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Principles for the Derivation of Emission Standards for Emission Sources Operating Simultaneously

Recommendation by the German Commission on Radiological Protection

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Grundsätze bei der Ableitung von Emissionsstandards bei gleichzeitig betriebenen Feldquellen

Empfehlung der Strahlenschutzkommission

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In the event of any doubts about the meaning, the German original as published shall prevail.

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1 Introduction

1.1 The issue

Low frequency electric and magnetic fields and high frequency electromagnetic fields in the frequency range between 0 and 300 GHz are generated by technical devices and equipment in increasingly diverse ways and by making increasingly exhaustive use of the available frequency spectrum. In the low frequency range, in addition to 16 2/3 or 50 Hertz, harmonics are being increasingly produced e.g. by phase-angle control. High and ultra-high frequency fields over a broad frequency spectrum are being used in new application areas in particular for wireless communication systems. Against this background and in view of the intensive debate on the health effects of electric, magnetic and electromagnetic fields of all frequency ranges, the German Federal Environment Ministry (Bundesumweltministerium) asked the German Commission on Radiological Protection (Strahlenschutzkommission, SSK) to develop a procedure for the evaluation of simultaneous exposure to various emission sources in the above mentioned frequency range of 0 to 300 GHz.

1.2 Limit values and technical standards

In Germany, statutory regulations for the protection of the public against the risks associated with electromagnetic fields have been in place for ten years. The limits laid down in the 26th Ordinance implementing the German Federal Immission Control Act (26. BImSchV) are based on the recommendations of national and international advisory bodies and specialist organisations. The recommendations are based on the Guidelines of the International Commission on Non-Ionizing Radiation Protection, ICNIRP [ICNIRP 98]. In the low frequency range they limit the relevant effects arising from current density (J) and give protection against neural excitation. The specific energy absorption rates (SAR) give protection in the high frequency range against excessive body heating.

In order to avoid field effects, the ICNIRP Guidelines define basic restrictions for J and SAR which, however, cannot be measured directly in practice. For this reason the ICNIRP Guidelines give additional reference levels for field quantities which are easier to check. These are derived from the basic restrictions for the worst-case exposure conditions, so that remaining below the reference levels also ensures compliance with the basic restrictions. If the reference levels are exceeded, the basic restrictions may still however be complied with: this must be checked using more elaborate methods for individual cases.

For stationary emission sources (e.g. transmitters) the reference levels have been adopted as limit values in the 26th Ordinance (26. BImSchV). There are various standards for mobile emission sources (devices) which set limits for emissions resulting from electric, magnetic and electromagnetic fields.

In these technical standards, the ICNIRP Guidelines, which state immission levels, are at present implemented in such a way that even the emissions of a single emission source are permitted to use up the immission limit to its full extent. This means that no account is taken of the potential exposure of an individual to several emission sources in the vicinity, although in practice the summation of such exposures, e.g. from several devices, is a frequent occurrence.

2 Protection in cases of multiple exposure

2.1 Basic principles

The Commission on Radiological Protection has already addressed the issue of multiple exposure in earlier statements [SSK 01, SSK 03] and reaffirms its recommendation to all manufacturers to make the minimisation of emissions a quality feature as a matter of principle when developing devices so that, for emission sources with unintentional emission of low and high frequency fields, additional evaluation rules should not be necessary.

It is the opinion of the Commission on Radiological Protection that assessment of the potential total exposure situation for emission sources operating simultaneously should be obligatory for the manufacturer or distributor of a single emission source within the scope of general product liability and operational safety regulations. Information on restrictions of use arising from this must be stated in the operating instructions. However, determination of a customer's exposure situation is highly variable due to the large number of possible emission sources from other manufacturers and can often not be measured fully due to the diversity of parameters involved.

In order to guarantee compliance with the ICNIRP Guidelines during simultaneous exposure to several emission sources in the frequency range 0 to 300 GHz (multiple exposure), the Commission on Radiological Protection has derived the following rules for practical application.

2.2 Simultaneous operation of emission sources in the frequency range 0 to 300 GHz: Rules for emission standards and their scope of application

The following rules apply solely to uncontrolled areas used by the public and to exposure to electric, magnetic and electromagnetic emissions, i.e. the issue of direct contact currents is not dealt with here.

The rules are to be applied to those emission sources whose function is achieved by an intentional emission of electric, magnetic and electromagnetic fields (intentional field emitting device, IFED) in those environments which are accessible to at least parts of the human body not only under favourable conditions, but also under the worst-case conditions of intended use which may occur in practice. This includes, for example, all high frequency emission sources of wireless communication applications, but also induction furnaces, induction cookers, anti-burglar alarms and "magnetic field devices for well-being".

Rule 1:
Should the expected field strength levels of an emission source use up to a maximum of a third of the reference level defined by the ICNIRP after addition of all the measurement and/or theoretical determination inaccuracies (expanded total measurement uncertainty with a coverage factor of 2), then compliance with the basic restrictions can also be assumed in the event of multiple exposure from further emission sources in everyday use, and no additional measures on the part of the manufacturer are necessary. For the purpose of this statement, the manufacturer is required to consider those criteria deemed necessary from a safety point of view which apply to worst-case operating conditions and geometry and not the typical criteria. As a rule, allowance should be made for the smallest distance of a body from an

emission source during normal use, and the worst-case body geometries must also be taken into account. It is a further criterion that these statements apply to all emission sources produced e.g. for all devices of a series production.

Rule 2:
Should the expected field strength levels of an emission source lie above the limit of one third of the reference levels according to Rule 1 and if the manufacturer is able to prove by additional analyses/measurements carried out according to the best available technology and scientific knowledge under those criteria laid down in Rule 1 that the basic restrictions are not being utilised by more than one third, then compliance with the basic conditions can be assumed even in the event of multiple exposure from additional sources in everyday use, and no additional measures on the part of the manufacturer are necessary.

Rule 3:
Should exposure to an emission source lead to exceedance of the basic limit values according to the one third limit under Rule 2, then the manufacturer must identify not only typical but, with due diligence and according to the criteria set down in Rule 1, worst-case multiple exposure scenarios which are possible in practice. The total exposure in relation to the basic restrictions must be established according to the summation rules laid down in the ICNIRP Guidelines. Warnings about possible scenarios presenting a risk of exceedance of the basic restrictions must be stated in the operating instructions with appropriate guidance as to how these can be avoided.

3 Recommendations

The Commission on Radiological Protection recommends that steps be taken to urge that these rules be implemented by European and national standards agencies. The Commission on Radiological Protection recommends to the German Federal Environment Ministry (BMU) that it takes appropriate steps (voluntary commitments, mandates for technical standards, statutory regulations) which will ensure that the proposed rules are applied in practice and that compliance with the ICNIRP Guidelines can therefore be assumed even for simultaneous use of several emission sources.

4 Scientific clarification

In Rule 1 no consideration is given to the fact that the basic restriction “current density” has a linear relationship to the derived reference field strength levels whereas the basic restriction “SAR” has a quadratic relationship to them. The ensuing “stricter” assessment of high frequency field exposures in Rule 1 is supported by the practical experience that “background exposure” generated by more distant emission sources has only been recorded in the case of large transmitters in the high frequency range. This matches the theoretical distance behaviour of emitted fields to their source, which decreases in amplitude more slowly with distance than do the near fields. In addition, the aim was to have a rule which is as simple and easy to apply as possible.

If devices in the high frequency range use up the SAR basic restrictions above the one third limit for body parts only, it must first of all be ascertained whether an overlapping of body parts exposed above the one third rule is possible as a result of multiple device usage, based on the geometric positioning options of one device to another. If this is not the case, then no further additional measures are necessary.

The one third rule used as a benchmark in relation to the basic restrictions (Rule 2) is based on the evaluation of existing data on numerous exposure scenarios taken from practice. It is considered unlikely that more than three emission sources (e.g. a “background source” and two “near field sources”) would each use up more than one third of the basic restriction in the same body part.

References

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