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

In the matter of	)	
	)	
An Inquiry Into the Commission's	)	MM Docket No. 93-177
Policies and Rules Regarding AM	)	RM-7594
Radio Service Directional Antenna	)	
Performance Verification	)	

Reply Comments of du Treil, Lundin & Rackley, Inc.

I. INTRODUCTION

These reply comments have been prepared in response to the comments that had been submitted in this proceeding before the November 9, 1999 filing deadline. Based on our review of the comments that were filed by others, we wish to express our opinions on several issues that were raised in them and to provide further information that we believe is needed to clarify certain of the positions stated in our original comments. We have attempted to give particular attention to how the proposals that were tendered in the comments might impact the FCC's efforts to achieve the highly desirable goal of streamlined electronic filing for 302 form exhibits by the licensees of AM radio stations employing directional antennas.

II. FURTHER NOTICE OF PROPOSED RULEMAKING

A. FORMATION OF A COMMITTEE

With many of the other commenters, we support the concept of a further notice of proposed rulemaking to examine the question of how computer modeling might be employed to reduce the amount of field strength measurement work required for AM DA proofs. We are particularly pleased that the National Association of Broadcasters has offered to assist with creating a special committee to study this matter and intend to offer our services to that committee. We urge the Commission to continue with expedited consideration of how the proof of performance field strength measurement process can be simplified in the present rulemaking and to defer the topics related to computer modeling for later consideration by the committee in the context of the requested further notice of proposed rulemaking.

B. PROOF-RELATED TOPICS FOR FURTHER NOTICE

We believe that the following topics should be considered in the further notice:

1. The inherent characteristics and environmental requirements for an array to qualify for computer modeling

2. The sampling system requirements for arrays proofed with computer modeling

3. The internal array and sampling system performance measurements required for a proof using computer modeling

4. The requirements for monitor points, if any, for arrays proofed with computer modeling

5. The desirability of requiring a field strength measurement proof in a situation where a credible interference complaint is lodged after a station has completed a proof using computer modeling.

C. NEW TOPICS FOR FURTHER NOTICE

1. BASE VOLTAGE SAMPLING

Several commenters mentioned base voltage sampling. We believe that action on the proposal to allow base voltage sampling should be postponed until the concept can be considered in the context of the further notice. Base voltage sampling offers a big advantage over base current sampling in that its relationship with the field of a tower is not affected by stray currents near the base, but we are concerned that it might not be appropriate for all ranges of tower height. We believe that voltage sampling should be examined under our suggested topic 2 (above) and that, if it is found acceptable for proofs using computer modeling, the sampling system Rules for all stations should be revised to allow it. We intend to conduct a study on the relative merits of voltage and current sampling for various tower heights and present the results to the NAB committee.

2. INTERNAL MEASUREMENTS FOR POWER CORRECTION

Hammett and Edison Consulting Engineers, in their comments, suggested that it should be possible to base the power necessary to overcome losses in directional antenna systems on measurement of the operating base impedances and currents of the towers in an array. We believe that this proposal is worthy of consideration and suggest that it be taken up in the context of the further notice, since it involves the measurement of internal array characteristics to determine radiated field.

III. PROOFS OF PERFORMANCE

A. BASIC REQUIREMENTS

The comments of Clear Channel Communications, Inc. made a similar suggestion to one that we made in our comments when they said "We also urge the commission to eliminate the graphical analysis process for determining the non-directional inverse field, and to authorize stations to employ the estimated non-directional RMS for the non-directional radiator employed in the proof of performance." The Walt Disney Company observed "…sufficient close-in measurements made on the reference nondirectional tower of a directional array, with antenna power correctly measured, virtually always show the tower to be performing in accordance with theory, provided that the other towers in the array have been properly isolated unless there is something wrong or unusual (non-sinusoidal) about the tower itself." There was little, if any, mention of this subject in the other comments. We believe that this was due to philosophical "inertia" and not because the other commenters actually believe that licensees of AM stations employing directional antennas should fund research into the performance of nondirectional antennas and radio wave propagation at the time of every proof of performance.

We believe that the sole purpose of a directional antenna proof of performance is to prove a directional antenna's performance. Since nondirectional antennas are normally licensed without any field strength measurements being made to examine the circularity of their radiation patterns, RMS efficiency, or the conductivity of nearby soil, we believe that it is inequitable to require stations employing directional antennas to undertake such efforts if they are not necessary for determining that their directional antenna patterns are adjusted correctly.

The present Rules require many field strength measurements on each radial of a proof, with a high concentration of them near the transmitter site, to prove the radiation pattern of the nondirectional antenna and the ground conductivity out to approximately 32 kilometers from the transmitter site along the radials. It must be understood that these requirements represent a late stage of the "snowballing" process through which the requirements for proofing directional antennas have compounded since the 1930s. We believe them to be unnecessary.

B. NONDIRECTIONAL PROOFS

1. HISTORICAL PERSPECTIVE OF NONDIRECTIONAL PROOFS

At first, nondirectional measurements were not required for directional antenna proofing. A pattern was "proven" by analyzing the field strength versus distance characteristics of the radial field strength measurements for directional operation only.

This led to abuse – it was possible to reduce a null radial's analyzed radiation by choosing higher ground conductivity. We believe that one reason the FCC's M-3 map generally shows significantly higher conductivity than do objectively analyzed field strength measurements made today is that high conductivities chosen for analyzing directional antenna nulls in proofs of the 1930s and 1940s formed the basis for the M-3 map. The M-3 map was developed in the early 1950s, only shortly after the requirement for nondirectional field strength measurements was imposed.

Around 1950, the FCC changed the proof requirements to reduce the potential for conductivity-selection abuse. This was done by requiring that an additional proof be run with measurements on each radial for nondirectional operation. Nondirectional measurements can be made closer to a transmitter site without being subject to array proximity effects and radials that are in directions of directional pattern nulls will not exhibit the degree field strength measurement scatter for nondirectional operation that is commonly found for directional operation, reducing analysis ambiguity. The nondirectional proof was introduced to validate the ground conductivities used for graphically analyzing directional mode field strength measurements.

2. NONDIRECTIONAL PROOFS NEED NOT BE REQUIRED

We believe that the large body of evidence on nondirectional antenna performance that has accumulated through the proofing process over the last 50 years clearly demonstrates that it is unnecessary to proof nondirectional patterns in order to proof directional patterns. Before the standard pattern Rules were adopted for all AM stations approximately 20 years ago, measured radiation was used for allocation study work and firms such as ours maintained extensive files on measured radiation patterns in-house. We still have those records, so we decided to use them to research the subject. Three frequencies that should be representative of the entire AM band were selected, 600 kHz, 1090 kHz, and 1590 kHz, and the measured nondirectional patterns of the 57 proofs in our records for those three frequencies were reviewed. We found that, while most were quite circular, a significant number had irregular shapes indicative of either poor detuning of unused towers or of analysis to improve directional antenna pattern shape. [It is not unusual for nondirectional fields on null radials to be analyzed low and, when arrays have RMS problems, for major lobe radials to be analyzed high under the present proof requirements.] We calculated the theoretical nondirectional field level for each station and compared it with the highest and lowest analyzed radial radiation for each nondirectional proof with the following results:

Error Range (dB)	Below Theoretical (%)	Above Theoretical (%)
0.0 – 0.5	38.5	49.2
0.5 – 1.0	28.1	26.3
1.0 – 1.5	15.8	10.5
1.5 – 2.0	5.3	7.0
2.0 – 2.5	5.3	3.5
2.5 – 3.0	7.0	3.5
Over 3.0	None	None

The RMS error for radials with field below theoretical was found to be 1.2 dB, while the RMS error for radials with field above theoretical was found to be 1.0 dB.

These data demonstrate that, even with "real world" influences on nondirectional antennas used for proofing, the dB error, either statistical or worst-case, that will be encountered if the nondirectional radiation is assumed to be theoretical rather than derived from a nondirectional proof will be a fraction of the approximate 6 dB errors that are inherent in the allocation process and the observations of directional pattern suppression performance according to the FCC sources cited in our previous comments. Based on our experience proofing both directional and nondirectional antennas, we believe that the findings of an analysis of every antenna system in existence would not depart materially from the findings of our three-frequency study.

We believe that it is unnecessary to burden the licensees of directional AM stations with the large number of field strength measurements necessary for the graphical analysis of nondirectional radiation. We believe that directional proofs employing nondirectional measurements at only a sufficient number of points to support DA/ND ratio analysis, with the nondirectional field assumed to be within a reasonable (perhaps 1 dB) range of theoretical, will suffice in virtually all cases. Antenna monitor readings should be supplied for the towers that are not used for nondirectional operation, to demonstrate their degree of detuning.

3. WHEN A NONDIRECTIONAL PROOF IS REQUIRED

For rare instances where the method of DA/ND ratio analysis employing assumed nondirectional field is not appropriate, it will be obvious that graphical analysis is necessary either from the characteristics of the measurement data or because the array includes non-standard antenna elements. We advocate the simplified DA/ND ratio approach only for arrays consisting of linear radiating elements of sufficient height to produce satisfactory performance under the Rules. We believe that it should be allowed

for conventional height towers with or without top loading, but not for novel, unproven designs. If arrays are built using short elements (of insufficient height to meet the requirements of the Rules) with tuned loading to increase their efficiency, for instance, nondirectional proofs should be required for them. Additionally, the option of a nondirectional proof should be available in any instance where the engineer responsible for a proof wishes to employ it.

C. DA/ND RATIO ANALYSIS AND ELECTRONIC FILING

While we understand that there are circumstances where graphical analysis of directional antenna field strength measurements is desirable, and agree that sufficient nondirectional measurements should be made in those cases to validate the ground conductivity used in their analysis, we believe that over 95% of the existing directional antennas should only require enough nondirectional measurements to allow DA/ND ratio analysis for proofing. The vast majority of proofs filed today base their measured radial fields on such analysis, even though they are required to contain graphs depicting their nondirectional and directional field strength measurements. DA/ND ratio analysis is sufficient in every case except where satisfactory analysis cannot be achieved with assumed nondirectional radiation… such cases become obvious to the engineers conducting the proofs who may then decide to opt for more close-in nondirectional measurements and graphical analysis if the Rules permit, but do not require them.

Hatfield and Dawson, in their comments, requested that "…a standard format for the submission of measurement data, so long as the format can be generated with and read by common spread sheet programs such as Quattro and Excel…" be adopted. We agree, and wish to point out that this should be possible in the great majority of cases without any requirement for generating materials that need to be submitted as pdf-type files if the method of DA/ND ratio analysis that we propose is adopted.

The Rules should permit, but not require, graphical analysis in proofs of performance. If the simple DA/ND analysis procedure we have proposed is allowed for proofing directional antennas, we believe that it will be possible to streamline the electronic filing of proof reports by totally eliminating their graphical content in over 95% of cases. A standardized procedure for filing measurement graphs in Adobe pdf format should be established for the cases where graphical analysis is required.

D. NUMBER OF RADIALS REQUIRED

1. MAJOR LOBE RADIALS SHOULD NOT BE REQUIRED

We agree with the comments of Sellmeyer Engineering that "…the normal three radials required to establish the efficiency in the major lobes need not be measured since they are usually not germaine to the interference protection requirements for other stations. Elimination of these requirements would be consistent with the direction of the

Commission's efforts to rely on the marketplace for compliance with non-interference aspects of the Rules and Policies. " We add that we have never seen one case where a major lobe, subjected to any form of measurement analysis, exceeded the standard pattern envelope to a significant degree given the number of dB of uncertainty that is inherent in the overall interference avoidance process.

We believe that it is only necessary to make measurements on radials at null and minor lobe azimuths to know that a directional antenna is operating properly. We point out that, although some believe that major lobe measurements are necessary to demonstrate that a directional antenna is radiating a minimum level of field, such a requirement would be an inequity since nondirectional stations are licensed without such a requirement. There would be nothing to prevent a licensee from making major lobe measurements for diagnostic purposes if low fields are suspected. We agree that minimum performance is a matter for which the decision to make field strength measurements may be left to the marketplace.

The comments of the Carl T. Jones Corporation suggest that "…radials should be selected in the directions of the pattern minima (typically specified by the Commission in the Construction Permit and/or license) and in the general directions of the peaks of the minor lobes of the pattern." We note their underlining of the word "general" and agree that it is not necessary to run a radial at precisely the peak of a minor lobe to have meaningful information on its size. In many cases, a little flexibility in selecting measurement radials can simplify the field strength measurement process by making it possible to locate radials where point accessibility is best and/or consolidate radials for stations that operate with more than one directional antenna pattern. We suggest that the Rules specify that radials for minor lobes be required within +/- 3 dB of their peaks in standard pattern radiation. This also suggests that minor lobes that rise less than 3 dB from the nulls that surround them need not be measured.

We favor retaining the Commission's proposal to require at least one major lobe radial for stations that construct non-standard antenna systems (not conventional radiators whose characteristics can be predicted using the methods contained in the Rules) or those that wish to request additional power to overcome system losses under the policy for doing so that was established in 1985, when the Rules were changed to require that the RMS of all standard patterns be specified for 1 ohm loss.

2. MINIMUM SPACING BETWEEN RADIALS

We believe that the Commission's proposed radial spacing limits are inappropriate unless the proof is used to determine RMS. This will only be the case for stations using non-standard antenna elements and/or requesting higher than nominal input power to overcome system losses. Where a proof is used to determine RMS, we believe that a minimum of four radials spaced at 90 degree intervals should suffice. It should be noted that this would allow just four radials to be used to proof a nondirectional antenna

if they are evenly spaced, but that directional antennas would generally require more than four radials to meet the requirement for measuring their pattern features and major lobe(s) with no more than 90 degrees between adjacent radials.

E. NUMBER OF POINTS PER RADIAL

1. MINIMUM NUMBER OF POINTS

We disagree with the commenters who believe that the Commission's proposal goes too far in eliminating measurement points. We believe that 10 points per radial are sufficient for the method of DA/ND ratio analysis that we envision as being satisfactory for the vast majority of stations and that they may normally be made within the range of 3 to 15 km from a station. For a rare situation where graphical analysis of nondirectional field is required, five additional nondirectional measurements within 3 km of the transmitter site should be sufficient to support the required graphical analysis.

2. THE POINT SELECTION PROCESS

The comments of the Walt Disney Company state that it is "…concerned that reducing the number of points might result in selective reporting of points along the radial. The measurement of 15 points will tend to limit the leeway for pattern adjustment by reporting selective data, particularly in urban areas, and most particularly in deep nulls (where scatter is often extremely bad)." While we believe that selective reporting of measurements would be intellectually dishonest in the context of a scientific research program looking at the nature of radio wave propagation in the vicinity of an array, we do not agree that this is the purpose of a directional antenna proof of performance. We view the proofing process as an engineering task to determine if an antenna system has been adjusted to produce the required pattern shape, not as scientific research. The science behind the proofing process has been long established. We also disagree with the characterization of selective point reporting as "pattern adjustment."

The cited examples of "urban areas" and "deep nulls" illustrate a couple of the best reasons we know to selectively report field strength measurements. In urban areas, it is typical to find pronounced scatter of directional field strength measurements due to the presence of objects that reflect and locally disturb the magnetic field component of the propagating wave that is measured by a field strength meter. On deep null radials, the scatter can be extreme. The errors introduced are not randomly distributed about the mean for a null radial, since the theoretical field is very low and any disturbances tend to increase, not decrease, the field strength meter's indication. It helps to remember that the fields produced by a directional antenna are two-dimensional vector quantities – they have both magnitude and phase – and that, in the case of a null radial, the sum of the vector fields from the towers of the array is a two-dimensional resultant lying very close to the origin of the complex plane. Disturbances to such a vector can appear as errors in either magnitude, phase, or both. Because a field strength meter yields only single-

dimensional information on the magnitude of the resultant, its indications cannot be statistically analyzed to cancel random errors as can be done when true single-dimensional quantities are measured.

A simplified example might help make this point. Let's look at a gun range problem where, for ease of math, we posit that shifting winds cause errors in equal number that alternately make bullets miss by 20 cm to the left and right of the point-of-aim on a distant target. If we fire 10 shots, 5 will hit 20 cm to the right (20 cm at 0 degrees on the complex plane) and 5 will hit 20 cm to the left (20 cm at 180 degrees on the complex plane) of the point-of-aim. We want to confirm that the gun is aimed at the center of the bull's-eye (the bullets would go there if the wind were not blowing). If the point of aim is actually at the center of the bull's-eye and we analyze the target viewing the 20 cm misses as single-dimensional quantities (like field strength measurements), we will conclude that the average error is 20 cm and that the gun is not pointed very well. If we had averaged the errors as complex numbers, though, we would have concluded that the aim was correct in the first place, since the average of 5 X 20 (for the hits that are 20 cm at 0 degrees from the center on the complex plane) and 5 X –20 (for the hits that are at 20 cm at 180 degrees from center on the complex plane) is 0. If we are misled into re-aiming the gun to try to find the center of the bull's-eye by looking at the average single-dimensional error, we will waste a lot of time, become very frustrated, and never achieve our goal because we will never be able to reduce it to anywhere near zero… as we re-aim left or right a few centimeters half of the errors will go up and half of them will go down. With the point of aim 20 cm to the right or left of the center of the bull's-eye, for instance, the average error of the five shots at the center and five shots displaced by 40 cm will still be 20 cm using single-dimensional analysis.

It needs to be pointed out that the methods of statistical analysis that are most familiar to engineers today assume random distribution of errors in what is known as a Gaussian process, named after the astronomer who laid its foundation - Karl Friedrich Gauss (1777 to 1855). The Gaussian process has often been used for radio wave propagation analysis, viewing field strengths, whether measured or calculated, as single-dimensional quantities. This may be appropriate for propagation analysis, but it fails for directional antenna null analysis because the errors that are encountered are two-dimensional quantities. Although it is possible to develop a joint probability density function for any number of random variables in a Gaussian process (by nature a very complicated undertaking), such analysis is impossible in the case of a directional antenna null where it is necessary to infer the magnitude of the field radiated by the array within a "constellation" of two dimensional errors using the single-dimensional data available from a field strength meter. Therefore, many statistical methods that are in general use are invalid for analyzing null radial field strength data – such as eliminating points with DA/ND ratios both above and below a defined number of standard deviations for the measurements along a radial while the low points, not the points with ratios lying at the center of a "bell curve" are actually the ones with the lowest errors.

3. ADEQUACY OF 10 POINTS PER RADIAL

The situation is the same for someone trying to prove that the adjusted parameters of a directional antenna are producing the required null(s) in an environment of field scatterers as for the gun range example, except that the errors have angles that place them all over the complex plane instead of along the 0 degree/180 degree line that was chosen to simplify the math on the "gun range." Since the type of statistical analysis that must assume randomly distributed single-dimensional errors is not valid for null radials, about the best you can do is be selective in the field strength measurement process. For field adjustment of directional antennas, we employ a computer-aided complex-plane analysis technique that infers the angle of a radial's measured field from its behavior with small parameter changes. In difficult circumstances, we occasionally have to perform vector calculations with this method for individual measurement points. When we do this, it is possible for us to see the fields at the points along a radial as derived two-dimensional quantities and to observe the differences in the errors that occur in them on complex plane plots that can sometimes resemble shotgun blasts. This lets us see which points are grouped together and are most probably representative of the actual fields leaving the transmitter site, so that our final measurement efforts can be focused on them.

While we find computer-aided complex plane analysis to be very useful in adjusting directional antenna patterns in difficult environments, the "engineering judgment" required for its use is an art that must be learned through experience. We do not think that it would be practical for the Commission to attempt to regulate its use or accommodate it beyond recognizing that the errors that occur on null radials do not lend themselves to simple statistical methods, because they are not Gaussian in nature, and that more points do not necessarily mean better data. Our experience with many high-suppression arrays in difficult environments indicates that, if an array can be adjusted to produce satisfactorily low field strength at 10 points along a null radial, that alone is sufficient evidence that it is functioning properly. We believe that a minimum of 10 points should be required for directional pattern analysis. The minimum should not be higher. The Commission need not be concerned that engineers are selecting points; it is good engineering practice to do so in the real-world electromagnetic environment.

4. DISTANCE SPAN REQUIREMENTS

We point out that, although the Rules may specify the minimum ranges of distance that should be measured for a proof, such as 3 to 15 km for directional mode measurements and from five times the tower height to 3 km for additional nondirectional mode measurements, when required, these should not be given as rigid requirements. In some cases, it will be necessary to alter the distance spans to make valid measurements due to local conditions. In a case where there is a lot of electromagnetic "clutter" near the transmitter site, 10 measurements between 10 and 25 km might give much more meaningful data. In a case where a radial traverses a mountain range at 10 km, it might be necessary to make the 10 measurements between 3 and 8 km. We suggest that the

Rules should specify distance spans and measurement distance intervals in a flexible way that allows for unusual circumstances. The Rules could require that an explanation of engineering factors be submitted with a proof report containing radials with non-standard distance spans.

F. PARTIAL PROOFS

The comments of the National Association of Broadcasters indicated agreement with the concept of eliminating partial proofs and said "We believe that scaled-back full proofs of performance can be made no more burdensome on AM licensees than the existing partial proof requirements…" and "We note that a singular standard could streamline the proofing process without compromising AM signal integrity." This is in agreement with the position of our comments.

Since most AM stations operate with parameters determined from a partial proof run subsequent to their last full proof, discussions of how the full proof requirements might be improved are largely academic given the inherent inaccuracy of the new-old DA/DA ratioing process used for partial proofs. If it were possible to make the full proof process completely perfect for a station this winter, this perfection would only last until next summer when a partial could be run and analyzed on a DA/DA basis to take advantage of the lower effective ground conductivity of the hot, dry months to let the pattern nulls out and the station could become licensed with the corresponding new parameters. The proposal to require full proofs in cases where partial proofs have been required in the past will result in permanent improvement in the performance of directional antennas in general.

We acknowledge that there are stations that would be inconvenienced by having to run a DA/ND proof in place of a partial because they do not have the capability to readily operate in nondirectional mode. We suggest that the rules continue to allow conventional DA/DA partial proofs as an option for a period of 10 years from the effective date of the new Rules to accommodate them.

G. MONITOR POINTS

1. MOVING AND SETTING LIMITS FOR MONITOR POINTS

After indicating agreement with the Commission's proposal to allow a monitor point to be moved with reference to original proof data, the comments of Hammett and Edison Consulting Engineers also suggested that "… a partial proof on the monitoring point in question be allowed, and be used to provide a new reference, if necessary, due to environmental changes on the radial of if an entirely new point must be used because of local construction or other constraints." We agree. Sellmeyer Engineering's comments went a little further, stating "If a suitable point cannot be located, we suggest that non-directional and directional measurements be run on the radial and analyzed according to

present practice. A new monitoring point should be selected from this data which need not be limited to originally measured points provided the inverse distance field is within the limits imposed by the standard or modified standard pattern." We agree that, if it is not possible to use previous proof data to select a new point to replace a monitor point that has become unusable, measurements at 10 points, not necessarily from any previous proof, may be analyzed on a DA/ND basis to support selection of a new monitor point. We believe that the same process should also be allowed in the case where it is necessary to raise the maximum limit for an existing monitor point.

2. MONITOR POINT DESCRIPTIONS AND MAPS

Many commenters agreed that it should not be necessary to submit monitor point maps. We agree with them. Many suggested that descriptions should be submitted. We agree with them also. We believe that Hammett and Edison Consulting Engineers addressed the question of using GPS coordinates for defining monitor point locations well when they said " Our hesitation with a coordinates-only approach stems from the fact that we have often noted , during the implementation of the FCC's tower registration program, towers with incorrect GPS-determined coordinates…" We have had the same experience and we agree with their statement "We have no objection to specifying the locations with GPS coordinates, as long as a description is also included."

We believe that the current practice of leaving monitor point descriptions off of FCC licenses is counterproductive for enforcement. We recommend that the Rules require that a complete description with sufficient detail to make it possible for someone to accurately locate each monitor point, including information on where to stand relative to nearby objects, be included in a proof report and that the descriptions be printed on the station's license document. We note that it should be possible to accomplish this efficiently with electronic filing by requiring that the descriptions be presented in an acceptable text or word processing format. It should not be necessary to provide monitor point maps or photographs in a proof of performance report, although we believe that the necessary maps should be required to be maintained in the station's files. These do not need to be specially prepared maps as are now required for monitor points. The monitor points may be marked as such on the maps from the most recent proof that we believe should be required to be maintained in station files.

3. ELIMINATING MAPS FROM PROOF REPORTS

We believe that it is not necessary to require that maps showing field strength measurement locations be submitted in a proof report at all. The formal preparation, photo-reduction, and printing of them increases the cost of a proof report considerably, and adds unnecessary bulk to it as well. The result is not very useful – topographic maps that have been reduced to 8 ½ X 11 inches are typically unreadable. It should be noted that, although new maps can be prepared from radial tabulations of point distances at any time, the proposal to replace partial proofs with simplified full proofs in the

Commission's licensing process would, if implemented, make it unnecessary for stations to measure the same points as were measured before to evaluate their antenna systems' performance. The need to include maps will complicate the electronic filing process far beyond any benefit that it might offer.

We wish to point out a parallel precedent - at one time, it was necessary for an FM construction permit application to include the topographic maps used to determine the average elevation of the area within 10 miles of the proposed site. About 20 years ago (years before the terrain elevation database made determining average elevation from maps obsolete), the Commission dropped the requirement that the maps be supplied with every application with the stipulation that they would need to be available for reference if needed. We believe that the Commission should similarly drop the requirement for filing directional antenna proof of performance maps today but require them, with the monitor points clearly marked, be maintained in the station's records that are available for an FCC inspection. This Rule change would significantly decrease the cost of proof reports from the standpoint of licensees as well as provide considerable streamlining of the paperwork that the Commission must process – with the additional benefit of greatly simplifying the electronic filing process.

H. BASE CURRENT AMMETERS

We note that virtually all of the commenters favor doing away with the requirement that ammeters be installed to measure the tower base currents of an array, although some noted that their indications can be useful at times for troubleshooting. The comments of Delta Electronics and Potomac Instruments suggested that the requirement should be kept for that reason. We believe that, if the Commission decides to keep the requirement for base current meters, their readings should be for information only and stations should not be required to maintain their ratios within any specified limits. The requirement to regularly read base currents was dropped from the Rules approximately 20 years ago, several years after the requirements for antenna monitoring systems were "tightened," and we find today that the requirement to maintain all base current ratios within 5% of their licensed values is a "stumbling block" for many stations that have been able to maintain their directional antenna systems within all of the other required tolerances using their modern antenna monitoring systems.

I. CRITICAL ARRAYS

1. DOES THE CRITICAL DESIGNATION DECREASE INTERFERENCE?

Several commenters agreed with us that the critical array designation should be simply eliminated and several others basically supported the Commission's proposal to standardize the process of pattern evaluation and apply it to all applications uniformly. There was not much sentiment for keeping things exactly as they are, which we believe is clearly the legacy of a "back-door" process of selectively imposing non-standard

requirements through case-by-case intimidation, instead of through rulemaking, that lead to the creation of the small number of critical array anomalies that exist today. We believe that it is clear that the present situation should not be allowed to continue.

The comments of Hatfield and Dawson Consulting Engineers point out that "The Commission could have adopted a method of determination of the standard pattern based on parameter variation. At least one commenter in the rulemaking (Docket 16222) made such a suggestion. However, upon review of the statistical nature of the underlying allocation process and of the equally statistical nature of the performance of directional antennas, the Commission chose a straightforward formula using a quadrature component with a relatively high minimum in the cases of arrays with low RSS values and, 2.5% of the RSS in cases where that percentage exceeded the minimum." We note that the data contained in the Commission's 1957 report by Damelin and Fine (T.R.R.1.2.7) that was filed in this proceeding as an appendix to our comments suggests a higher percentage of RSS than was actually adopted. We believe that the record of the standard pattern rulemaking of over 30 years ago indicates that the Commission was well aware that the inherent imprecision of predicting array performance made parameter variation analysis unnecessary.

2. ARRAY ELEMENT TOLERANCES MUST BE SET INDIVIDULALY

Should the Commission decide to adopt its proposed method of analysis, we agree with the suggestion of the Walt Disney Company to "…evaluate the antenna system on a per element basis, then restrict those elements that are most likely to cause interference" and believe that this is a very important point. Applying the same reduced percent ratio and degree phase tolerances to all elements of an array is unjustified from a theoretical standpoint, since the parameter shift in the case of a tower with a low ratio would not produce as much change in radiation pattern as the shift in the high ratio tower that resulted in the critical designation in the first place. Maintaining the parameters of low ratio towers within the present 5-percent and 3-degree tolerances is already very difficult for many stations that do not now have critical arrays. It is an injustice for the stations that now have critical arrays to have to maintain the "tighter" tolerances for all of their array elements. If the Commission wishes to make parameter variation studies a part of the application process, the Rules must specify that the phase and ratio tolerances of the towers of an array be determined on an individual basis in order to avoid placing an undue burden on licensees with absolutely no valid scientific basis. We further suggest that the 5-percent and 3-degree tolerances be dropped as maximum values and that towers that may have higher tolerances without exceeding their standard patterns should be allowed to have them.

3. THE EFFICACY OF HORIZONTAL PLANE NULL ANALYSIS

The comments of the Walt Disney Company disagreed with the Commission's proposal to limit parameter variation studies to standard pattern minima and maxima in

the horizontal plane. They stated "…the only way to know if interference will be caused is to analyze the vertical pattern." We disagree. We believe that, from an engineering standpoint, such analysis would carry the process well beyond what can be justified given the uncertainties of the overall interference avoidance process. Since null-radial horizontal plane field strength measurements serve to establish *de jure* compliance in the proof of performance process, carrying the theoretical analysis to a higher level to find parameter permutations that would not result in excessive horizontal plane radiation on null radials cannot be justified from a legal standpoint, either. In other words, there can be no legal basis for restricting the parameter tolerances of an array because it theoretically might drift to a set of parameters that would be satisfactory if the system were adjusted to them and proofed. Besides failing to meet the test of logic, such analysis violates the common law principle of *De minimis non curat lex*; i.e., "The law does not concern itself with trifles." We believe that, should the Commission decide that it is necessary to retain the critical array designation at all, their proposed method of analysis, modified to study the parameters of array elements individually, should be adopted.

J. COMMON POINT IMPEDANCE

There was general agreement among the commenters that the requirement for making impedance measurements over a band of frequencies should be eliminated. On the issue of whether or not the Rules should specify that common point reactance be set to 0 ohms, the comments of Greater Media said "…Greater Media suggests a plus or minus 10 ohm limit on the reactive component." We disagree. We agree with the comments of the Carl T. Jones Corporation which said "…we support the proposal to eliminate the requirement that the common point reactance be set to zero Ohms and, further, recommend that no limit be imposed on the absolute value of the common point reactance" for the reasons given.

K. CONCLUSION

We believe that the recommendations we have made in this proceeding, if enacted, will lead to better overall performance verification for AM directional antenna systems at much less cost to their licensees. Licensees would be encouraged to make directional antenna pattern modifications to provide better service to the public and decrease interference within the AM band, since many stations that could otherwise make directional antenna pattern changes inexpensively - without constructing towers, for instance - are deterred from doing so by the cost of proofing a directional antenna system under the present Rules. We believe that the overall level of Rule compliance will increase also, since the cost of proofing a directional antenna system will be much less than at present and those who provide engineering services will be better able to provide realistic quotes for the work required to return errant systems to licensed operation.

The elimination of the need to submit graphic material in most cases, and the considerable reduction in the requirements for graphic material in the rest, will greatly simplify implementation of electronic filing of Form 302 exhibits for AM directional antennas. This will suit the interests of both the broadcast industry and the Commission very well.

Louis R. du Treil, Sr., P.E

John A. Lundin, P.E.

Ronald D. Rackley, P.E.

Louis R. du Treil, Jr., P.E.

W. Jeffrey Reynolds

Charles A. Cooper, P.E.

du Treil, Lundin & Rackley, Inc.
201 Fletcher Avenue
Sarasota, Florida 34237
Phone (941) 329 6000
Facsimile (941) 329 6030

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