IN-SITU MEASUREMENTS OF ELECTRIC, MAGNETIC AND ELECTROMAGNETIC FIELDS IN THE ENVIRONMENT

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1. INTRODUCTION

- With regard to Non-ionizing radiation protection, the relationship between human exposure to electromagnetic fields and health is controversial. Electromagnetic fields have become omnipresent in our daily environment. The use of devices emitting electromagnetic fields (EMF) ranging from static to microwave frequencies has significantly increased in the past two decades.
Electromagnetic Spectrum

Non-Ionizing Radiations

Ionizing Radiations

5 keV

12.4 eV
Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.
Important fact 1

- Significant public and media concerns are expressed about increases in EMF exposure of people and its potentially adverse effects on health, particularly children health. These associations are not explained by any confirmed biological mechanism and there are doubts as to their causal nature, as the available evidence is inadequate to make sound scientific conclusions.
Important fact 2

• In order to evaluate population exposure, knowledge of the field levels is very important. Measurements are basic both for the verification of the results obtained through the use of numerical models, and for the evaluation of the field levels when the sources are unlikely to be simulated because of their number, working condition, and complex distribution.
I n t e n t i o n
of the presentation

• 1) to give the basic information about relevant EMF standards in connection with in-situ measurements

• 2) to circumscribe the basis of in-situ broadband measurements and so contribute to the development of non-ionizing radiation protection in Serbia
2. STANDARDIZATION OF EMF MEASUREMENTS

- **IEC** - The International Electrotechnical Commission
  **Technical committee TC 106**, “Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure”

- **CENELEC** - The European Committee for Electrotechnical Standardization
  **Technical committee TC 106x** - the deals with various aspects of the exposure of people to EMF
<table>
<thead>
<tr>
<th>IEC TC 106</th>
<th>CENELEC TC 106x</th>
</tr>
</thead>
<tbody>
<tr>
<td>WG 1: Measurement and calculation methods for LF fields and induced currents (0 to 100 kHz – Basic Standards)</td>
<td>WG 1: Mobile Phones and Base stations</td>
</tr>
<tr>
<td>WG 2: Low frequency fields produced by specific sources (product standards)</td>
<td>WG 2: Anti-theft devices</td>
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<tr>
<td>WG 3: Measurement and calculation methods for high frequency EM fields and SAR (100 kHz – 300 GHz)</td>
<td>WG 3: Basic Standards     WG 4: Generic Standards</td>
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<td>WG 4: High Frequency EM Fields produced by specific sources(Product standards)</td>
<td>WG 7: Broadcasting     WG 9: Inductive and dielectric heaters</td>
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<td>WG 5: Generic standards</td>
<td>WG 13: Domestic appliances</td>
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3. Measurement methods

- **CENELEC Standard EN 50413** gives elements to establish methods for measurement and calculation of quantities associated with the assessment of human exposure to electric, magnetic and electromagnetic fields in the frequency range from 0 Hz to 300 GHz.

- The major intention of this Basic Standard is to give the common background and information to relevant EMF standards.
3.1. Low frequency range (up to 100 kHz)

- The electric and magnetic fields in the low frequency range are mainly independent from each other and shall both be assessed, when measurement is to be made.

- **IEC 62110** - in the domestic environment and in areas accessible to the public (TS and HVPL)

- **IEC 61786** - provides guidance for measuring
3.2. High frequency range (100 kHz – 300 GHz)

- Several field types exist which should be assessed differently depending on the distance \( r \) from and the biggest dimension \( D \) of the radiating source.

<table>
<thead>
<tr>
<th>Distance ( (r) )</th>
<th>Reactive near field</th>
<th>Radiating near field</th>
<th>Far field</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r &lt; \lambda )</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>( \lambda &lt; r &lt; \frac{2D^2}{\lambda} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( r &gt; \frac{2D^2}{\lambda} )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E, H ( \sim \frac{1}{r} )</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>( Z_0 = \frac{E}{H} )</td>
<td>( \neq Z_0 )</td>
<td>( \approx Z_0 )</td>
<td>( = Z_0 )</td>
</tr>
<tr>
<td>To measure</td>
<td>E and H</td>
<td>E or H</td>
<td>E or H</td>
</tr>
</tbody>
</table>

To measure \( E \) and \( H \) in the reactive near field, measure \( E \) or \( H \) in the radiating near field, and measure \( E \) or \( H \) in the far field.
• CENELEC EN 50492:2008, “Basic standard for the in-situ measurement of electromagnetic fields strength related to human exposure in the vicinity of base stations” (GSM, UMTS, WLAN, RTV...)

The term „base station“ includes the radio station and antenna
4. Our experience
with in-situ measurements

- Summary of values of environmental broadband in-situ measurements of low frequency (ELF: 30 Hz to 2 kHz) magnetic fields and RF (100 kHz – 3 GHz) electromagnetic fields in over 35 municipalities in Serbia.

- These investigations were motivated by the local population requesting information about levels of general public exposure to time-varying electric and magnetic fields in living spaces.
4.1. ELF Magnetic field in-situ measurements


The percentile distribution of measurement values
4.2. RF EMF in-situ measurements


The percentile distribution of measurement values
• With standpoint of possible health effects, annotations of these measurements should be cautious. The maximum values for both investigations are well below ICNIRP reference levels.

• Prospective activity should be to obtain more data (technical data of main sources, meteorological conditions, evaluation of uncertainty in the measurement etc.) in order to assure stricter monitoring of the measurement in “sensitive” places (residencies, nursery schools, junior schools, hospitals etc.).
5. CONCLUSION

• In order to evaluate population exposure, knowledge of the field levels is very important.

• In situ broadband measurements are basic for the evaluation of the field levels.

• A comparison is possible only between the result of EMF measurements obtained following IEC/CENELEC methods and the reference levels of contemporary safety standards (i.e. IEEE C95.1) and ICNIRP guidelines.
Thanks for Your Attention

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