

# Protection of Workers Exposed to EMFs above Occupational Limits

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*Summary — In this contribution some applicative difficulties related to the management of overexposures to electromagnetic fields, allowed by the directive 2013/35/EU, are discussed. Critical features and possible solutions are addressed.*

## I. INTRODUCTION

Directive 2013/35/EU, setting the exposure limits values (ELVs) for the protection of workers against electromagnetic fields (EMFs), allows to exceed the ELVs (overexposure) in duly justified circumstances provided that the employer demonstrates that workers are still protected against adverse health effects and against safety risks [1].

In this contribution it will be discussed how the employer could demonstrate that workers are still protected against adverse health effects even when the ELVs set to protect against these effects are exceeded. For this purpose, it would be necessary to understand, in relation to how much the health effects ELVs are exceeded, which effects could be expected and if these effects cause just discomfort or real health risks for workers. This issue involves the type of exposure, the biological and/or dosimetric rationale supporting the ELVs as well as individual and environmental circumstances.

The approach to manage health and safety requirements in overexposure conditions may be different for static magnetic fields, low-frequency electric and magnetic fields and radiofrequency electromagnetic fields.

## II. STATIC MAGNETIC FIELDS

The health effects ELV for static magnetic fields, relative to controlled working conditions, set by the Directive 2013/35/EU, is equal to 8 T, as recommended by ICNIRP in 2009 [2]. Actually, based on an analysis of known action mechanisms, ICNIRP states that the major potential concerns with respect to limiting exposure to static magnetic fields are cardiovascular and neurological effects, but studies on humans exposed up to 8 T do not provide evidence of any irreversible or serious adverse health effects.

ICNIRP recommends restricting exposure below 8 T because for higher exposures there is no human experience and therefore there is lack of knowledge. We are not aware of further studies investigating the possibility of health effects in volunteers exposed over 8 T and ICNIRP has not updated its recommendations about static magnetic field exposures. Owing to the persistent lack of knowledge, we do not deem possible to guarantee the health of workers exposed to these levels [3].

## III. LOW-FREQUENCY ELECTRIC AND MAGNETIC FIELDS

ELVs for non-thermal health effects of low-frequency electric and magnetic fields (1 Hz – 10 MHz) correspond to the basic restriction set by ICNIRP on the basis of biological thresholds of stimulation of excitable tissues introducing reduction factors to compensate for uncertainties [4].

In order to guarantee the health of workers exposed at levels exceeding the health effects ELVs for low-frequency fields, it is necessary to consider that the lowest biological effect threshold corresponds to the mere perception of the electric currents induced by external low-frequency fields at the body surface. It has also to be considered that the thresholds of painful perceptions, and of potentially dangerous effects, such as involuntary muscle contraction and cardiac stimulation up to the induction of ventricular fibrillation, are increasingly higher.

Protection of workers can be assured if it is guaranteed that just minor effects like non-painful perception can occur, as described in [3].

## IV. RADIOFREQUENCY ELECTROMAGNETIC FIELDS

As in the case of low-frequency fields, basic restrictions for thermal effects of radiofrequency fields (100 kHz–300 GHz) have been derived by ICNIRP from biological thresholds introducing reduction factors to compensate for uncertainties.

For whole-body exposures, in the light of the recent pertinent ICNIRP guidelines [5], derogation from compliance to the ELV of 0.4 W/kg on the whole-body SAR, taken from the basic restrictions set by ICNIRP in 1998 [6], could be considered acceptable up to 2 W/kg, a value implying only a slight thermal stress, unless the worker operates in severe thermal environments and/or wears thermal insulating clothes, requiring a more detailed risk assessment.

For localized exposures, derogations from compliance to the local SAR ELVs, derived from biological thresholds with a very small reduction factor, do not seem justified [3].

#### REFERENCES

- [1] "Directive 2013/35/EU of the European Parliament and of the Council of 26 June 2013 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)", *Off. J. Eur. Union*, L179, pp. 1–21, June 2013.
- [2] International Commission on Non-Ionizing Radiation Protection, "Guidelines on limits of exposure to static magnetic fields", *Health Phys.*, vol. 96, pp. 504–514, Apr. 2009.
- [3] G. M. Contessa, S. D'Agostino, R. Falsaperla, C. Grandi and A. Polichetti, "Issues in the implementation of Directive 2013/35/EU regarding the protection of workers against electromagnetic fields", *Int. J. Environ. Res. Public Health*, vol. 18, p. 10673, Oct. 2021.
- [4] International Commission on Non-Ionizing Radiation Protection, "Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz to 100 kHz)", *Health Phys.*, vol. 99, pp. 818–836, Dec. 2010.
- [5] International Commission on Non-Ionizing Radiation Protection (ICNIRP), "Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz)", *Health Phys.*, vol. 118, pp. 483–524, May 2020.
- [6] International Commission on Non-Ionizing Radiation Protection, "Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)", *Health Phys.*, vol. 74, pp. 494–522, Apr. 1998.