

Standards for Occupational Exposure to Electromagnetic Energy

David Black

School of Population Health, University of Auckland, New Zealand, d.black@auckland.ac.nz

INTRODUCTION

The idea of controlling and regulating exposure to electromagnetic energy began with radio frequencies soon after the end of World War II. Long before that, the dangers of electricity had been accurately recognised as shock and burns, while similar effects were known and avoided with radio frequencies. As higher power densities arose with use of very high frequencies and above the standards moved to control tissue heating. At electricity transmission frequencies the issues were perception of electric fields on the surface of the body and induced internal electric fields from external electric and magnetic fields. All of these were matters which had been encountered in the radio and electricity distribution industries and so standards were only devised to provide protection for workers against these deterministic acute effects. There was no attempt to protect against any concept of chronic or cumulative effects. When standards were extended to cover public exposure, the idea of dose accrued equivalence was introduced, possibly erroneously, although limits derived from this approach have persisted and continue to serve well.

The concept of protecting occupationally exposed populations includes an acknowledgement that workers are a controlled group of known and generally favourable health status who can be monitored. There is also a reasonable expectation of trade or training and skills to keep safe and so precautions in terms of permissible levels of exposure are perhaps less important. These risks are differently managed compared with those to the general public. Included in such an approach for workers can be medical pre-assessment or screening and ongoing monitoring and which has been attempted and even incorporated in some standards. Some early approaches which still persist are no longer supportable in the light of current understandings and evidence. One important difference in the occupational exposure scenario is the risk of further over exposure and procedures required for managing this if it occurs. A recent area of particular concern and interest surrounds the inevitable exposure to time varying fields to workers managing the use of magnetic resonance scanners (MRI). The manner in which this should be controlled and managed particularly in Europe is still far from agreed.

While the direct effects of electromagnetic fields on workers is well understood and controlled, indirect effects, those involving intermediate conductors, are less easy to manage and less amenable to control by standards limits.

Workers in the electrical, radio and general electronic industry nowadays account for a significant percentage of the workforce in many countries. In addition, many workers in areas as diverse as health care, law enforcement, library management and building maintenance may be regarded as legitimately occupationally exposed to radiofrequency or power frequency electromagnetic fields in the course of their work and management of this becomes an occupational health responsibility for employers. Usually, this is achieved by a combination of controls, education and personal protective equipment using the modern established hierarchy of hazards which is importantly different to the precautionary approach advocated for wider population exposure.

There is a marked difference in the categorisation of occupational versus public exposure between the ICNIRP[1] derived standards and the method recommended by IEEE[2, 3]. Whilst ICNIRP define classification of the personnel, IEEE suggests control of areas of

higher than public exposure limits. Some standards allow for both approaches and there seems no reason to argue against that approach as both have merit.

Despite best intentions and management incidents of potential over exposure do occur and these can result in fear and ongoing distress in some cases. Recent and substantial experience has shown that a thorough and vigorous early management is essential to avoid such adverse outcomes however this is not yet generally practised.

CONCLUSIONS

Overall, in occupational standards are well based, coherent, consistent and stable generally with a good safety margins. The "first effects" are sometimes variable and remain arguable. Medical screening and monitoring whilst important and useful remains in need of further revision.

REFERENCES

1. ICNIRP, *Guideline for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300 GHz)*. Health Physics, 1998. **74**(April 1998): p. 4.
2. IEEE, *ICES Standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz*. 2005.
3. IEEE, *IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0-3 kHz*, in *Standard*. 2002, IEEE: New York, USA.