SAFETY AND HEALTH LEGISLATIVE REQUIREMENTS REGARDING WORKERS EXPOSURE TO RISKS GENERATED BY ELECTROMAGNETIC FIELDS

GEORGETA ALECU, ANDREEA VOINA, WILHELM KAPPEL, CARMEN MATEESCU

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For complying with the European legislation regarding electromagnetic field exposure, Romania has adopted appropriate national legislation. Thus, Decision 1136 from 30.08.2006 is the main national law where are stipulated the minimal safety and health requirements for working exposure in risks generated by electromagnetic fields in the range of 0 Hz – 300 GHz. There are mentioned some predictions referring to safety and health risks caused by the short-term hazardous effects against human body due to induced currents and energy absorption and due to contact currents. Some regulation are established for the employer which must assure information of workers exposed at their working place to electromagnetic risks and must inform the working responsible factors about the risks assessment results. This paper also present some predictions mentioned in Law 319/2006 for removing or at least reducing the risks generated by electromagnetic fields exposure.

1. INTRODUCTION

Romania, as European Union country, strictly complies with the main requirements established by Communitar Acquis, especial those for communitar requirements concerning Unique European Market – area having no internal barriers, in which is assured free traffic of people, services, capital and goods.

For fulfilling increased consumers demands, the quality assurance of products and services as well as complying assessment are very important for any producer that aim to belong to internal and external market.

2. EUROPEAN AND NATIONAL LEGISLATION

Complying with the communitar reglementation stipulated in the second edition of EMC Directive 2004/108/EC is the start point in electromagnetic

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pollution problem approach, having immediate implications on life quality by biological effects of electromagnetic emission that are not well known yet.

This regulation has got in force since 1 October 2006 and it is a transposition of Directive 2004/40/CE regarding minimal safety and health requirements for working exposure in risks generated by physical agents (electromagnetic fields), that is published in the European Community Official Journal no. L 159/2004.

Referring to electromagnetic emission aspects and to immunity against such type of perturbation, in the last 15 years we have noticed a justified and significant increase of their importance. For applying the conformity European label it must fulfill all the conditions stipulated in Electromagnetic Compatibility Directive 89/336/EEC (since July 2007, EMC 2004/108/EC).

A low electromagnetic emission level, thoroughly regulated and controlled, in opposition with huge development of telecommunication traffic, represents a distinct component of an unpolluted environment.

For demonstrate this domain dynamic, we can mention that in the last 30 years it has reported a 3 dB increase (1.4 times) at every 4 – 5 years for the ambient electromagnetic levels.

In contrast, the signal levels that are processed in numerical electronic cycles have reported a 20 dB decrease. This fact involves a similar decrease of signal levels that act as perturbing factors, determining a significant improvement of anti-disturbing techniques.

For next years, we estimate maintaining a similar evolution that will cause a corresponding decrease of admissible electromagnetic pollution level. The increase of integration density simultaneously with increase of working frequencies of circuits has led to a susceptibility increase for electromagnetic interferences effects.

In this scope, in the Romanian legislation the Decision no. 1136 from 30.08.2006 has got in force, regarding the minimal safety and health requirements for working exposure in risks generated by electromagnetic fields in the range of 0 Hz – 300 GHz. This Decision is referring to safety and health risks caused by the short-term hazardous effects against human body due to induced currents and energy absorption and due to contact currents.

The employer must assess and, if necessary, determine and/or calculate the electromagnetic field levels where are exposed the workers. These testing can be performed according to the valid standards and, in some cases, considering the emission levels indicated by the equipments producers, when the equipment are regulated by national legislation before the data for publishing the national
standards based on the European standards that are harmonized by CENELEC, that
cover the hole set of operations: assessment, measurement and calculation.

It is not quite necessary for these operation to be performed in public access
working places, having condition that one assessment had yet been performed
according to the regulation norms stipulations for admits reference levels
concerning the people exposure against electromagnetic fields with the frequencies
in the range of 0 Hz – 300 GHz.

These norms have to be approved by Health and Family Ministry Decision
December 2002 and the restrictions stipulated in these norms have to be abided by
the workers, so that the safety risks being removed (Table 1).

In accordance with Law no. 319/2006, in risks assessment the employer must
pay significant attention to the following aspects:

a) the level, frequency spectrum, duration and type of exposure;
b) limit values of exposure and action response values.

### Table 1

<table>
<thead>
<tr>
<th>Frequency domain</th>
<th>Induced current density in head and trunk (J) [mA/m²] (rms)</th>
<th>Average SAR for the whole body [W/kg]</th>
<th>SAR for head and trunk [W/kg]</th>
<th>SAR for limbs [W/kg]</th>
<th>Power density (S) [W/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1 Hz</td>
<td>40</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1–4 Hz</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4–1000 Hz</td>
<td>10</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1000 Hz–10 kHz</td>
<td>(f/100)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>10 kHz–10 MHz</td>
<td>(f/100)</td>
<td>0.4</td>
<td>10</td>
<td>20</td>
<td>–</td>
</tr>
<tr>
<td>10 MHz–10 GHz</td>
<td>–</td>
<td>0.4</td>
<td>10</td>
<td>20</td>
<td>–</td>
</tr>
<tr>
<td>10–300 GHz</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>50</td>
</tr>
</tbody>
</table>

**Note:**
1. \(f\) means frequency, expressed in Hertz;
2. The exposure limit value for current density must assure protection against the acute effects
   of exposure for nervous system tissue at the head and trunk level;
3. SAR means specific absorption Rate

Action response values mentioned in the Table 2 have been obtained starting
to exposure limit values in accordance with the principles established by
International Commission for Non-ionizing Radiations Protection (ICNIRP), in the
regulation ICNIRP no. 7/99 regarding non-ionizing radiation exposure
limiting.
Table 2

<table>
<thead>
<tr>
<th>Frequency domain</th>
<th>Electric field intensity $E$ [V/m]</th>
<th>Magnetic field intensity $H$ [A/m]</th>
<th>Magnetic induction $B$ [T]</th>
<th>Power density for the equivalent plane wave $S(eq)$ [W/m$^2$]</th>
<th>Contact current $I(C)$ [mA]</th>
<th>Induced current in extremities $I(L)$ [mA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–1 Hz</td>
<td>$1.63 \times 10^5$</td>
<td>$2 \times 10^5$</td>
<td></td>
<td>$1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–8 Hz</td>
<td>$20.000$</td>
<td>$1.63 \times 10^5/f^2$</td>
<td>$2 \times 10^5/f^2$</td>
<td>$1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8–25 Hz</td>
<td>$20.000$</td>
<td>$2 \times 10^5/f$</td>
<td>$2.5 \times 10^5/f$</td>
<td>$1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.025–0.82 kHz</td>
<td>$500/f$</td>
<td>$20/f$</td>
<td>$25/f$</td>
<td>$1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.82–2.5 kHz</td>
<td>$610$</td>
<td>$24.4$</td>
<td>$30.7$</td>
<td>$1.0$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5–65 kHz</td>
<td>$610$</td>
<td>$24.4$</td>
<td>$30.7$</td>
<td>$0.4f$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65–100 kHz</td>
<td>$610$</td>
<td>$1.600/f$</td>
<td>$2.000/f$</td>
<td>$0.4f$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1–1 MHz</td>
<td>$610$</td>
<td>$1.6/f$</td>
<td>$2/f$</td>
<td>$40$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–10 MHz</td>
<td>$610/f$</td>
<td>$1.6/f$</td>
<td>$2/f$</td>
<td>$40$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10–110 MHz</td>
<td>$61$</td>
<td>$0.16$</td>
<td>$0.2$</td>
<td>$10$</td>
<td>$40$</td>
<td>$100$</td>
</tr>
<tr>
<td>110–400 MHz</td>
<td>$61$</td>
<td>$0.16$</td>
<td>$0.2$</td>
<td>$10$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400–2.000 MHz</td>
<td>$3f^{1/2}$</td>
<td>$0.008f^{1/2}$</td>
<td>$0.011^{1/2}$</td>
<td>$f/40$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–300 GHz</td>
<td>$137$</td>
<td>$0.36$</td>
<td>$0.45$</td>
<td>$50$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
1. “f” means frequency expressed in measure units shown in the frequency column;
2. For frequencies in the range of 100 kHz and 10 GHz, the average of values $S(eq)$, $E$, $H$, $B$ and $I(L)$ is measured for 6 minutes period.

c) the effects on health and safety of the workers that are susceptible to specific risks;
d) the indirect effect, such as: interferences with electric medical devices and equipments, including heart stimulators and implanting devices, risk for ferromagnetic object design in static magnetic fields, having a magnetic induction above 3 mT, electro-explosive devices fusing, burning and explosions caused by flammable material firing due to sparks generated by induced fields, contact currents or spark release;
e) existence of an alternative working equipments designed for reducing the electromagnetic exposure levels;
f) the proper information obtained by health monitoring, including the published information, if possible;
g) the multiple exposure sources;
h) simultaneously exposure to multiple frequency fields.

The employer must keep a risk assessment, according to Law no. 319/2006 and he must establish the protective measures for workers safety and health.

In case the nature and the amplitude of risks regarding electromagnetic fields does not justify a more detailed assessment of the risks, the risk assessment must be accompanied by the employer arguments for justify this fact.
Risks generated by electromagnetic fields exposure must be removed or at least reduced to minimum, taking into account the technical progress and the existence of control measures for source risk, based on the prevention general principle stipulated in the Law no. 319/2006.

Based on risks assessment when the measured values rise above the limit values, excepting the case that the assessment demonstrate that exposure does not go above the limit values and there is not any safety risk, the employer must establish and apply a technical and/or organizational measures programme to guarantee that exposure will not exceed the limit values, taking into consideration mainly the following elements:

a) other working methods that will lead to a more reduced exposure in electromagnetic fields;

b) selecting of equipments that emit less electromagnetic fields, taking into account the specific activity;

c) technical measures for reducing the electromagnetic fields emission, including, if necessar, using of block and screen mechanism or other similar methodologies for health protection;

d) proper maintenance programme for working equipments and working places;

e) design and equip the working places;

f) duration and exposure intensity limit;

g) availability of a proper working protection equipment.

Based on risks assessment, in case the workers are supposed to be exposed in electromagnetic fields that are higher than response starting actions, the working places must be signaled properly, in accordance with Decision no 971/2006 regarding minimal conditions for signalization of working place as far as safety and/or health are concerned, excepting the case that the performed assessment guarantee that the exposure does not go above the limit values and that the safety risks are excluded.

If the exposure are above the limit values, in spite of the protective measures followed by the employer for complying with this Decision, the employer must implement immediately proper measures for decrease the exposure to a low level and must change the previous protective measures for avoiding any other situation of passing values.

The employer must assure information of workers exposed at their working place to electromagnetic risks and must inform the working responsible factors about the risks assessment results, especially regarding the following aspects:

a) protective measures followed for complying with this Decision;

b) values and concepts refering to the limit exposure values and to starting response actions values, as well as to the potential asociated risks;

c) results of assessment, measurement and calculation regarding exposure levels to electromagnetic fields;
d) detection mode for harmful effects of exposure against health and their identification mode;

e) conditions in which the workers have the right to their health monitoring;

f) safety professional practices, in scope of decrease to the minimum the risks caused by the exposure.

In order to prevent and detect as far as possible any harmful effect against health due to electromagnetic fields exposure it must assure a proper supervising of workers health, in accordance with predictions stipulated in Law no. 319/2006. In any case it is noticed an electromagnetic exposure that rise above the limit values, the worker have to be a subject of a medical control. The Ministry of Labour, the Family and Equal Opportunities has reported at every 5 years to the European Commision data concerning stadium of put this Decision into operation, mentioning the social partners points of view.

A prove of problem importance and of the obstacles is represented by standardization dynamic in this domain, having always been made proposals for new editions or amendments (some of them being accepted and some other rejected), in conditions of many differences between european standards (EN) and american standards (ANSI) in electromagnetic compatibility domain.

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