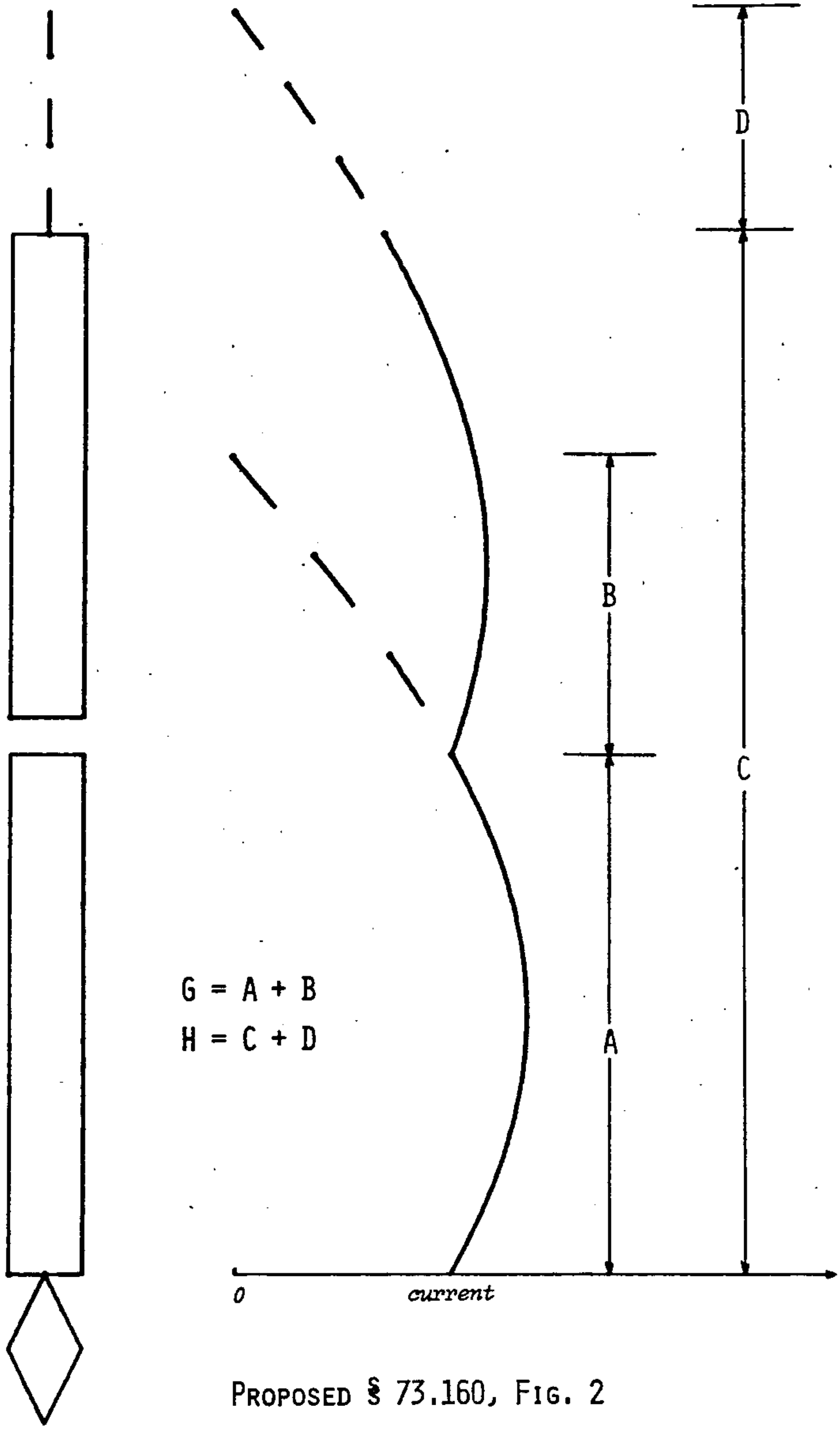
(ii) Class III-B stations, which operate with a nighttime nominal power of 500 watts and a daytime nominal power of no less than 500 watts and no greater than 5 kilowatts, and are normally protected to the 4000 uV/m contour nighttime and the 500 uV/m contour daytime.

Note: * * *

* * *



PROPOSED § 73.160, FIG. 1



PROPOSED § 73.160, FIG. 2