

REQUEST FOR PROPOSAL

Study of the correlation between power density and temperature increase

1. Background

Spectrum is a scarce resource, and the interest for utilizing frequency bands above 6 GHz for future radio communication systems is very high. The possible use of higher frequency bands implies new challenges in terms of electromagnetic field (EMF) exposure assessments since the fundamental exposure metrics (basic restrictions) change from SAR to power density (PD).

The basic restrictions in power density, as provided by ICNIRP, FCC and IEEE for general public exposure, are presented in Table 1. ICNIRP [1] specifies basic restrictions in terms of power density starting from 10 GHz and the limit value is intended to be spatially averaged over an area of 20 cm²; in addition, the spatial maximum PD averaged over 1 cm² should not exceed 20 times the given limit. For frequencies above 6 GHz, FCC [2] specifies a spatial peak PD of 10 W/m² for the general public. In IEEE C95.1 ([3] and [4]) PD basic restrictions are specified starting from 3 GHz. These are intended to be spatially averaged values over an area of 100 squared wavelengths for frequencies below 30 GHz and over 100 cm² for frequencies above 30 GHz. The peak PD limit in IEEE C95.1 is $18.56f^{0.699}$ for frequencies between 3 GHz and 30 GHz (where f is the frequency in GHz). Above 30 GHz, the peak power density in IEEE C95.1 is 200 W/m².

Table 1 EMF power density basic restrictions as provided in [1], [2], and [3-4] for general public exposure.

ICNIRP	FCC	IEEE C 95.1 – 2005 + IEEE C 95.1 – 2010a	
$f \geq 10$ GHz	$f \geq 6$ GHz	$3 \text{ GHz} \leq f \leq 30 \text{ GHz}$	$f \geq 30 \text{ GHz}$
10 W/m ² (averaged over 20 cm ²)	10 W/m ² (spatial peak)	10 W/m ² (averaged over $100\lambda^2$)	10 W/m ² (averaged over 100 cm ²)
200 W/m ² (averaged over 1 cm ²)	–	$18.56f^{0.699}$ (spatial peak)	200 W/m ² (spatial peak)

The Mobile & Wireless Forum (formerly the Mobile Manufacturers Forum - MWF) has previously sponsored research in two areas:

1. Dosimetric understanding at frequencies above 6 GHz

The main objective of this work was to suggest possible improvements of the basic restrictions at frequencies above 6 GHz for whole-body and localized exposure in terms of power density limits and related averaging areas.

2. Compliance testing at frequencies above 6 GHz

The main objective was to define compliance assessment methods and procedures to demonstrate compliance of wireless equipment with the basic restrictions at frequencies above

6 GHz. The focus was on measurements for portable devices used in close proximity of the body.

The MWF sponsored a workshop at the 2016 BioEM Conference in Ghent in June and the complete set of presentations can be downloaded from <http://emfhealth.info/publications.cfm?cat=Presentation>

For frequencies between 10 MHz and 300 GHz existing guidelines are based on the prevention of adverse effects resulting from either partial-body or whole-body exposures that could bring temperature rises about a few degrees in humans. There has been a great deal of research performed at the existing cellular band frequencies but there is less research at frequencies above 6 GHz and as stated previously the interest for utilizing frequency bands above 6 GHz for future radio communication systems is very high.

2. Study of the correlation between PD and ΔT in a realistic human in-vivo model

Based on the MWF sponsored research, the effect of energy deposition due to the presence of reactive near-fields needs to be further investigated. The frequencies initially identified for 5G are above 24 GHz and as devices will be used close to the body, this RFP is specifically requesting research to address the following questions for frequencies above 24 GHz (such as 24 GHz, 28 GHz, 37 GHz, 60 GHz, 76 GHz and more):

- i. How does ΔT vary with incident PD? Effects of PD profile and varying dimensions of the exposed area shall be considered
- ii. Is free space PD a suitable metric to assess exposure from portable devices in a realistic human in-vivo model? Exposure scenarios both with and without presence of reactive-near field shall be considered.
- iii. Will compliance assessments based on power density alone result in negligible temperature increases in a realistic in-vivo model even in the presence of reactive near-fields from the antennas?
- iv. Is there a relationship between the averaging area for the free space PD and ΔT in the realistic in-vivo model?

3. Work products

The principal work product will be one or more reports summarizing the results of the investigation, and address the relationship between ΔT and power density in accordance with the research questions above. The report should provide a description of the experimental technique and a verification of the results. The most important findings should be published in one or more suitable peer-reviewed journals.

All work products from this project will be presented to the relevant MWF working group. The MWF may use the results of the research that it is commissioning to draft inputs to standards setting bodies, and the work products may be used in whole or in part for that purpose. The MWF may request the researchers to present the work products to one or more standards bodies, but until such time as this request is made by the MWF, no external dissemination or discussion of the results is to be undertaken without the explicit agreement of the MWF. The researchers are encouraged to publish their findings wherever possible. The MWF would

suggest that such publications are only submitted to a journal three months after the principal work products are provided to the MWF in order to allow the MWF sufficient time to review and to use the results for the above-mentioned purposes.

4. Time plan

A report is to be submitted within 6 months of the commencement of the project.

5. Budget

The MWF will make available a total budget of €40,000.

6. Proposal Response Format

The proposal must be submitted electronically and in the format outlined in Appendix A.

7. Method of Evaluation

The MWF will undertake an evaluation of proposals in accordance with the Evaluation Criteria outlined in Appendix B. The MWF reserves the right to determine, in its sole and absolute discretion, whether a response to this RFP satisfactorily meets the provided evaluation criteria.

The MWF may elect to fund more than one proposal.

The MWF and its members will treat all the proposals as confidential.

8. Contractual and IP Issues

Nothing in this RFP document shall be construed as an offer to enter into contract with any party, and the MWF will not pay for the information solicited or obtained during this process. The MWF may elect not to award a contract based on the responses received to this RFP.

The MWF Standard Terms and Conditions will apply to any contracts that result from this process, including coverage by the laws and courts of Belgium. A copy of the Standard Terms and Conditions can be obtained by email from: michael.milligan@mwfai.org

In consideration of the funding received as part of any contract awarded the MWF will have a joint right to any intellectual property rights generated in the course of the project.

The MWF reserves the right for one or more other associations to fund part/s of this research on the same or similar terms as the MWF. In the event that this is the case, successful proponents will be informed prior to the conclusion of a contract.

9. Additional Information Requests

The MWF reserves the right to request additional information from a proponent during any phase of the proposal evaluation process. During the evaluation and selection process, the MWF may require the presence of proponents to make presentations and answer specific questions. Notification of any such requirements will be given as necessary.

10. Instructions for Submission

All proposals must be received by 5pm Central European Time on the 24 March 2017 at the following email address: michael.milligan@mwfai.org

Please Note: The subject line of the email must include *Response to RFP: PD and Temperature Rise*

APPENDIX A: Format for Research Project Proposals

1. Executive Summary. An 'Executive Summary' comprising of:

- A. Proposed Project Title
- B. Name of the project leader
- C. Which work package/s are addressed
- D. Site(s) of research
- E. MWF funding period requested
- F. Amount of funding and the number of person-years
- G. Brief objective and description of the project and main deliverables
- H. Relevance for on-going international standardization work

2. Background. The background should be brief and provide necessary information to support proposed procedures only.

3. Specific objectives. Provide concise objectives in chronological order. Under each objective give a statement of the approach or methods to be used. If a specialized procedure has been previously published, attach publications containing the relevant materials and methods sections.

Example:

Specific objective 1

Approach or methods

Anticipated accomplishments

Specific objective 2

Approach or methods

Anticipated accomplishments

Et cetera

4. Work Products. The principal work product will be one or more papers published in a suitable peer-reviewed journal and contributions made to standardization working groups. In addition, progress reports and a final report are required in line with payment milestones.

Time sequence. Include a flow chart for the proposed work. This chart should include milestones as well as submission dates for quarterly reports, publications, and a final report.

Group qualifications. Discuss experience with numerical or experimental dosimetry, and/or any relevant fields of study. Describe the responsibilities of each individual staff member. Attach resumes of principal investigators. List up to ten most important publications supporting the proposal.

Facilities. If and as appropriate briefly demonstrate that you have the required facilities to accomplish the proposed work.

5. Funding. Include a separate document with a proposed budget denominated in Euros. Please supply a description of status and amount of current or planned applications for complementary funding from national or other sources. Participation by National bodies is desirable and demonstrates a broad interest as well as supports the independent nature of the research.

APPENDIX B: Criteria for Evaluation

The MWF will evaluate the scientific merit of each proposal according to the following specific criteria:

- responsiveness to the call for proposals
- appropriateness and adequacy of the proposed approach and methodology
- qualifications and research experience of the principal investigator and associates, particularly (but not exclusively) in the area of the proposed research
- availability of resources to conduct the research
- proposed budgeted cost and duration in relation to the proposed research

Please note: The MWF does not require proposals to include a general literature review and/or a general scientific background on topics relevant to RF standards due to the high level of technical and scientific competencies within the MWF. The proposals should be focused only on technical and administrative issues concerning the proposal.

If the need arises, proposals may be reviewed by an ad-hoc Scientific Review Committee (SRC) appointed by the MWF. In the event that this is deemed necessary, those asked to participate will be required to sign a confidentiality agreement with respect to the non-disclosure of information contained in the proposals reviewed.