Review and Discussion of New AM Detuning Requirements

Jeremy D. Ruck, PE
Jeremy Ruck & Associates, Inc.
Canton, Illinois
jeremy@jeremyruck.com

jeremy@jeremyruck.com

jeremy@jeremyruck.com

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The New Requirements

- Became effective February 20, 2014.
- Revised previous procedures.
- Part of AM DA Verification Proceedings.
- MM Docket 93-177.
- Original proceeding began in 1991.

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History

- Concern dates back at least fifty years.
- Ties in with “last guy on” concept.
- This concept is even older.
- Valid in other areas but less overt as before.
- Requirements were inconsistent.
- Requirements were nebulous.

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New Rule Fundamentals

- Now applicable to ALL services.
- Three main parts to the new rules.
- Threshold Test – Is study necessary?
- Study Methodology – How to make study.
- Notification Requirements.
- Rules spelled out in Sections 1.30000-30004

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Section 1.30000

- This rule part protects operations of AM broadcast stations from nearby tower construction that may distort the AM antenna patterns. All parties holding or applying for Commission authorizations that propose to construct or make a significant modification to an antenna tower or support structure in the immediate vicinity of an AM antenna, or propose to install an antenna on an AM tower are responsible for completing the analysis and notice process described in this subpart, and for taking any measures necessary to correct disturbances of the AM radiation pattern, if such disturbances occur as a result of the tower construction or modification or as a result of the installation of an antenna on an AM tower….

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To Whom Does this Apply?

- AM.
- FM.
- TV.
- BAS.
- Two-Way.
- Amateur Radio.
- EVERY Authorization.

jeremy@jeremyruck.com

Threshold Test

- Structure Distance.
- Structure Height.
- Modification/Construction Type.

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Offending Structure Distance

- Previous requirements were fixed distance.
- Distance depended on operation mode.
- Current requirements frequency dependent.
- Operation mode dependency remains.
- Distance is to AM antenna location.

jeremy@jeremyruck.com

Non-Directional Threshold

- Location within one-wavelength.
- Height 60 degrees or greater.

Directional Threshold

- Lesser of 10 wavelengths or 3 kilometers.
- Height 36 degrees or greater.

jeremy@jeremyruck.com

Wavelength

- Recall the inverse relationship between wavelength and frequency.
- Velocity of light is the product of wavelength and frequency.
- Wavelength can be solved for by dividing velocity of light by frequency.

jeremy@jeremyruck.com

Wavelength

$$c = f\lambda$$

jeremy@jeremyruck.com

Wavelength Distance Examples

- 540 kHz – 555 meters / 1822 feet / 0.34 miles.
- 1000 kHz – 300 meters / 984 feet / 0.19 miles.
- 1600 kHz – 187 meters / 615 feet / 0.12 miles.
- 1700 kHz – 176 meters / 578 feet / 0.11 miles.

jeremy@jeremyruck.com

Electrical Degrees

- Will see on AM authorizations.
- Convenient way of expressing height.
- Actual height frequency dependent.
- 360 degrees in wavelength.
- 60 degrees 1/6 wavelength.
- 36 degrees 1/10 wavelength.

jeremy@jeremyruck.com

Electrical Degree Examples

- 60 degrees at 540 kHz = 304 feet.
- 36 degrees at 540 kHz = 182 feet .
- 60 degrees at 1000 kHz = 164 feet.
- 36 degrees at 1000 kHz = 98 feet.
- 60 degrees at 1600 kHz = 103 feet.
- 36 degrees at 1700 kHz = 62 feet.

jeremy@jeremyruck.com

Non-D Threshold Examples

- 540 kHz ND – 304 feet at 0.34 miles distant.
- 1000 kHz ND – 164 feet at 0.19 miles distant.
- 1600 kHz ND – 103 feet at 0.12 miles distant.

jeremy@jeremyruck.com

Directional Threshold

- More complex.
- Lesser of 3 kilometers or 10 wavelengths.
- 3 km = 9,842 feet or 1.86 miles.
- Equivalency point at 1000 kHz.
- Below 1000 kHz use 3 km.
- Above 1000 kHz use 10λ.

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Calculating Distance from AM

- Distance is based on tower location for ND.
- Distance is based on array center for DA.
- Broadcast coordinates based on NAD27.
- Wireless coordinates based on NAD83.
- NAD83 approximately 0.5 second west here.
- Approximately 36 feet differential.

jeremy@jeremyruck.com

Calculating Distance from AM

- Ensure coordinates are in same datum.
- Verify coordinates.
- Use the FCC web utility.
- FCC method preferred over great circle.

jeremy@jeremyruck.com

Construction and Mods

- Classified as major or minor.
- New structure construction considered major.
- Tower height alteration by 5 degrees or more.
- Detuned towers.
- Base insulated towers.
- Antennas and/or transmission changes.

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Additional Considerations

- Towers located on buildings considered.
- Analysis required if tower by itself meets previously discussed criteria.
- Building presence is ignored.
- Outside criteria assumes no impact.
- Station could still be affected.

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Example 1

- A new tower 300 feet in height is proposed to be located 1700 feet from a 600 kHz ND.

$$\lambda = \frac{c}{f} = \frac{299792458}{600000} * 3.2808 = 1639.3\ feet$$

$$G = \frac{h}{\lambda} * 360 = \frac{300}{1639.3} * 360 = 65.9°$$

- Tower does not exceed requirements.

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Example 2

- A proposed monopole of height 164 feet is to be constructed 2,459 feet from a four-tower inline directional array that operates on 1000 kHz. The proposed monopole will be located at 180 degrees true from the array.

jeremy@jeremyruck.com

Example 2

$$\lambda = \frac{c}{f} * 3.2808 = \frac{299792458}{1000000} * 3.2808 = 983.56\ feet$$

$$h = 164\ feet$$

$$G = \frac{360h}{\lambda} = \frac{360 * 164}{983.56} = 60°$$

$$S = \frac{360d}{\lambda} = \frac{360 * 2459}{983.56} = 900°$$

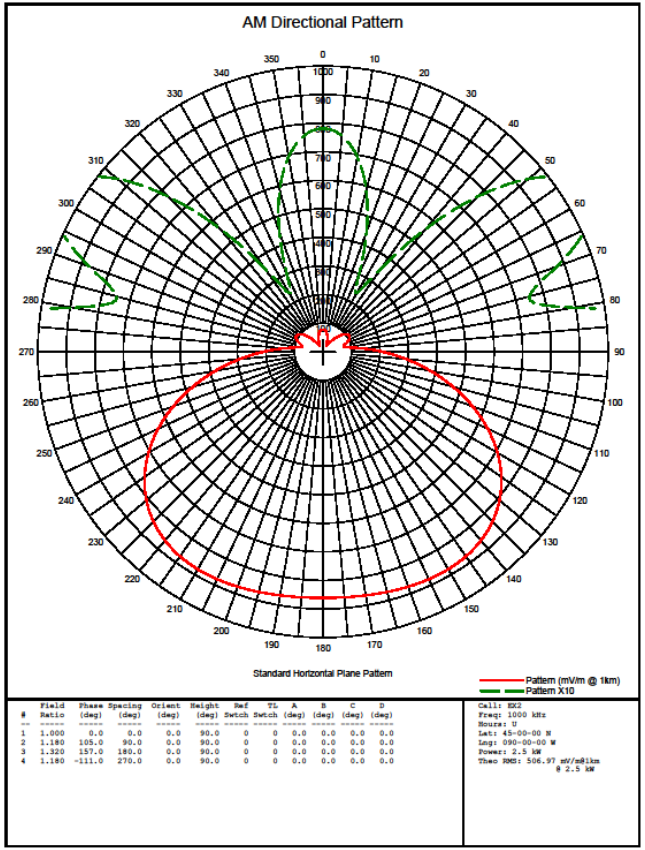
$$x = \frac{900}{360} \rightarrow x = 2.5\lambda$$

$$km = \frac{d}{5280} * 1.609 = \frac{2459}{5280} * 1.609 = 0.75$$

jeremy@jeremyruck.com

Example 2

Tower	Orientation	Spacing	Field	Phase	Height
1	0.0	0.0	1.000	0.0	90.0
2	0.0	90.0	1.180	+105.0	90.0
3	0.0	180.0	1.320	+157.0	90.0
4	0.0	270.0	1.180	-111.0	90.0



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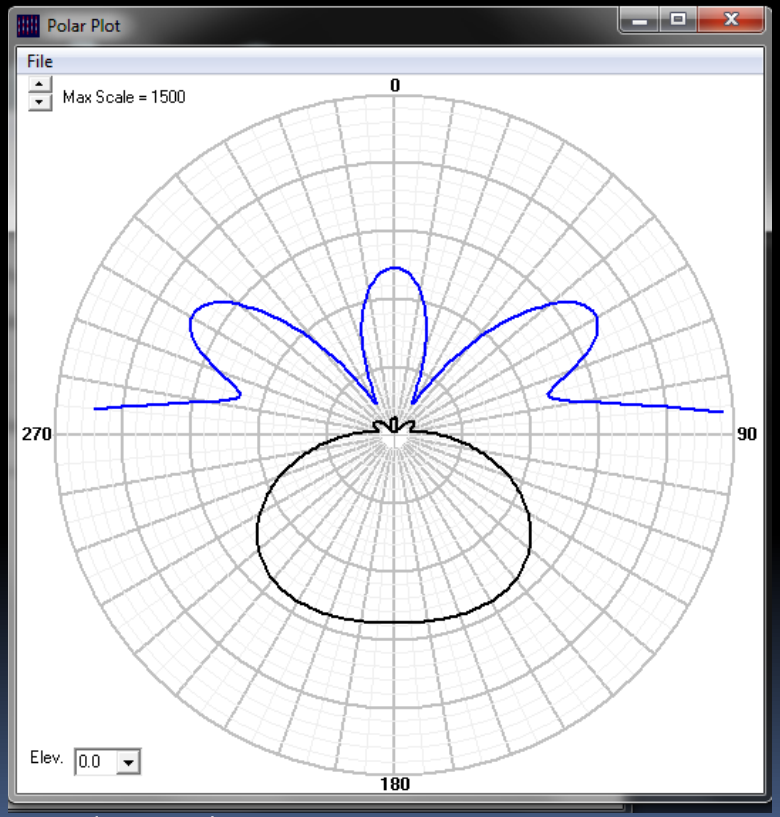
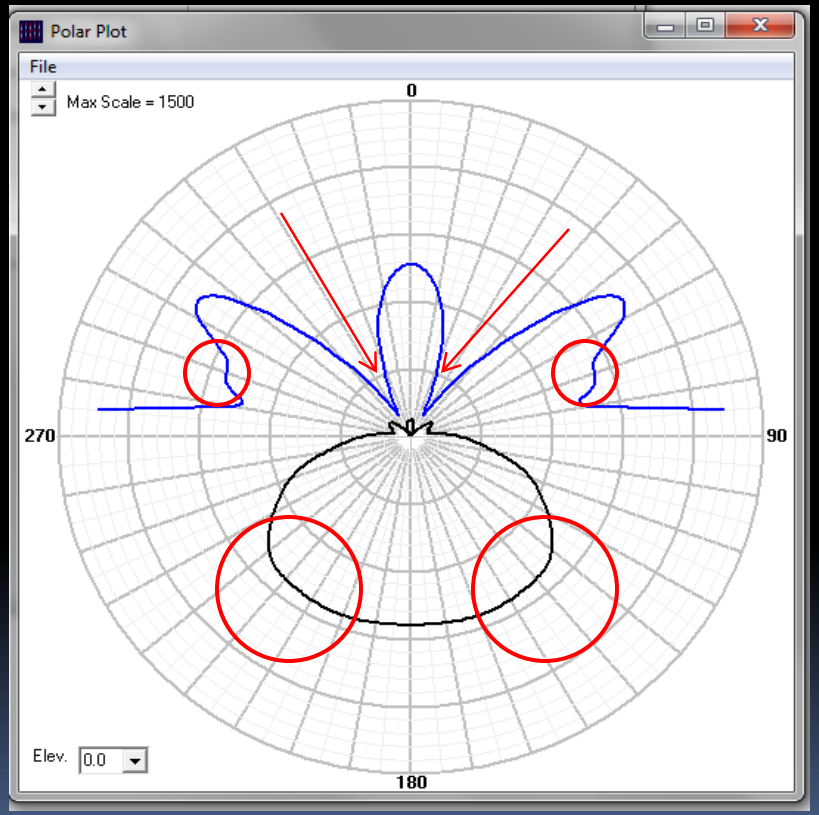
Example 2





jeremy@jeremyruck.com

Example 2

- Note the proposed structure impacts the directional pattern.
- Permissible impact is less than 2 dB.
- In this case some azimuths are disturbed by nearly 4 dB.

jeremy@jeremyruck.com

Example 2

Azimuth	Field	Dist. Field	Ratio	dB Change
20	40.141	35.676	0.8888	-1.02
25	24.563	17.562	0.7150	-2.91
30	17.833	11.590	0.6499	-3.74
35	32.420	24.902	0.7681	-2.29
40	53.617	42.184	0.7868	-2.08
45	74.364	65.840	0.8854	-1.06
315	74.364	65.840	0.8854	-1.06
320	53.617	42.184	0.7868	-2.08
325	32.420	24.902	0.7681	-2.29
330	17.833	11.590	0.6499	-3.74
335	24.563	17.562	0.7150	-2.91
340	40.141	35.676	0.8888	-1.02

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Example 2

- Model predicted detuning reactance to ground is +j678 ohms.
- At 1000 kHz this requires ~107 μH.
- Skirting tower will change this value due to reactance of skirt.

jeremy@jeremyruck.com

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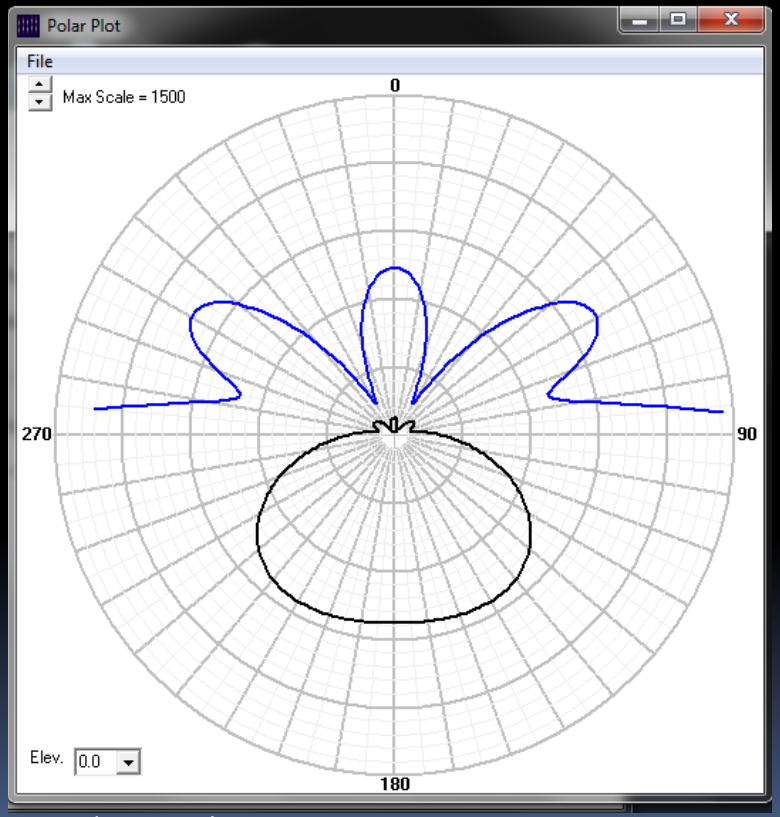

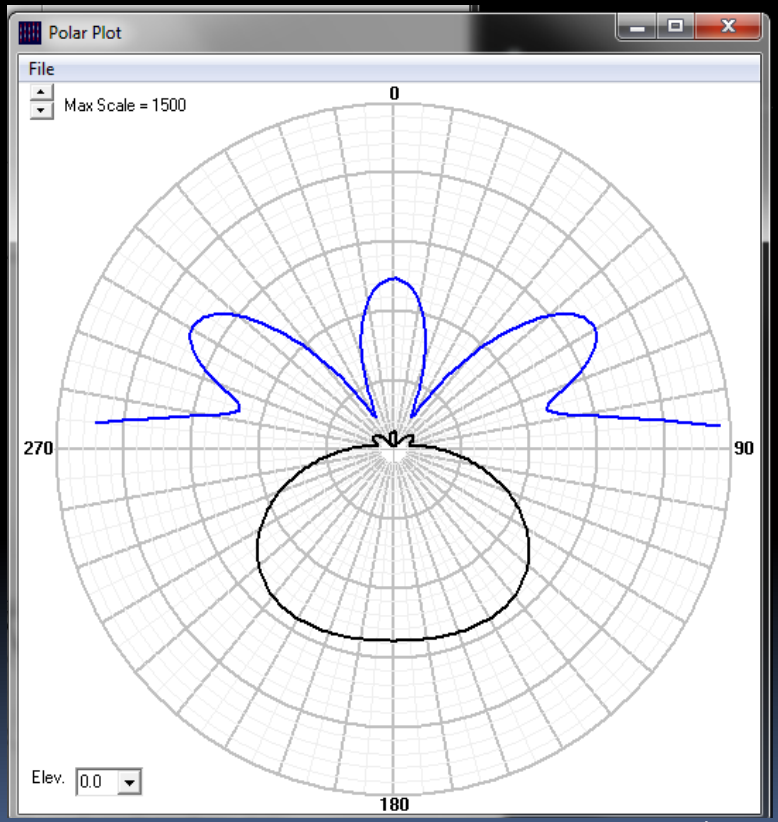

jeremy@jeremyruck.com

Example 2

Azimuth	Field	Detuned Field	Ratio	dB Change
20	40.141	40.151	1.0003	0.00
25	24.563	24.222	0.9861	-0.12
30	17.833	16.305	0.9143	-0.78
35	32.420	30.679	0.9463	-0.48
40	53.617	51.812	0.9663	-0.30
45	74.364	72.400	0.9736	-0.23
315	74.364	72.400	0.9736	-0.23
320	53.617	51.812	0.9663	-0.30
325	32.420	30.679	0.9463	-0.48
330	17.833	16.305	0.9143	-0.78
335	24.563	24.222	0.9861	-0.12
340	40.141	40.151	1.0003	-0.00

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Mounting Antennas on Towers

- ND towers require indirect method.
- Perform base impedance measurements.
- If variance exceeds 2% BZ app required.
- DA by field strength requires partial proof before and after construction.

jeremy@jeremyruck.com

Mounting Antennas on Towers

- Measure base impedance of tower on which antenna is mounted.
- Maintain record of measurement.
- New model required for resistance variance of more than 2 ohms and 4 percent.
- Other towers can be ignored.

jeremy@jeremyruck.com

Notification Process

- At least 30 days prior.
- Uses CDBS information.
- May be oral or written.
- Documentation required for oral.
- Expedited processing possible.
- 5 days for emergency situations.

jeremy@jeremyruck.com

Final Considerations

- Structures outside criteria may impact.
- Notify FCC within two years.
- Use moment method or field strength.
- Field strength readings may be used for compliance by proponent.
- Watch the horizon.

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Thank You!
Questions and Discussion…

Jeremy D. Ruck, PE
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P.O. Box 415
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