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MOBILE COMMUNICATIONS AND INTERACTIONS WITH FURTHER RF & EMF SIGNAL SYSTEMS

1. LOCAL AUTHORITY COMPLIANCE

It is understood that local authorities will accept an ICNIRP Compliance certificate as proof of field strength when giving planning permission. Those to whom the writer has spoken are unaware of SSLs or non-linear fields. They are also unaware of Radio Frequency Interference (RFI), which is well known in the Motor industry and others to jam signals and also to give spurious signals to electronic equipment.

2. ATYPICAL VARIATIONS IN FIELD STRENGTH NEAR TRANSMITTERS

Radiation fields in similar sites around (transmitter) stations of the same category are completely different, suggesting that the variety of existing base station installations is too large for an easy categorization. (C Bornkessel COST 281 Workshop May 2003 Dublin) Communications companies use, in the main, computer programmes to forecast field strengths near their corporate transmitters. Further, the common assumption that the "umbrella effect" (low RF levels just beneath a transmitter) should be questioned.

Most AM broadcast stations have vertically polarized (direction of the emitted electric field) antennas, TV station antennas often have horizontal polarization, sometimes circular or elliptical polarization. Cell tower antennas are usually either vertically polarized or else have polarization at 45 degrees with respect to the axis of the antennas. However, the polarization axis is usually tilted slightly downward, because either the antennas are tilted a few degrees toward the ground, or else the antenna design includes an electrical tilt of the radiation pattern.

"Antenna Theory Analysis and Design" by C.A. Balanis, Wiley and Sons, New York (1982) has a very comprehensive chapter about the fields from antennas over partially conducting ground. The same basic arguments apply to fields near partially conductive structures. The field enhancement due to interaction of the direct and reflective fields is dependent on the antenna size (dipole length), relative to the wavelength of the radiation, the distance of the antenna from the ground or partially conducting structure, the polarization of the antenna, and the dielectric constant and electrical conductivity of the bounding surface (ground) or partially conductive structure.

For an AM broadcast radio tower, the antenna is nearly always a straight dipole. For TV stations and some FM radio stations, there may be more complex structures than just dipoles, but the analysis of their emitted fields can usually be represented as arising from multiple dipole sources (e.g. log periodic antenna) or as an emitting element plus reflective and directive rods (Yagi antenna).

Sources such as cell towers usually have antennas that are of two types:

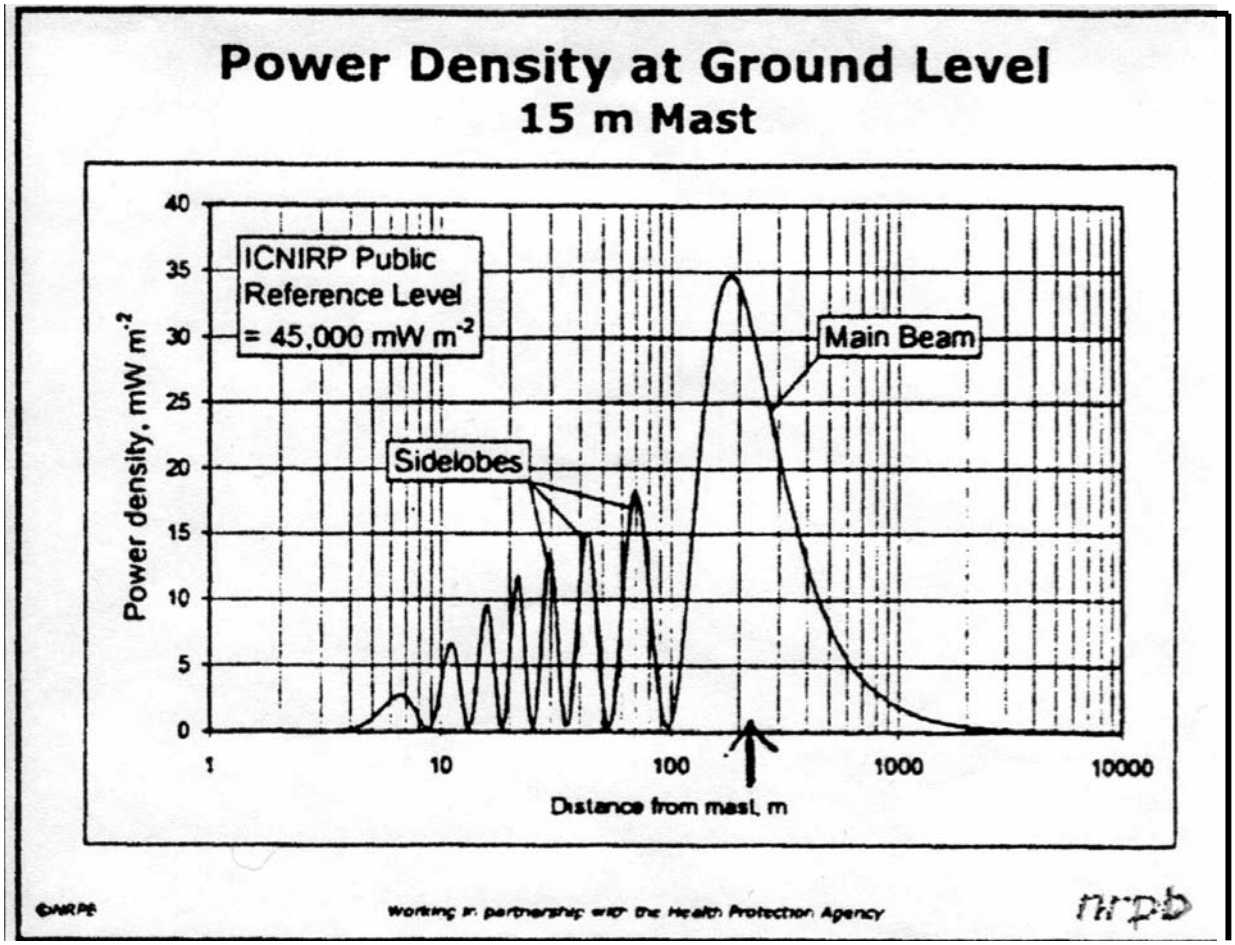
1. either whip antennas (long straight dipoles) that may or may not have flat reflectors (when the antennas are mounted on the sides of buildings) and
2. antennas that have rectangular folded dipoles encased in weatherproofing plastic.

The latter antennas resemble flat blades, and they produce a directional emission pattern. The relation between the essential parameters of a folded dipole and those of linear dipoles are given in the Balanis book, so that one can compute approximate radiation patterns, allowing for the effect of the finite conductivity of nearby objects or boundary surfaces.

3. SUBSIDIARY SIDE LOBES

Although the Stewart Report depicted the 'throw' of a theoretical Subsidiary Side Lobe (SSL) on page 37 as a 6.0 degree angled down beam from the masthead, and states at 4.33 "The RF intensity on the ground is not zero outside the main beam, because of the power emitted into the side lobes. …..*it seems unlikely that it could ever be significantly more than that within the beam*". An MoD diagram clearly depicts what is described as the Interference region with several SSLs (ground bounce) between the mast and about 4 Kms. Further the NRPB in 2003 produced a diagram "Power density at ground level" from a 15m mast, which clearly shows seven SSLs before the Main beam. In the NRPB diagram the main beam is strongest at 200m from the mast. (For the reader unfamiliar with SSLs, think of a tennis ball bouncing with shorter and shorter 'rise times'.) If this is extrapolated to a high multi-user mast it is obvious that the first SSL hits the ground much further away than the NRPB exampled cited.

Figure 1



4. WHAT OF THE POSITION WHEN SEVERAL SSLs MEET AT ONE POINT IN SPACE?

There is no mention of the fact that, due to multiple transmitters sited on many masts, several SSLs may co-incidence at one point in space, which may be on the ground, in a building. Further, whereas it is usual to add the field strengths, as quoted in the European Parliament document C147E 20-06-02 p8, these will be Mean (averaged) field strengths. The EU document does state, in relation to Peak Pulsed fields, that "*little information is available on the relation between biological effects and peak values of pulsed fields*". To illustrate this, think of a concert with varying sound levels, from the soft violins to the full tone of an organ. Now average the sounds – a median acoustic will result. But what of the peaks, where sound can be deafening?

5. UNUSUAL EFFECTS GENERATED WHEN SEVERAL Txs ARE IN LINE

Quite separately from SSLs and near fields from a single, even if multi user Mast, there is a separate point which should be addressed. This is when several Txs are deliberately built in a line. These may be TV or radio, less likely to be communications.

To sum up the electrical behaviour, we can state that two or more sources of transmission, having different periodicities, will tend to generate fields where the powers add in an algebraic fashion, but as a beat is produced some peak-voltages will occur that are the sum of all the voltages and hence the power at those peak intervals is square of the powers;

$$P_{peak} = (\sqrt{P1} + \sqrt{P2} + \sqrt{P3} + \ldots\ldots\ldots)^2$$

P = power

What this means is that high voltage breakdown of structures might be caused by a combination of EM effects, and that such breakdowns are then momentarily capable of causing high energy destructive power. One of the biological failure mechanisms that is identified is electroporosis, where a cell may become damaged by 0.3 – 0.5 V fields, which last for a matter of 100 μs. Also interesting is the possibility that a number of radio-transmitters may be working in concert to achieve similar peaks of energy. This is likely to occur in locations where a common mast is used for a number of different transmitters. It is quite common to see multiple user sites. After all, prime sites for 'line of sight transmissions' are at a premium.

6. METRICS

Is there a current system available in 2004, which will take into account

(a) varying signal capacity from transmitters
(b) varying signal strengths from transmitters
(c) beam direction of signals from the transmitter whether omni-directional or narrow line-of-sight 3 degree (for example) beam
(d) albedo (reflectivity) from water, glass, and other materials in signal path?

In the power frequency range, H fields are relatively stable over time. But this condition is unlikely to be satisfied in the mobile phone frequency range as the rate of installation of new transmitters has been so rapid and RF-EMF is strongly affected by its surroundings and environment. (RF fields are reflected by walls, artefacts etc., whereas H fields will pass through unaffected.)

7. SPOT MEASUREMENTS AND INTERMITTENTLY TRANSMITTING SOURCES

Measurements should be interpreted with care, due to the fact that, performed over a range of frequencies and within a practical timeframe a short time interval can be recorded for each frequency. Since the radiated power from a mobile phone base station will depend on the number of calls at any given time, short-term measurements may be inadequate to estimate exposure over time. The contribution to total exposure arising from signals from intermittently transmitting sources may also be over emphasized or neglected completely, depending upon whether the signals are present or not during the recording interval. (Schuz and Mann 2000)

8. AMBIGUITIES IN MEASURING DISTANCE FROM TRANSMITTERS

'Distance from residence' measurements have been used in some studies where broadcast towers are involved. However, such towers radiate power in the range of hundreds of Kilowatts and are therefore likely to be the dominant signal source in the area. But this is not the case with mobile phone base stations as the powers are very much lower.

9. POPULATION EXPOSURE

Thus it is very difficult to identify those people whose RF-EMF exposure is higher than median. Distance between a residence and a base station is a poor proxy for total power density within the residence as:

(a) Are the directional characteristics of the main beam from base station antennas known?
(b) The signal will undergo scattering, shielding and reflection by house walls, barns, metals etc.
(c) What are the power density contributions from other sources, such as base stations of digital cordless phones.

[To this we can add Radio amateurs, security, emergency, utilities, MoD etc. ACAS]

Therefore proximity to a nearby mobile phone base station CANNOT be used as a surrogate for exposure to RF-EMF. Exposure classification, particularly classifying unexposed subjects as exposed, would be likely to mask any effect present. (Schuz and Mann 2000)

10. STRESS – THE 21ST CENTURY CATCH-ALL PHRASE – AND CONVERSION DISORDER

The increasingly strident calls in the media for Tetra investigations in 2004, and prior to that in 2002 and 2003 for mast investigations, serve only to stir up great public concern. When extreme anxiety is aroused, from whatever cause, this can lead to psychological disorder, which in turn may translate into physical symptoms. This is known as Conversion Disorder. However, despite the reports of poor sleep, anxiety, nausea etc. etc. from many groups, there are three symptoms which are being reported from many groups all over the UK which may be less easy to define.

(a) Ulceration of mucosa – commonly in the mouth. These are painful and difficult to treat. But these can be a sign of immune dysfunction and/or chronic low-grade infection.
(b) Epistaxis (nosebleeds). Many cases are reported when there is no previous history of the condition. This may be due to sudden hypertensive episodes.
(c) Epileptic seizures when not know previously.

1) *C Bornkessel COST workshop May 2003 – Dublin*
2) *J Schuz & S Mann – A discussion of potential exposure metrics in epidemiological studies on Human exposure to Radiowaves from mobile phone base stations. J Expo Anal Env Epidemiology 10 (6:1) 600-605, 2000*
3) *T Jarvis – TETRA the noise source – preventing interference. Compliance Engineering June 2000*
4) *R Page-Jones Radio Amateurs Guide to EMC RSGB 2004*