

SAR-based Exposure Ratio Compliance Assessment Constraints

Martin Batt⁽¹⁾, Danie Ludick⁽¹⁾⁽²⁾, and Matthew J Butcher⁽³⁾

(1) Alphawave Mobile Network Products (IXUS), Stellenbosch, South Africa,
mbatt@ixusapp.com, <https://ixusapp.com>

(2) Stellenbosch University, Stellenbosch, South Africa, dludick@sun.ac.za

(3) Sublight Engineering PLLC, Virginia, USA (matt@sublight.net)

The advances and deployment of new technologies in the mobile communication sector, such as 5G, require accurate electromagnetic field (EMF) exposure assessments. The derivation of compliance boundaries attributed to mobile base station antennas is becoming more challenging, as calculations near the radiating elements are required. Although guidance is provided by international regulations and guidelines, such as ICNIRP, Safety Code 6 and FCC OET 65, evaluating exposure ratios close to the antennas remains a challenge. Overly conservative assessment results can be generated by using calculations based on reference levels (i.e., derived from incident power density). In this work, a technique is presented to limit exposure ratio calculations (derived from the reference levels) using basic restrictions, as defined by the metric, specific whole-body average specific absorption rate (SAR). Rigorous full-wave simulations were performed using a phantom and appropriate antenna models, such as the example shown in Figure 1. These results were used to validate the *exposure ratio limit*, that can be calculated for a particular antenna frequency band, as follows:

$$ER_{\%} \leq \frac{SAR_{wb}}{SAR_{lim}} \times 100\%, \quad (1)$$

where SAR_{lim} is set equal to the whole-body average SAR restriction for the general public, 0.08 W kg^{-1} , as defined in the guidelines. SAR_{wb} is the worst-case whole body average SAR and is calculated as follows,

$$SAR_{wb} = \frac{P_{abs}}{m_{wb}}, \quad (2)$$

Here P_{abs} is the power absorbed by the phantom and is set equal to the transmit power associated with the antenna frequency band, and m_{wb} corresponds to the mass of the phantom's body (46 kg as per the phantom used in Figure 1).

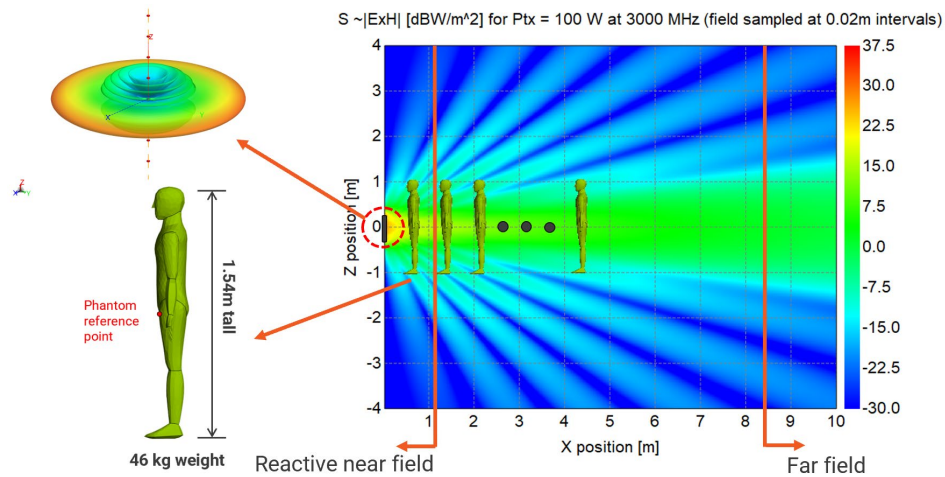


Figure 1. An example of a human phantom positioned at various distances from an omnidirectional antenna operating at 3 GHz. The dimension of the phantom is also shown, as well as the antenna.