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Reducing the area of potentially hazarous field strength close to an LF Tee antenna

A practical case study

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***Abstract*— The paper reports a practical method for reducing the area close to the feedline of an Tee transmitting antenna where high field strength exists. The paper provides details of field strength measurements before and after implementation, simulations using NEC-4 and the mechanical solution adopted.**

Keywords—MF antennas LF antennas, Tee antenna, EMF exposure limits, RADHAZ

I. Introduction

An on-site field strength survey had shown that the electric field strength caused by a Tee antenna operating with 100W input power at approximately 300kHz, exceeded the ICNIRP limit for electric field (87V/m) in nearby areas of public access [1-3]. The antenna was supported by two 18-m towers spaced 80m apart (0.01λ x 0.08λ) and had a limited buried ground system. The solution was addressed by simulating the existing antenna, devising a novel means of mitigation, and jury-rigging a simple experimental version of the solution, which was measured on site. Simulations were carried using the MoM program *NEC-4* [4], which allows accurate simulation of an antenna with a buried ground system.

II. Electric field distribution around the antenna

Figure 1 is a partial plan view of the site and shows the simulated electric field intensity 1.5m above ground level over an area 60m x 60m centered on the antenna feed. The single-wire top of the Tee runs centrally across this area, parallel with the x-axis. There is a region of raised field under the whole antenna with a rapidly increasing field within 10m of the fed central downlead.

III. Reducing local fields below the ICNIRP limit for public exposure

The proposed solution, modeled using *NEC-4* and evaluated on site, was to place vertical grounded conductors around the central feedline of the antenna, extending approximately 3m above ground level.

Simulations were carried out for different conductor height, spacing and diameter, as well as for various numbers of conductors. Fig 2 shows that the central region of intense field is now largely contained within area bounded by the grounded conductors surrounding the feedline. The proposed full mechanical arrangement is shown in Fig. 3. The containment of the E-field below the upper ends of these conductors is seen clearly in Fig. 4. To demonstrate the effectiveness of the solution before building the permanent arrangement, a similar arrangement was made using vertical wires. The simulation showed that containment of the field would be less effective using wires only 3mm in diameter, but using this arrangement the resultant field strengths were measured at points in the public access area and are listed in Table 1.

The additional base capacitance caused by the presence of the grounded conductors close to the feedwire is small, so adoption of the solution has almost no effect on the input impedance or efficiency. of the antenna. This was confirmed by checking that fitting the grounded wires had no significant effect on the field strength radiated by the antenna, measured at an established monitoring station approximately 100km distant.

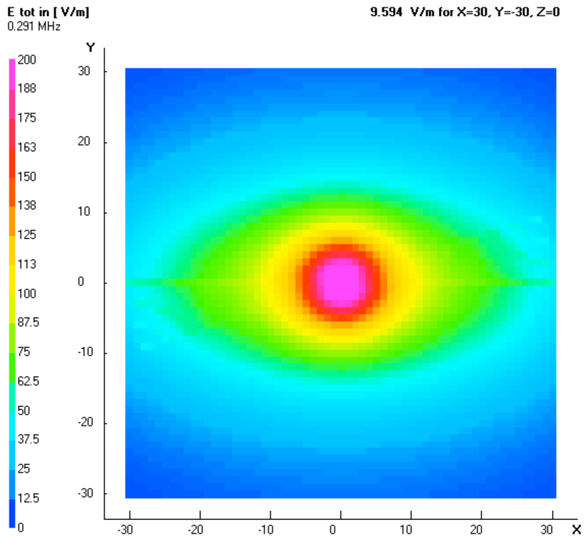

Fig. 1: Simulated distribution of electric field below the antenna in its original configuration (plan view).

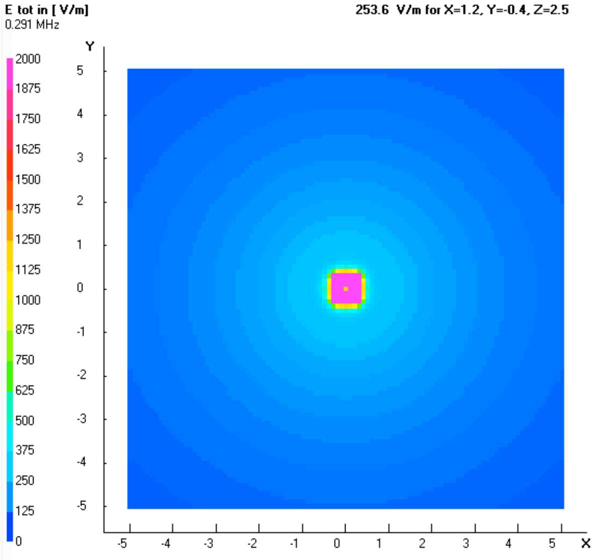

Fig. 2: E-field in the central area with four vertical conductors surrounding the feedline. Note the difference in both the geometrical and field intensity (color) scales between Figures 1 and 3.

IV. Conclusion

The solution described in this paper is an effective means by which the low-level field strength close to the feed of a Tee antenna can be reduced.

V. Note

The full version of the paper will provide a plan showing the measurement locations referred to in Table 1, will define the applications of the method in terms of the electrical height, and input power of the antenna, and will discuss the effect of a restricted ground system and poor ground conductivity on its effectiveness. Field strength measurements will be provided for the final arrangement.

References

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[5] For corresponding international references, see: http://en.wikipedia.org/wiki/Electromagnetic_radiation and_health

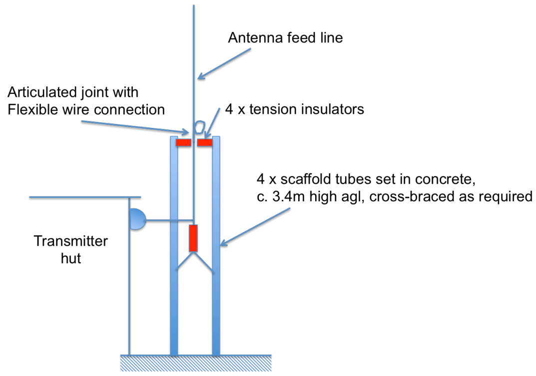

Fig. 3: Physical arrangement of the solution.

TABLE 1. Field strength in identified locations before and after erection of grounded conductors

Location No.	Measured field strengths	
	Original antenna	*With 4 grounded conductors around feedline*
1	105	26
2	120	39
3	46	(not recorded)
4	40	56
5	69	59
6	60	51
7	46	69
8	63	68

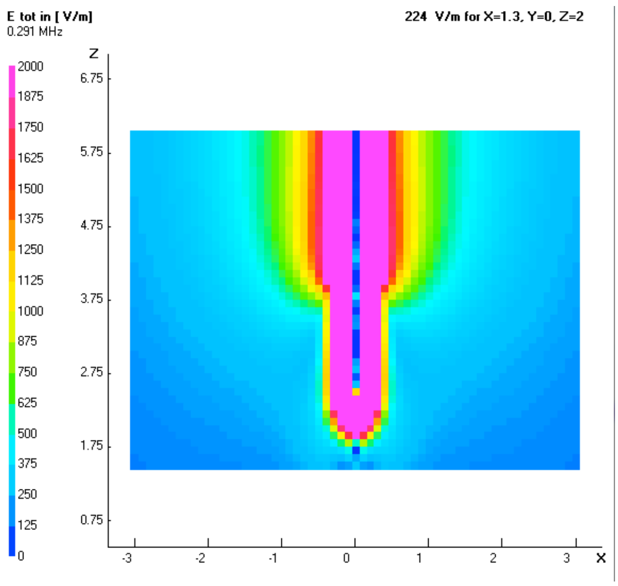

Fig. 4: Elevation plane cut through the antenna downlead, in a plane bisecting the angle between adjacent grounded wires in plab. The central vertical line is the feed wire, modeled correctly but here exagerated in diameter to one pixel (100mm).