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JUN 23 1994

FCC MAIL ROOM

Before the

Federal Communications Commission

Washington, D. C. 20554

In the Matter of:	)	
An Inquiry into the Commission's Policies and Rules Regarding AM Radio Service Directional Antenna Performance Verification	))))	**MM Docket No. 93-177**

EX-PARTE REPLY COMMENTS of R. Morgan Burrow, Jr., P. E.

1. R. Morgan Burrow, Jr., a consulting engineer whose qualifications are known to the Federal Communications Commission herby submits reply comments relevant to the topics discussed in the Notice of Proposed Rulemaking. The comments submitted herein are strictly those of the writer and do not express the views of any employer, engineer, station licensee, or any other concerned organization or individual. Any agreement with other parties is strictly a coincidence.

2. **This commenter** **was an attendee** at the directional antenna forum meeting held January 13, 1994, at the National Association of Broadcasters' offices in Washington, D. C. My attendance at this meeting does not imply endorsement of any implied conclusions resulting from attendance at this meeting.

3. **Reliance on Moment Method Computer Programs:** This commenter agrees with Jules Cohen, P. E., that "one measurement is worth a thousand computations". Therefore, I **do not believe** that drive point measurements in agreement with a computer model is an

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adequate substitute for the proof field intensity measurements. Unlike most FM and TV antennas, an AM array is built "on site" and not unpacked factory ready from a box or crate. Construction techniques may vary; therefore, non-uniformity and variations may exist due to various causes including but not limited to the ground system. Non-uniformity probably exists (whether the FCC admits it or not) in high frequency applications such as FM or TV where mounting techniques affect an "omnidirectional" antenna.

a. Copyright matters. It is appropriate to remind the Commission staff at this time of comments made during the course of Docket 88-56 (the FM-TV propagation algorithm). Commenters indicated concern with the use of a copyrighted algorithm used in a propagation model which the docket attempted to codify. This commenter believes that any computer code or algorithm for general use or acceptability by the FCC be government-owned and be free and clear of any restrictions on its use, duplication, or modification.

b. Published "bugs" in the model program(s): This commenter is especially concerned when correspondence such as the item shown in the Appendix concerning "bugs" with the "MININEC" program proposed as the computer model are brought to my attention. The appropriate question to be asked initially is "What percentage of copies of the software that are in use are going to be fixed - in other words how many users will a "bug notice" reach?" The first two notices date from 1987; there is a chance some have not even seen these. The last MININEC notice is relatively recent.

There is a general problem with all of the moment method codes available to the general public; the interface at junctions between conductors of significantly different diameters is not resolved properly and as a result predicted results disagree significantly with measured results. There is also a problem with the currently available codes with proper resolution of "fat" conductors (diameter/width approximating the length).

The NEC-4 program supposedly handles this, but since the software is available only to Government agencies and their contractors at the time of this writing, I have not had the opportunity to try running models using this software and therefore am not prepared to discuss it. The Commission is urged to negotiate with the Federal agencies having custody of the NEC-4 program and arrange limited release authority.

This commenter uses NEC-3 and some derivative programs to estimate antenna drive points for the design of antenna phasing and coupling equipment. If measured drive points disagree significantly with the predicted values, the coupling networks can always be field-modified. The moment-method computer codes can and should be used in the design of good hardware and not used as a substitute for measurements.

c. Professional Responsibility: This commenter takes exception to statements suggesting that an antenna array be adjusted to the computer model and then simply left alone without benefit of field measurement. Professional responsibility to the client as well to the regulatory agency should imply that some type of field measurement should be made to verify the antenna array is working efficiently in the environment which it is installed, including but not limited to nearby structures which may reradiate the signal and invalidate the computer model.

d. Put the Case Histories (including measurement data) on the Table: No specific data was presented at the NAB conference concerning the number of directional arrays adjusted to predicted values and subsequently passing present FCC standards for pattern compliance and measured RMS. It would be appropriate as well as interesting for both participants in this proceeding and the Commission staff to examine "case histories", especially on situations where a directional antenna array did not meet FCC criteria (including measured RMS) when initially adjusted to predicted values.

e. Garbage In, Garbage Out ("GIGO"): The moment method computer codes are especially vulnerable to "garbage in, garbage out (GIGO)". All it takes is one granted application for nighttime service using "GIGO" data to foul the channel for hundreds of miles around the subject location. The resulting disruption of reception to potentially many thousands of people would be a public disservice effectively authorized by the FCC should the agency switch to reliance on a computer model. So much for "AM Improvement".

4. Ground Conductivity Graphs:

This commenter preserves retention of the requirement to file conductivity data graphs and supporting tabulated data for the full 20 mile distance where possible. This commenter also supports Ken Brown's (ABC, New York) comment in principle that monitor points be retained. The ground conductivity information is valuable for allocation work; the monitor points are useful in determining if a directional array is actually in some state of proper adjustment. Repeatedly, I hear reports of Government agencies talking about "accountability". The FCC should retain the monitor-point requirement as a minimal means of accountability both to the FCC and other users of the channel. This commenter believes that the FCC should use more latitude in assigning maximum limits to monitor points to account for seasonal changes; its present methods of assigning maximum limits are costly to stations with summer proofs that are affected by seasonal changes.

5. Measurement Maps:

This commenter concurs with proposals to delete the present requirement to file copies of measurement maps in a station proof. By the time file proof map copies are reproduced, they are essentially unreadable (especially if reproduced on the FCC copy contractor machines). It is easier simply to use the

tabulated data and carefully lay out new full-size topographic maps rather than to depend on a multiple-copied reduction from the FCC files. Deleting the map filing requirement is beneficial since it will save money and paper.

This commenter **supports** any proposals to file tabulations of measurement data with the point-by point measurement time requirement being changed to a date and time interval (bracket time); the distances should be tabulated to the nearest 0.01 mile (kilometer) since the scale on a typical 7.5 minute topo quad will permit interpolation to this degree of accuracy. If a GPS system is used, the GPS coordinates should also be logged. This commenter also supports a tabulation/description requirement similar to the sample in the Appendix. Some type of description indicating a proof point actually was "visited" should encourage those who choose to generate their proof points in a hotel room to go outside and do the proof properly.

6. **Reradiating Structures:** This commenter was not satisfied with proposals concerning incorporation of reradiating structures into a directional antenna model or ultimately a Form 301 application. The FCC will have real confusion on its hands if it decides to require inclusion of reradiating structures in antenna models; what to include and what not to include will vary among individual practictioners. Typical challenges to an applicant's model would undoubtedly make the attorneys rich and bring efficient application processing to a halt. Considering the present state of AM radio, delays in application processing result in unnecessary expenses to a radio service which has seen its listener share diminish significantly over the years. Unfortunately, the new allocation requirements of Docket 87-267 are proving to be a restraint to service; responsible licensees owning older stations (affected by the 50% night limit "ratchet") who want to develop their stations for the most part are doing nothing for the most part rather than incur an artificial Commission-sanctioned loss of service.

The concept of pattern augmentation is intended to handle the reradiation problem; "if it ain't broke don't "fix" it again". The present rules specify the purpose and procedure for pattern augmentation. This commenter supports modification of the present rules to permit augmentation beyond measured values on non-monitor point bearings.

7. **Misadjusted Directional Arrays:** The Commission's Notice of Inquiry claims that some commenters place the blame for interference on "misadjusted" directional antenna arrays. This may or may not be the actual case. This commenter disagrees with a statement overheard at the recent NAB meeting implying a directional array is "misadjusted" if significant disagreement with a moment-method model exists yet the measured inverse fields from properly obtained and analyzed proof data agree with the "standard" pattern computed using conventional (hemispheric integration and sinusoidal current distribution) methods.

8. **Lack of Adequate FCC Enforcement:** The Commission's **failure** to adequately field inspect and to enforce the rules is actually an incentive for stations to divert technical resources and funds from maintenance of their transmitting facilities toward other "more visible" areas such as remotes and/or studios. Therefore, licensees who may have otherwise maintained their AM antenna arrays when partial proofs were required have allowed them to slip into disrepair and subsequent improper operation. Many licensees "claim" that if the transmitter stays on the air, the antenna is working properly. This in most cases obviously is not the case. This commenter believes the new allocation rules adopted in Docket 87-267 were not required and American taxpayers spared the cost of the proceeding. Most of the alleged "interference problems" very likely result from run-down antenna systems and/or improper operation mode (day power/pattern at night, etc). We are aware of stations that have operated on STA's ("Special Temporary Authority") for several years without making any effort to repair problems or complete work in

progress.

a. Suggested Improvement: Identify STA operations on the AM Engineering Data Base: This commenter supports as an initial step that the FCC's AM Engineering Data Base records for each station be modified to contain a yes/no flag concerning Special Temporary Authority operation ("STA") and a brief comment inserted in the existing comment area. This would be useful to stations affected by the STA as well as provide some means to the Commission for statistical tracking.

The STA should be a vehicle for permitting a facility to operate at variance and implement repairs on a timely basis and not a vehicle for abuse by delaying repairs indefinitely.

b. Visible Effects of Broadcast Deregulation: The photographs in the Appendix are a memorial to the Commission's 14 years of excessive deregulation and failure to budget funds to adequately inspect all broadcast facilities on a regular cycle (once every five to ten years). The photographs of the Texas facilities were provided to this commenter by a reputable broadcast consultant in that state. One needs to consider that ease of finding so many stations in one state with apparent serious technical deficiencies implies the situation is probably typical for the remaining states. The photos of the Pennsylvania station were taken by this commenter using a telephoto lens.

This commenter intends to submit additional "appendixes" to these comments periodically when time permits to review my own library of photographs as well as those sent in by reputable technical people. The apparent rule violations and poor maintenance represented by these photographs is simply a matter of licensee responsibility and the failure of the FCC toward other broadcasters to periodically inspect **all** stations to call unsatisfactory conditions to the attention to errant licensees.

c. No computer model is a substitute for measurement and maintenance. It is apparent that ease in finding non-compliant or run-down communication facilities supports the contention that the FCC talks loud and does nothing, especially when travel budget funds for the Field Operations Bureau inspectors apparently is nonexistent. This problem is not limited to just the AM service.

d. Reinstiitute the Partial Proof Requirement for Directional AM Stations, interval not to exceed Five Years: The requirement almost 20 years ago for "type approved" antenna monitors helped to clean up sample system and antenna monitor instabilities while the lack of station inspections by the FCC aggravated the interference problem the approved monitor and sample system was supposed to minimize. Some licensees will respond only to the stimulus of an inspection, FCC Form 793's and a substantial fine to allocate funds to get essential equipment fixed.

e. Coordinate with the FAA all Form 7460 filings: This commenter also suggests the FCC develop with the FAA a mechanism for coordination and exchange of information from FAA Form 7460 filings with the FCC. The FCC should develop a mechanism for imposing the before/after partial proof requirement on **any** structure covered by the FAA notification requirements on nearby AM antenna systems. The presumption should be that any structure subject to the FAA's lighting or painting requirements is "electrically long" at AM frequencies and capable of causing adverse effects to the radiation characteristics of a nearby AM station. Why should a developer of a tall office building walk away from problems caused to an AM station (and corrected at the AM station's expense at substantial cost) while FCC regulants are held to a higher standard? A developer of a tall building should assume the same risks FCC regulants presently assume. Simple equity demands the higher standard be applicable to tall buildings as well as towers.

f. Can the FCC really follow through on troublesome broadcast situations? To my knowledge, the FCC's Inspector General has not followed up adequately on several known situations that were brought to the attention of that office directly. This commenter suspects "big money" or political interference has the investigations stalled. These cases deserve public exposure and proper adjudication in open proceedings. Reports about field intensity measurements being contrived in hotel rooms, measurements being taken while standing in a convertible at 60 mph with a field-intensity meter, increasing the height of towers and addition of top-loading to an AM array without grant of a construction permit modification disgrace honest engineering practice. The hotel-room measurement makers and others documented in these Commission filings should be bench-pressing barbells in jail rather than continuing to insult our profession. Situations such as this do not call for eviscerating the proof of performance requirements.

The international situation commented on previously where domestic U.S. facilities are required to protect improperly allocated or outright vagabond foreign facilities makes the Docket 87-267 proceedings a joke.

g. Disclaimer: For the record, no one in my employer's office nor myself represent the licensees of transmitter facilities pictured in the Appendix of this document; no one in my employer's office or myself have done work on the stations shown herein at any of the site photographs (with the exception of multiple-use sites shared by clients).

8. Instrumentation

General: Comments filed previously outlined a suggested equipment and calibration cycle. This commenter favors elimination of the Commission's current designation of a "critical array", requiring a special antenna monitor whose

design is now obsolete.

There is some vagueness concerning the arrays that were deemed "critical". Questionable computer stability models such as "MRV" and "SMKVAR" included in the FCC "RADIAT" computer program do not appear to be representative of real-world conditions since the modeling is not based on random occurrences. Evaluation of pattern stability of a directional array based on random variation of the parameters may be more realistic.

New antenna monitor designs utilize modern components and typically do not have the drift problems the older units had. This commenter favors the use of accurate antenna monitoring equipment universally suitable for all directional antenna systems. Products cost less when manufactured in quantity and electronics is no different.

SUMMARY:

The Cost of the Proof is a Legitimate Cost of Doing Business: This commenter does not favor Commission eviscerating the directional antenna proof of performance requirements. The cost of the proof has always been a cost of doing business with a directional antenna on the AM band. Those who don't want to demonstrate their facilities are working properly simply have no business being Commission licensees.

Respectfully submitted:

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17221 Beauvoir Blvd.
Rockville, Maryland 20855
22 June 1994

A P P E N D I X

NEC–3 ERROR ALERT!!! *

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Livermore, CA 94550

An error has been found in NEC–3 in the calculation of the radiation pattern for an antenna when using the radial wire ground screen approximation. The reflection coefficients for this case were the reciprocal of the correct values. The present incorrect statements at lines 165 and 166 of subroutine FFLD are

```
RRV=(ROZ+ZSCRN*ZRSIN)/(-ROZ+ZSCRN*ZRSIN)                    FF 165
RRH=(ZSCRN*ROZ+ZRSIN)/(ZSCRN*ROZ-ZRSIN)                     FF 166
```

The correct expressions are

```
RRV=-(ROZ-ZSCRN*ZRSIN)/(ROZ+ZSCRN*ZRSIN)                    FF 165
RRH=(ZSCRN*ROZ-ZRSIN)/(ZSCRN*ROZ+ZRSIN)                     FF 166
```

The same expressions are used in NEC–2 but are correct there since the sign of ROZ is changed before the image field is computed. The ground-screen reflection coefficients for the near field in NEC–3 are correct. It should be remembered, however, that a vertical monopole at the center of the radial wire ground screen will see an infinite wire density at the reflection point and, hence, the current will be the same as over a perfectly conducting ground.

The effect of this error on the antenna gain will be greater for sparse ground screens and poor ground. For dense ground screens the reflection coefficient is near unity so using the reciprocal makes little difference. In any case it should be remembered that the radial wire ground screen approximation is only valid for relatively dense screens and neglects diffraction from the screen edge.

The following NEC data set can be used to test the ground screen approximation:

```
CETEST OF RADIAL WIRE GROUND SCREEN APPROXIMATION
GW1,5,0.,0.,0.,0.,0.,2.5,.001,
GE1,
FR0,0,0,0,30.,
GN0,100,0,0,10.,.01,3.,.0001,
EX0,0,1,0,1.,
RP4,10,1,1000,0.,0.,10.,0.,
EN
```

* Work performed under the auspices of the U. S. Department of Energy by the Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

The input impedance for this monopole, using single precision NEC-3 on a VAX computer, was $40.1092 + j23.5529$ ohms. The antenna gains before and after correcting the error in reflection coefficients are show below.

Antenna gain computed by NEC-3 single precision with error in reflection coefficients for radial wire ground screen:

- - ANGLES - -		- POWER GAINS -		
THETA DEGREES	PHI DEGREES	VERT. DB	HOR. DB	TOTAL DB
0.00	0.00	-999.99	-999.99	-999.99
10.00	0.00	-12.14	-999.99	-12.14
20.00	0.00	-6.02	-999.99	-6.02
30.00	0.00	-2.37	-999.99	-2.37
40.00	0.00	0.24	-999.99	0.24
50.00	0.00	2.26	-999.99	2.26
60.00	0.00	2.98	-999.99	2.98
70.00	0.00	2.68	-999.99	2.68
80.00	0.00	-0.05	-999.99	-0.05
90.00	0.00	-999.99	-999.99	-999.99

Antenna gain computed by NEC-3 single precision after correction of error in reflection coefficients:

- - ANGLES - -		- POWER GAINS -		
THETA DEGREES	PHI DEGREES	VERT. DB	HOR. DB	TOTAL DB
0.00	0.00	-999.99	-999.99	-999.99
10.00	0.00	-12.20	-999.99	-12.20
20.00	0.00	-6.15	-999.99	-6.15
30.00	0.00	-2.61	-999.99	-2.61
40.00	0.00	-0.14	-999.99	-0.14
50.00	0.00	1.63	-999.99	1.63
60.00	0.00	2.45	-999.99	2.45
70.00	0.00	2.19	-999.99	2.19
80.00	0.00	-0.42	-999.99	-0.42
90.00	0.00	-135.40	-999.99	-135.40

MININEC3 UPDATED

This continues the update mechanism for MININEC3 (see ACES NEWSLETTER Vol. 1 No. 2, p.27). The following update will bring the distributed code up to version 10. To add lines of code, it is necessary to use the renumber option in BASIC to step the lines by more than one, add the appropriate lines, and then renumber by ones. Remember that the code as received will not run under the regular BASIC interpreter. You must compile it or reduce the large arrays which cause it to exceed BASIC's 64K memory limit.

```
1 REM ****** MININEC(3) **********  NOSC CODE 822 (JCL CHANGE 10) 5-1-87
.
.
.
342 REM ********** ADDITION OF LOADS **********
343 IF NL=0 THEN 377
344 F5=2*P*F*1000000!          <----- ADD *1000000 FACTOR
345 FOR I=1 TO NL
346 IF LS(I)<1 THEN 366        <----- CHANGE LINE
347 REM ----- S-PARAMETER LOADS
348 U1=0
349 U2=0
350 D1=0
351 D2=0
352 S=-1                       <----- CHANGE LINE
353 FOR J=0 TO LS(I) STEP 2
354 S=-S                       <----- MOVE OLD LINE 359 TO HERE
355 U1=U1+LA(1,I,J)*S*F5^J
356 D1=D1+LA(2,I,J)*S*F5^J
357 L=J+1
358 U2=U2+LA(1,I,L)*S*F5^L
359 D2=D2+LA(2,I,L)*S*F5^L
360 NEXT J
361 J=LP(I)
362 D=D1*D1+D2*D2
363 LI=(U2*D1-D2*U1)/D
364 LR=(U1*D1+U2*D2)/D
365 GOTO 369
366 LR=LA(1,I,1)
367 LI=LA(2,I,1)
368 J=LP(I)
369 F2=1/M
370 IF C%(J,1)<>-C%(J,2) THEN 372
371 IF K<0 THEN F2=2/M
372 ZR(J,J)=ZR(J,J)+F2*LI
373 ZI(J,J)=ZI(J,J)-F2*LR
374 NEXT I
.
.
.
```

NEC

EM modeling

MODELING NOTES

[The following bug report was sent by Brian Beezley]

I recently discovered two bugs in the MININEC antenna-analysis algorithm.

The most serious bug yields incorrect patterns for antenna models with grounded wires. The error overstates gain at low elevation angles by as much as several dB. The problem occurs only for models with wires connected to imperfected ground. It does not affect models using perfect ground or models with ungrounded wires.

The error decreases as you add segments to grounded wires. Therefore, if you habitually test algorithm convergence by increasing segmentation density until results no longer change significantly, the problem won't affect your results. However, I doubt that most users check convergence for simple models. Since the bug affects models regardless of complexity, I believe that the error often goes unnoticed.

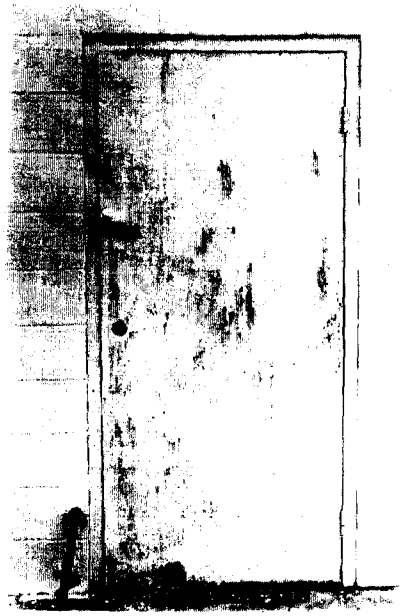
You can check any MININEC-based program for this bug by modeling a quarterwave monopole over imperfect ground and observing the response at zero degrees elevation. There should be no response at the horizon because direct radiation is cancelled by that reflected from ground. Uncorrected MININEC will show a significant response unless you use an unusually high number of segments. In contrast, the corrected algorithm has no response regardless of segmentation.

You can fix this bug in MININEC 3.13 by deleting lines 716, 717, and 733. After the change, lines 741 through 744 are no longer used and may be deleted as well. The original code erroneously uses perfect ground when calculating the field from pulses connected to imperfect ground. Perfect ground reinforces rather than cancels radiation near the horizon, so the grounded-pulse contribution corrupts the field summation calculated correctly for other pulses.

The second MININEC bug occurs only for sloping, grounded wires in the X = -Y plane. Since this geometry isn't common, you may never encounter the problem. The bug causes completely erroneous results which can be corrected only by moving the wires out of the plane. The error involves overzealous removal of redundant calculations. You can fix this bug by correcting two lines as follows:

```
239 IF CA (I1) = 0 AND CB (I1) =0  THEN 241
242 IF CA (J1) =0 AND CB (J1) =0  THEN 244
```

Brian Beezley
5071/2 Taylor St.
Vista, CA 92084
(619) 945-9824



1

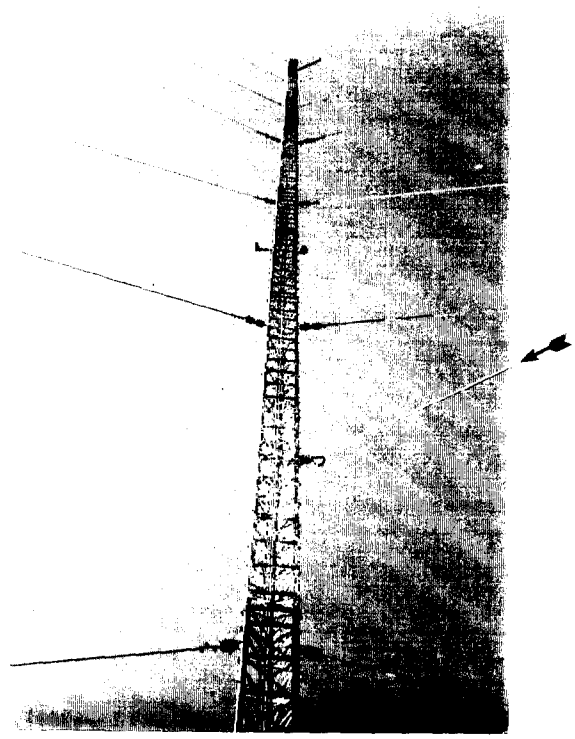
TRANSMITTER BLDG DOOR SECURED BY ROCK
(NO LOCK SET ON DOOR)

TEXAS
EXPOSED TRANSMISSION/SAMPLE LINES

2

TEXAS
ANTENNA COUPLER WIRING "PRACTICES"
EXTRANEOUS GUY WIRE ON TOWER

3



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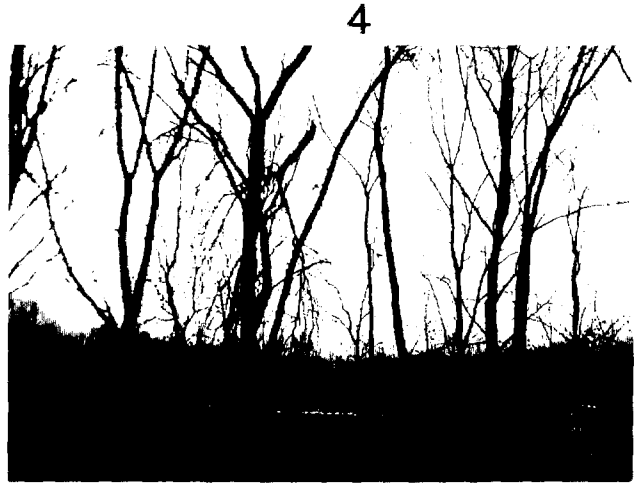
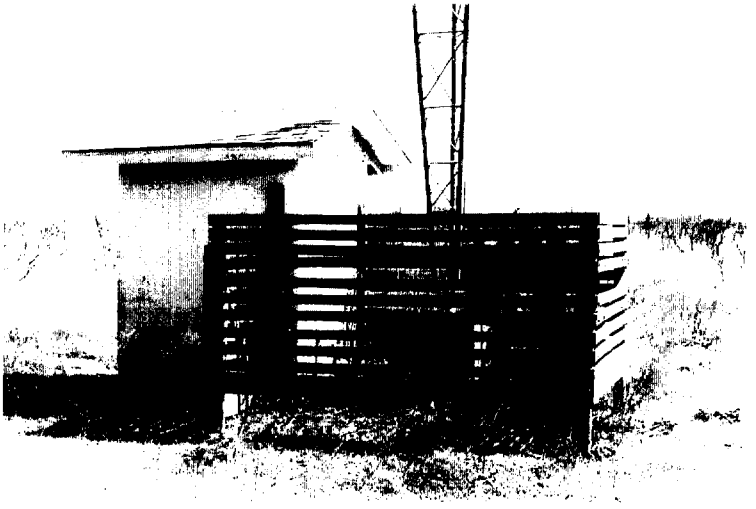


6

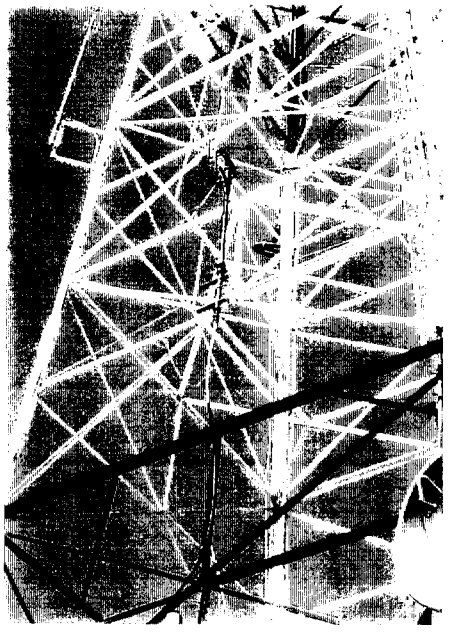
CENTRAL PA
DA ARRAY OVERGROWN GROUND FIELD
ALTERNATE VIEW OF OVERGROWN GROUND FIELD

7

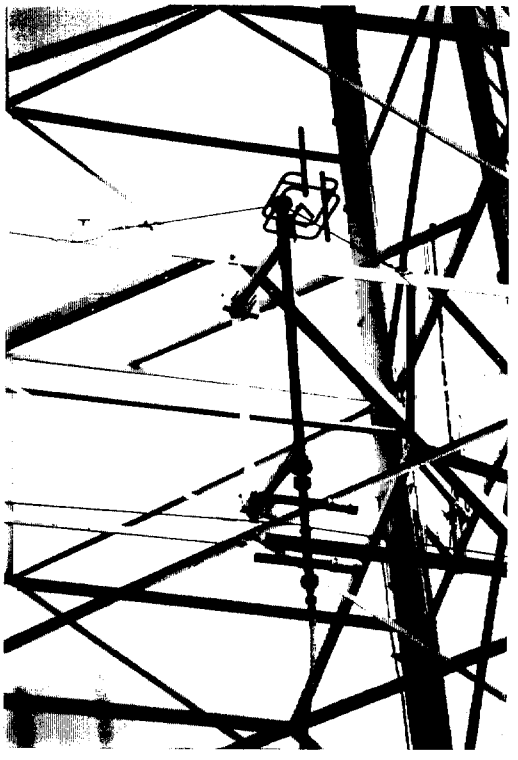


8

TEXAS
TRANSMITTER (DILAPIDATED EQUIP)
HANGING WIRES ON TRANSMITTER
TOWER FENCE TOWER AREA EASILY ACCESSABLE
BY CRAWLING UNDER FENCE



9



10

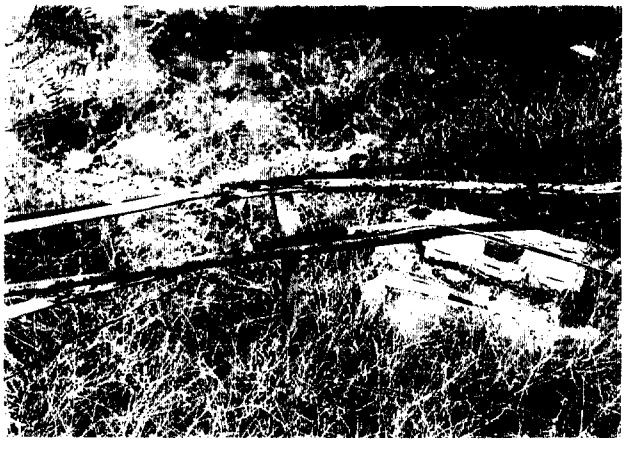
TEXAS
FM ANTENNA "SECURED" WITH BUNGEE CORD

11

TEXAS
DILAPIDATED TOWER FENCE AND AREA OVERGROWN

TEXAS 12

UNSECURED FEED AND SAMPLE LINES AT TRANSMITTER BUILDING 13

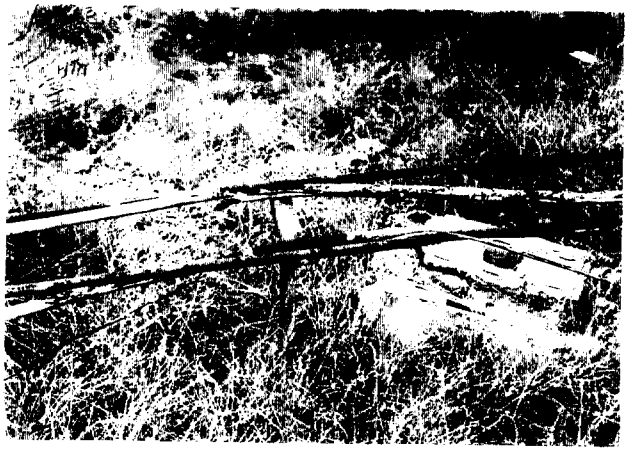


FEED SAMPLE LINES EXPOSED 15

14

RUSTING CONDUITS AND LOOSE WIRES

16



17

ANTENNA COUPLER HOLE IN CABINET, LOOSE WIRING (WEATHER DAMAGE TO COMPONENTS ?)

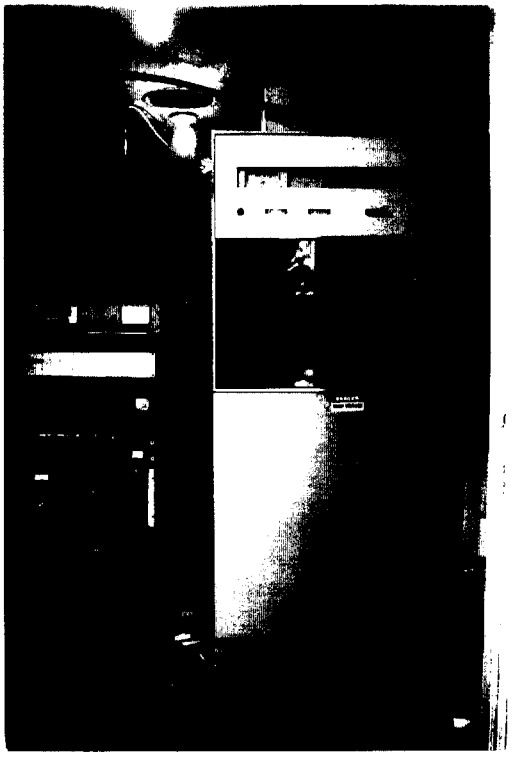
18

19

TEXAS
POOR CONDITION OF ANTENNA COUPLER UNIT

EASTERN TEXAS 20-23
OVERGROWN BUILDING AND TOWER PART OF DA

20

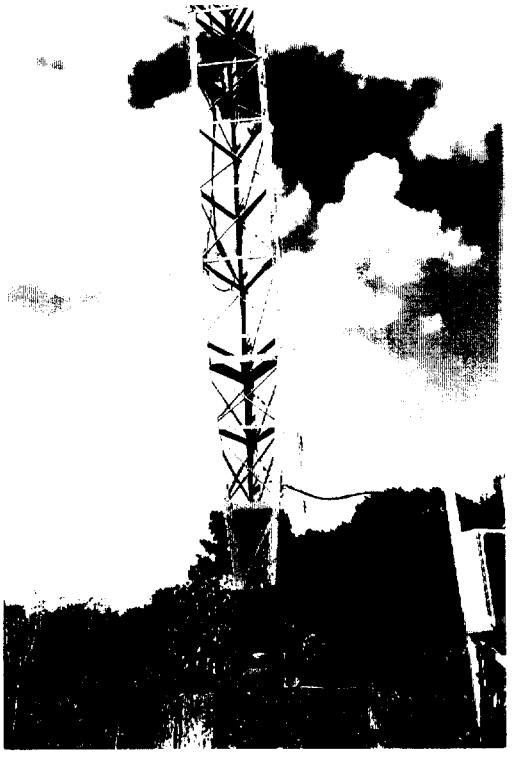


EASTERN TEXAS
BACK OFF OF TRANSMITTER CABINET,
CAN SEE THROUGH TO OUTSIDE
EXPOSED HIGH VOLTAGE.

21

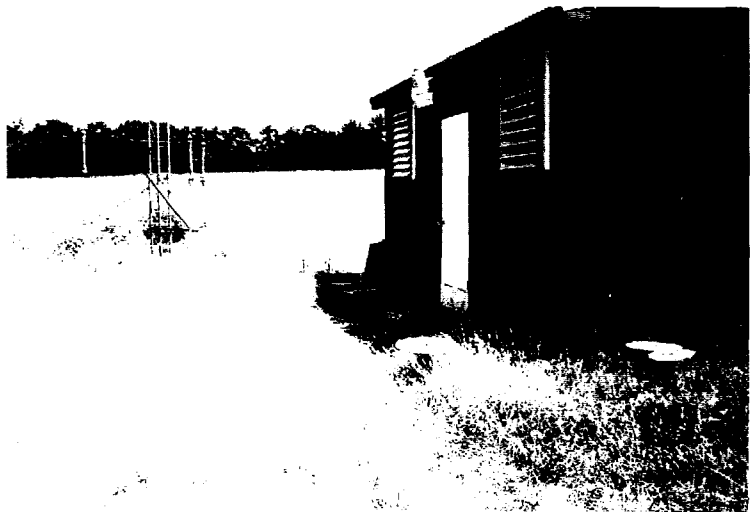
VIEW OF ANOTHER TOWER.
OVERGROWN BASE INSULATOR,
POOR PAINT JOB.

22



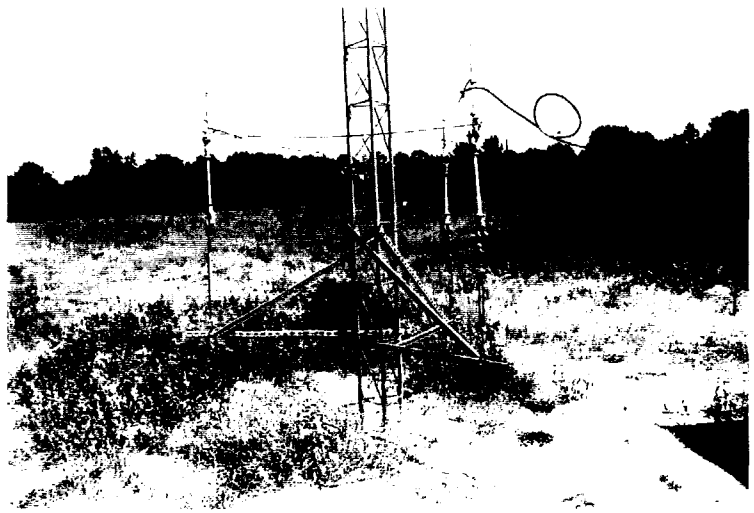
23

EXPOSED CONTROLLER LINES ON GROUND

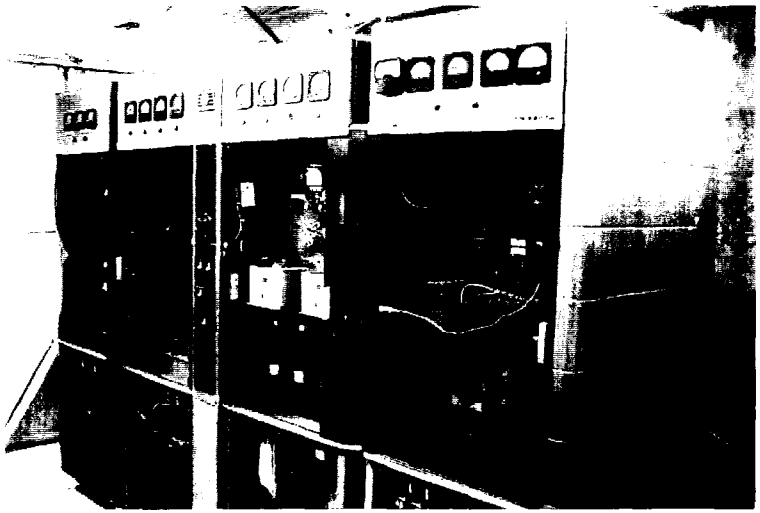


TEXAS 24

24-27

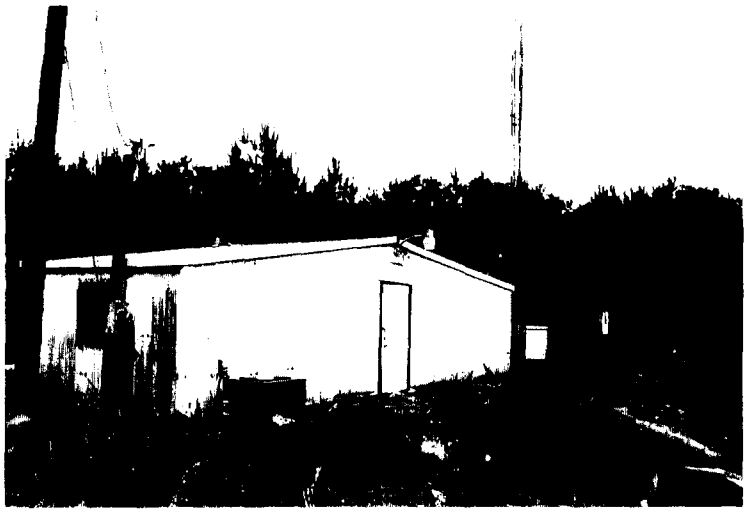


NO TOWER OR PERIMETER FENCES 26



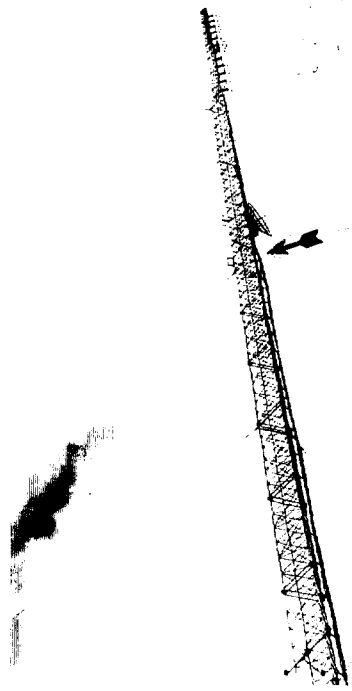
EXPOSED HIGH VOLTAGE POINTS IN TRANSMITTER WITH SAFETY DOORS REMOVED 25

HIGH VOLTAGE TRANSFORMER EXPOSED ON WOODEN PALLET 27



28

TEXAS
WATER DAMAGED BUILDING
(BUILDING INSIDE OF DYKE WITH NO DRAINAGE)



1/4 WAVE STUB ON A.M. TOWER

29

30&31

30

TOWER IN OVERGROWN SITE
BULLET RIDDLED UTU CABINET:
CONDITION AND PERFORMANCE OF COMPONENTS
INSIDE QUESTIONABLE

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