Whole body average SAR limits should be removed from RF safety standards

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This paper presents a case for removing basic restrictions on whole body average (WBA) specific absorption rate (SAR) from radiofrequency (RF) exposure standards and guidelines. WBA SAR basic restrictions have been the fundamental basis of RF safety standards and guidelines since they were first introduced in the ANSI C95.1 standard in 1982 [1] and are notionally intended to provide protection against systemic adverse whole body heating effects due to power absorbed in the body from an RF exposure. Derived limits for ambient electric (E) and magnetic (H) field exposures have been mainly formulated to ensure conformity with WBA SAR basic restrictions, and are widely used for determining RF safety compliance.

It seems likely that WBA SAR limits predominated in early RF safety standards due to the prevailing limitations in RF dosimetry techniques. In those days, the best available dosimetric data came from simple spheroidal models which provided reasonable estimates for WBA power absorption but no reliable estimates of *localised* RF absorption. Thus, WBA SAR provided the only feasible basis for specifying exposure limits for body heating and has remained entrenched in RF safety standards ever since.

However, despite their enduring and central place in setting the scene for RF safety exposure limits, there appears to be a distinct lack of credible documented medical reports for adverse *whole body* heating effects associated with RF exposure in the workplace. No citations are provided in the ICNIRP Guidelines [1] or IEEE standard [2] bibliographies which instead list animal studies of limited relevance to human physiology. This lack is particularly striking given the general awareness in the last 60 years of RF exposure as a potential occupational health and safety hazard in RF workplaces, especially in the last 15 years.

Certainly, there are very few realistic situations where adverse whole body RF heating effects could feasibly occur given the enormous RF power required. These scenarios are mainly limited to industrial uses of RF, and high powered broadcast and military sites, but *not* telecommunications sites which nonetheless command the overwhelming majority of RF safety compliance efforts. Moreover, the large thermal inertia of the whole body ensures that any rise in core temperature would be very gradual and hence provide ample sensory pre-warning and opportunity to avoid such uncommonly high RF exposures.

The peculiar approach for setting RF exposure *limits* for whole body heating stands in stark contrast to commonly accepted ways of controlling other whole body heating influences such as infrared exposures (e.g. fire), high ambient temperature, solar insolation, high humidity, high workload, clothing insulation, etc. Exposure limits are not generally specified for these other heating modalities even though they commonly induce much higher heat loads and are known to have caused serious injury. Rather, common sense measures that incorporate awareness and opportunity to avoid overheating (e.g. climate control, work breaks, appropriate clothing, fluid intake, etc) are widely accepted as more effective and practical ways of minimising the risk of harm from whole body heating. It makes good sense to adopt this approach for whole body RF heating also, and to simply include RF heating in an overall thermal stress management plan for all whole body heating sources using the well tried and established control measures developed for these other heating modes.

Lastly, the distracting focus on achieving conformity with WBA SAR basic restrictions has inadvertently made it more difficult to develop appropriate measures for controlling adverse effects due to *localised* RF heating,

for which there is much substantive evidence of the need for protection. E and H ambient field exposure limits which are formulated for protection against localised, rather than WBA SAR effects would likely look quite different to those that currently exist. In particular, such limits would be much better defined in terms of near field effects and spatial averaging considerations.

Thus, in conclusion, the removal of WBA SAR basic restrictions is strongly recommended.

References

[1] ANSI, "safety levels with respect to human exposure to radio frequency electromagnetic fields, 300 kHz to 100 GHz," American National Standards Institute, ANSI C95.1, 1st Sept 1982.

[2] ICNIRP, "Guidelines on limits of exposure to time-varying electric, magnetic and electromagnetic fields (1 Hz - 300 GHz)," *Health Physics*, vol. 74, pp. 494-522, 1998.

[3] IEEE SCC39, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," The Institute of Electrical and Electronics Engineers, International Committee on Electromagnetic Safety, New York, IEEE Std C95.1, 19th April 2005.