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A Brief Investigation of Tower Reradiator Impacts on AM Antennas under Proposed FCC MM93-177 Guidelines

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Introduction

FCC Docket MM93-177 sets out to adjust FCC rules regarding the adjustment and measurement of AM directional antenna arrays. It also, seeks to modify the manner in which the reradiation impact of nearby structures is considered. Today, all towers within a fixed distance of AM antenna systems must be evaluated. Under the new proposals, only those structures exceeding a three-dimensional test must be considered. The test consists of a frequency dependant height, along with a frequency dependant spacing distance. These limits are different for directional and non-directional antenna systems.

Understandably, some confusion has arisen among AM broadcasters and tower owner/users over the practical impact of operations complying with the three-dimensional test.

Using NEC (Numerical Electromagnetic Code) modeling of some typical antenna towers at typical distances from a hypothetical AM antenna site, LBA engineers Katherine Tesh and Marvin Brewer have provided some interesting results as a point of reference in considering these impacts. These results suggest that using the FCC proposed method will not necessarily protect either AM stations or tower users against unwanted pattern impacts.

Non-directional evaluation

In the non-directional case (ND), the proposed requirement is that towers (structures) not exceed 60 electrical degrees within 1 KM or 1 wavelength of the AM tower. As the map shows, the wavelength protection radii are all well within 1 KM for all AM frequencies. A 60 degree tower ranges from 303 feet at 540 kHz to 96 feet at 1710 kHz. Under the proposed rules, no notification, measurements or detuning would be FCC required for any structure at any location under 96 feet, with respect to a ND AM tower.

The potential impact of a simple monopole-type tower, without carrier antennas, was evaluated using NEC method of moments modeling. Three case scenarios were set up: (1) maximum FCC-free height below floor near AM, (2) maximum FCC-free height below floor at one wavelength, and (3)

Plausible height just beyond FCC one wavelength limit. The modeling was done at 1000 kHz. The graph presentation is a variance plot showing the percentage deviation from an ideal omni pattern.

All three cases would require a regulatory response under present AM protection rules, but none would require a response under the proposed rules. Interestingly, the worst impact is from an unregulated tower beyond the one wavelength limit. Case 3 results in +/-10% distortion which could be unacceptable to many AM operators. Under present rules, this tower would typically be detuned, but no FCC action would be required under the proposed rules. Under frequently used screening criteria (including LBA), Case 1 would be recommended for notification and detuning, as it produces over 5% distortion. Case 2 would typically be recommended for notification and before/after verification only, due to its minor impact.

It is important to note that impact grows rapidly with electrical height. Case 1, for example, loaded with antenna platforms could quite easily be much taller electrically than 60 degrees, and have an impact twice or more that created by the hypothetical bare tower we modeled. Self-supporting towers will be electrically taller than monopoles. Guyed towers, unless the guys are insulated, can appear to be much taller than a monopole. While we have not done strict analysis, experience suggests that, as a practical matter, any proposed structure in the FCC protection zone over about 45 physical degrees high will require NEC modeling to ensure that it does not violate the FCC 60 electrical degree limit. Alternatively, the current practices of measurement and/or detuning will need to be employed to ensure FCC compliance.

Directional evaluation

In the directional case (DA), the proposed requirement is that towers (structures) not exceed 45 electrical degrees within 3 KM or 10 wavelengths of the closest AM tower. As the map shows, for lower frequencies, the FCC protection limit will be defined by the 3 KM radius, while for the higher frequencies the 10 wavelength limit will govern. This sets up a scenario where the same electrical parameters producing the same interference to the AM will produce a very different regulatory result depending on frequency. A 45 degree tower ranges from 227 feet at 540 kHz to 72 feet at 1710 kHz. A 10 wavelength radius extends to 18,200 feet at 540 kHz and 5750 feet at 1710 kHz. Under the proposed rules, no notification, measurements or detuning would be FCC required for any structure at any location under 72 feet, with respect to a directional AM array.

It is important to note that the new proposal references the impact zone to "any tower" of a directional array. Most tools for screening AM's us the FCC array coordinates which are administrative in nature only. In fact, they will

always be wrong with respect to individual towers by hundreds to thousands of feet! Many AM towers do not need to be registered (some arrays contain both), so actual tower coordinates are often not in the FCC database or files, and will need to be determined by survey to ensure carrier compliance.

The potential impact of a simple monopole-type tower, without carrier antennas, was evaluated using NEC method of moments modeling. Three further case scenarios were set up: (4) maximum FCC-free height below floor near AM, (5) Plausible 200 foot height just beyond FCC ten wavelength limit, and (6) Plausible 300 foot height just beyond FCC ten wavelength limit. The modeling was done at 1000 kHz where 10 wavelengths is the same as 3 KM. The graph presentation is a variance plot showing the percentage deviation from the FCC licensed pattern envelope for a four tower directional station. The pattern chosen is fairly typical of AM directionals, but the impact will vary widely with exact carrier tower placement and AM parameters. AM arrays vary from two to twelve towers, and have front-to-back ratios to about 45 dB (the example was about 34 dB).

In the operating environment of an AM station, a 5% change in monitor point field values can result in an FCC violation. The proposed rules require that a carrier tower within the protection limits not change the AM pattern beyond its “standard pattern” which is about 5% more generous than its theoretical pattern. In cases 4 -6, for none of which the FCC would require notification, measurements, or detuning, all could produce more than a 5% change at many azimuths in the AM pattern studied! The impacts go as high as a 90% change in field.

It is important to note that impact grows rapidly with electrical height. Case 4, for example, loaded with antenna platforms could quite easily be much taller electrically than 45 degrees, and have an impact twice or more that created by the hypothetical bare tower we modeled. Self-supporting towers will be electrically taller than monopoles. Guyed towers, unless the guys are insulated, can appear to be much taller than a monopole. While we have not done strict analysis, experience suggests that, as a practical matter, any proposed structure in the FCC protection zone over about 30 physical degrees high will require NEC modeling to ensure that it does not violate the FCC 45 electrical degree limit. Alternatively, the current practices of measurement and/or detuning will need to be employed to ensure FCC compliance.

Conclusions

The proposed FCC rules will leave many AM stations open to interference from otherwise FCC-compliant carriers, with no apparent FCC redress available. The economic impact of this interference will be hard to quantify,

laying the carriers open to a negotiated or litigated resolution, perhaps even predatory agents for AM interests.

Many of these impacts may appear to be minimal, but even the adjustment of an AM array to accommodate impacts and the relicensing can incur tens of thousands of dollars of consultant fees. For a big city station, a 10 or 20% pattern distortion in a critical market direction could result in an imputed loss in station value of millions of dollars.

We should note also that this evaluation was toward often used carrier tower heights. Taller towers are not uncommon, and can have devastating effects on the AM's beyond FCC limits, as can even the examples used here when those physical heights are used at higher frequencies like 1600 kHz (and, of course, less at lower frequencies).

It should be further noted that the FCC proposes to require all towers previously measured/detuned under the present 3KM/1KM rule to continue maintaining that form of compliance, effectively validating the proposition that tangible impacts will occur beyond their proposed administrative limits. This suggests that, new rules not withstanding, carriers should continue to treat all tower/antenna proposals under the old rule for due diligence purposes.

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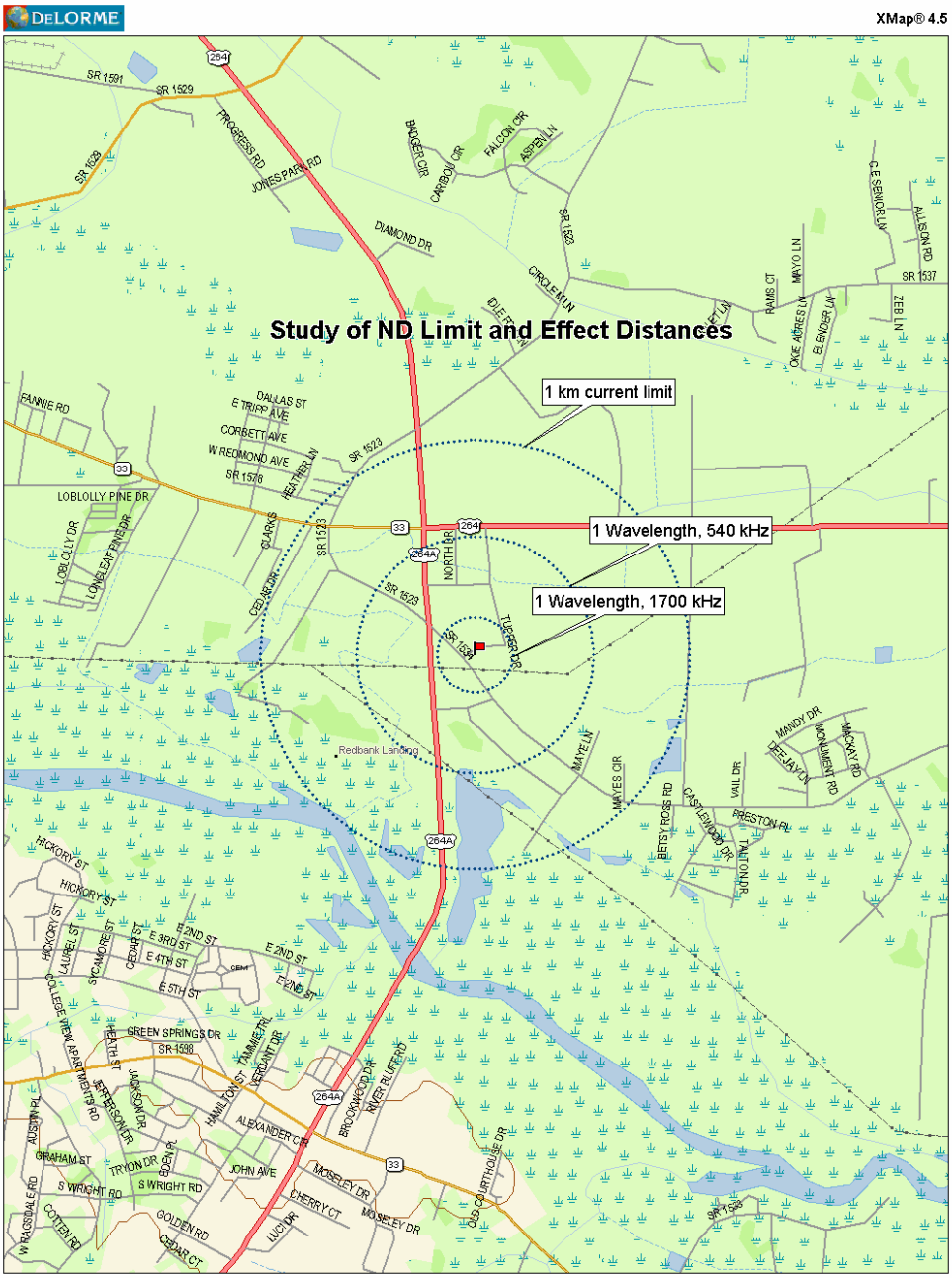
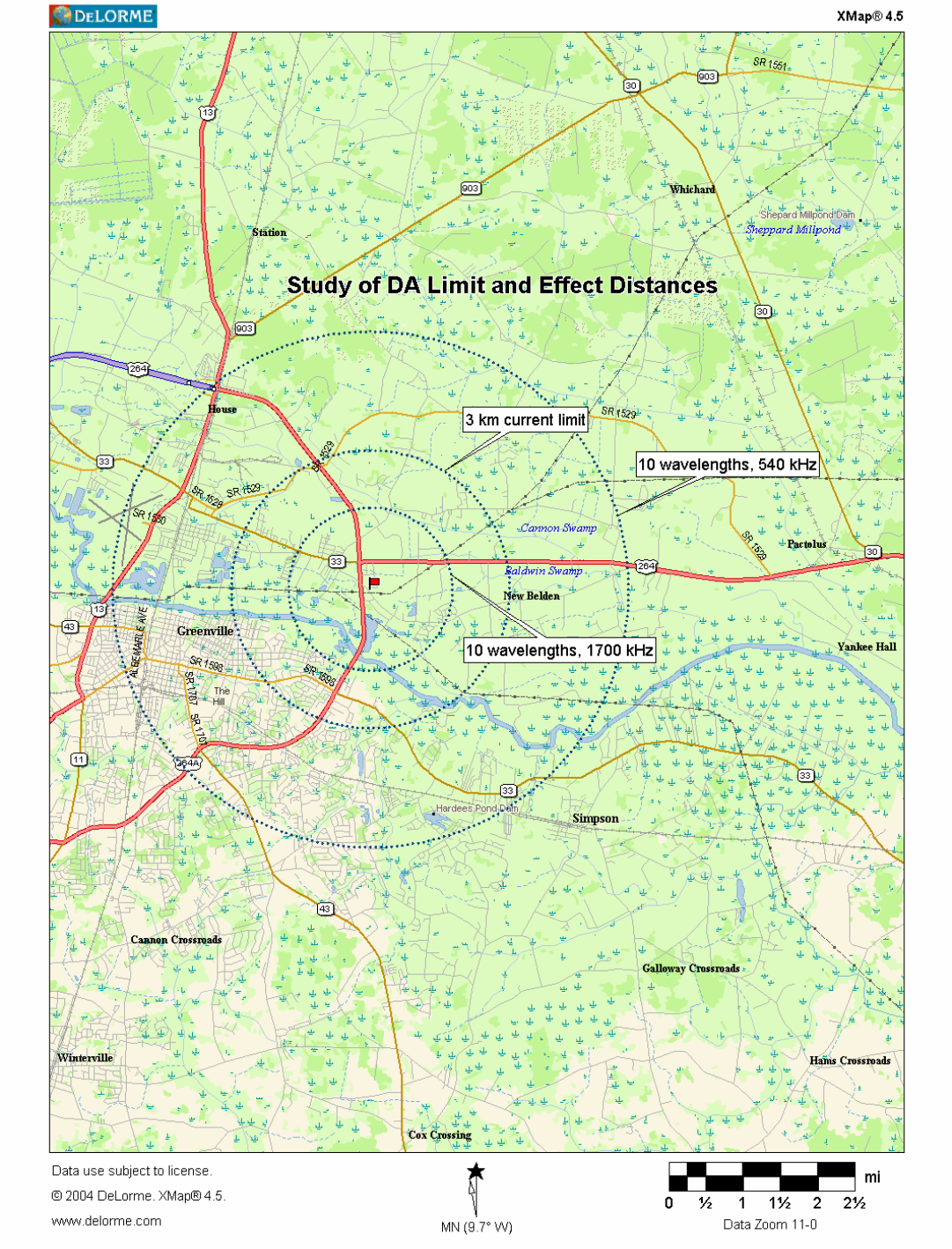
ND Study Area Map



DA Study Area Map



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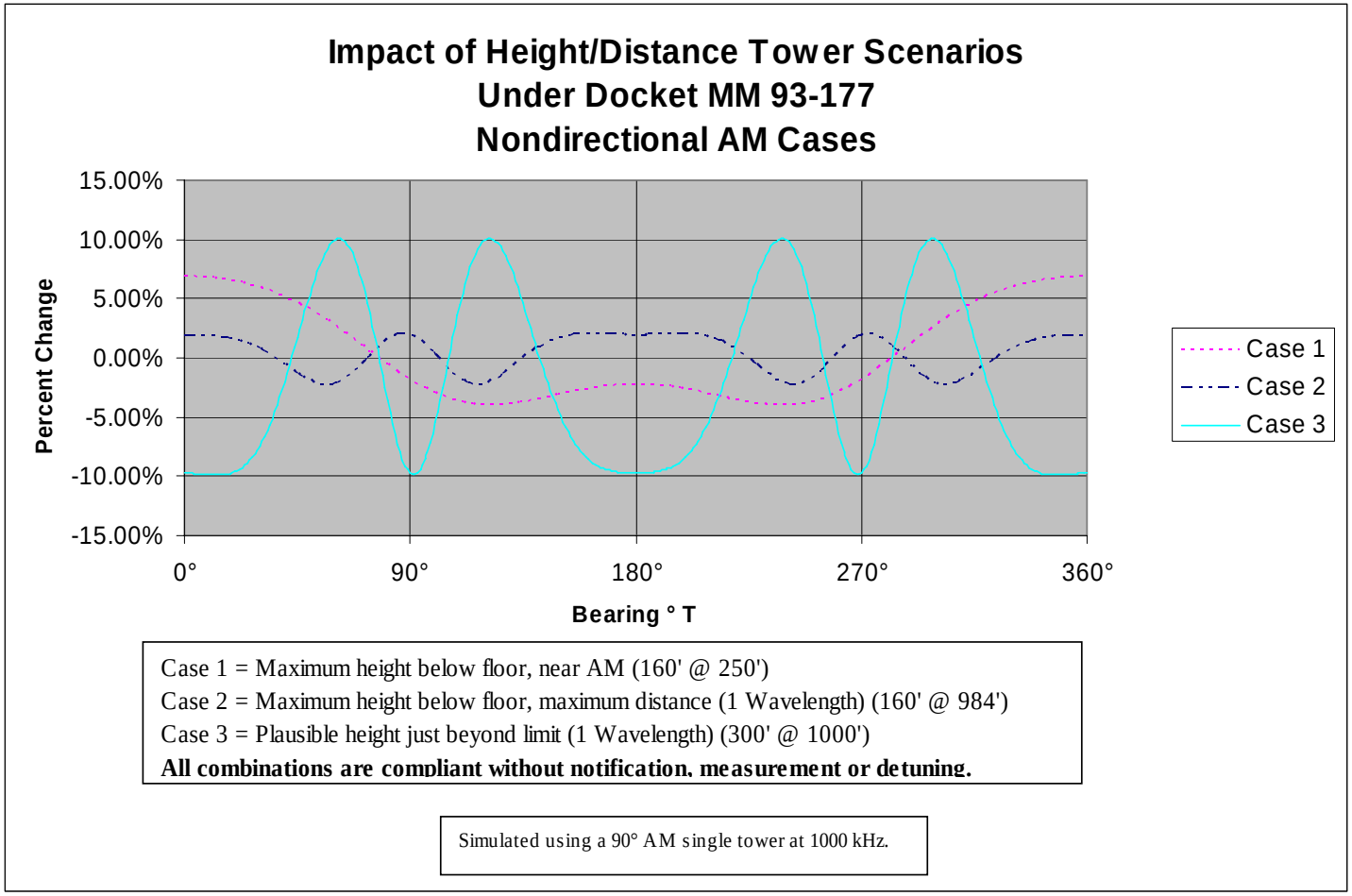
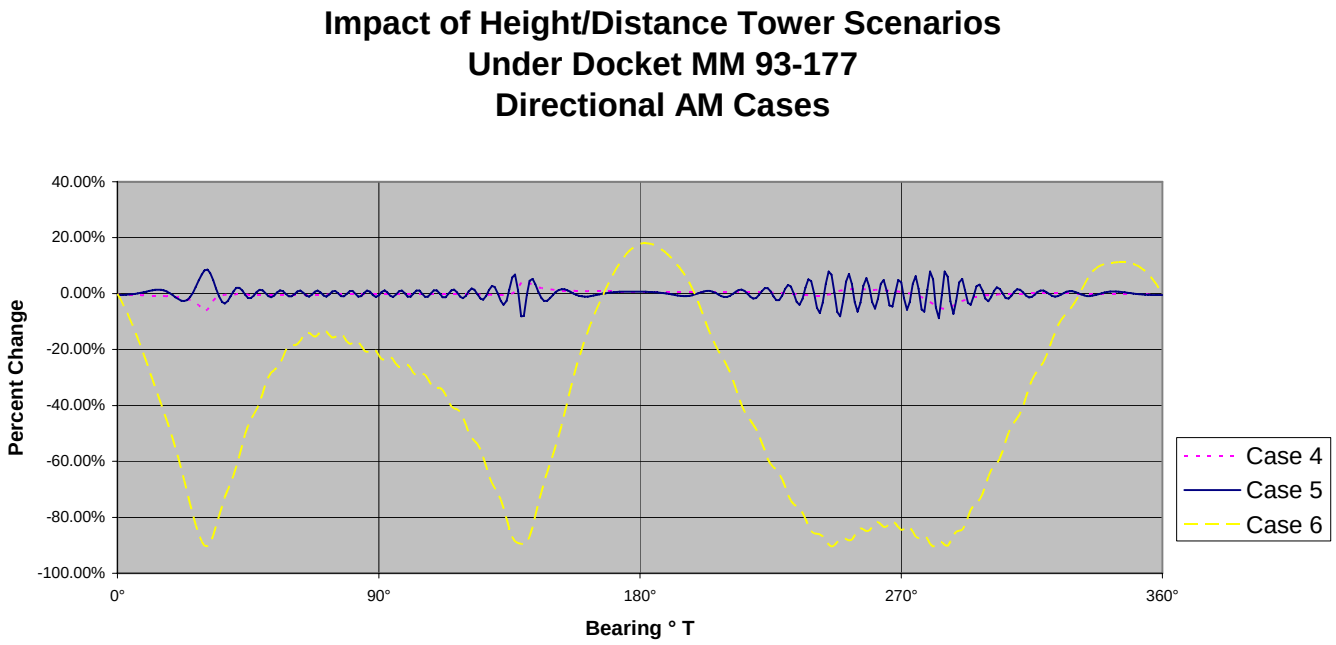
ND Evaluation Graph



DA Evaluation Graph



Case 4 = Maximum height below floor, near AM (120' @ 250' from nearest DA tower)
Case 5 = Plausible height just beyond limit (200' @ 10,000' from nearest DA tower)
Case 6 = Plausible height just beyond limit (300' @ 10,000' from nearest DA tower)
All combinations are compliant without notification, measurement or detuning.

Simulated using a 4-tower directional AM array selected at random from the FCC database and adjusted to 1000 kHz so 10 wavelengths = 3 kilometer