GUIDANCE DOCUMENT

An Explanatory Question & Answer Guide to the ARPANSA Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields - 3 kHz to 300 GHz

AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY

ARPANSA

AN EXPLANATORY QUESTION & ANSWER GUIDE TO

THE ARPANSA RADIATION PROTECTION STANDARD FOR *MAXIMUM EXPOSURE LEVELS TO RADIOFREQUENCY FIELDS — 3 kHz TO 300 GHz*

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AUSTRALIAN RADIATION PROTECTION AND NUCLEAR SAFETY AGENCY

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The mission of ARPANSA is to provide the scientific expertise and infrastructure necessary to support the objective of the ARPANS Act -- to protect the health and safety of people, and to protect the environment, from the harmful effects of radiation.

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An Explanatory Question & Answer Guide to

The ARPANSA Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields — 3 KHz to 300 GHz

Introduction

On 7 May 2002, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) published a Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz (ARPANSA, 2002 - referred to in this document as the 'ARPANSA Standard' or 'the Standard'). The ARPANSA Standard sets limits for human exposure to radiofrequency (RF) fields in the frequency range 3 kHz to 300 GHz. Current mobile phone handsets operate in the lower to middle range of this spectrum. The Standard also includes requirements for protection of the general public and the management of risk in occupational exposure, together with additional information on measurement and assessment of compliance.

This guide is intended to provide basic information to interested persons who are not familiar with the technical subject area covered by the Standard or of its context within the Australian legal framework. It is anticipated that this guide will usually be read in conjunction with the ARPANSA Standard and therefore frequent references are made to specific sections or clauses of the Standard.

Two versions of this guide document are available. You are currently viewing the electronic hypertext version available from the ARPANSA web site at www.arpansa.gov.au. For persons who do not have access to appropriate computer facilities, a printed version may be obtained upon request. The relevant printable file may also be obtained directly at the following link www.arpansa.gov.au/pubs/rps/rfqatxt.pdf. However, due to the limitations of print, the printed version is not as easy to navigate as this electronic document (refer How to navigate this document).

For your convenience, the questions and answers in this guide have been arranged under the following category headings. Simply click on your subject of interest.

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Q1. What does the ARPANSA Standard contain?

A1. The Standard contains mandatory limits of human exposure to radiofrequency (RF) fields in the frequency range 3 kHz to 300 GHz. These must be applied in association with specified risk management practices.

The basic restrictions are fundamental limits designed to ensure that known adverse health effects do not arise from exposure to RF fields. At the different frequency ranges relevant to these adverse physical effects, these basic restrictions are designed to prevent:

(i) Electrical stimulation of excitable tissues such as nerves and muscles (3 kHz - 100 kHz);
(ii) adverse effects arising from localised and/or whole body heating (100 kHz - 6 GHz);
(iii) excess heating of skin or cornea (6 GHz - 300 GHz);
(iv) nuisance auditory effects (300 MHz - 6 GHz); and
(v) adverse effects associated with extremely high pulsed fields (3 kHz - 300 GHz).

Because the basic restrictions are fundamental quantities derived from effects on the body, they are not readily measurable. Therefore the Standard also provides indicative reference levels which are more measurable quantities.

The Standard also includes:

- approaches to verification of compliance with the Standard (Section 4);
- requirements for management of risk in occupational exposure and measures for protection of the general public (Section 5);
- a comprehensive rationale, ie. statement of the underlying reasoning employed in the development of the Standard (Schedule 1) ;
- the contact details of relevant regulatory and radiation protection authorities (Annex 9);
- a review of epidemiological (human health) studies (Annex 3); and
- a review of bio-effects research at low levels of exposure (Annex 4).

For additional details, refer to the specific questions on the Application & interpretation of the Standard that deal with these matters.

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Q2. What are basic restrictions?

A2. 'Basic restrictions' are mandatory fundamental limits of exposure to RF fields. These are specified in Section 2 of the ARPANSA Standard. There are a number of basic restrictions defined in terms of different quantities. All of these basic restrictions must be satisfied simultaneously.

For most RF applications, the basic restrictions are defined by quantities that are internal to the body. A direct assessment of compliance with the basic restrictions may therefore be difficult.

Specific absorption rate (SAR) is related to the rise in temperature caused by absorption of RF fields in body tissue. SAR is a key indicator of potential adverse health effects for radiofrequencies above about 100 kHz, and a number of basic restrictions are defined by, or closely related to, SAR. In fact, there are five different basic restrictions that are defined by, or closely related to, SAR. Basic restrictions address the SAR average for the whole body [ie. whole body average SAR (WBA SAR)]. There are also basic restrictions to provide protection against non-uniform energy absorption and localised exposure to particular body parts. Such basic restrictions to protect against localised effects are identified by the term "spatial peak".

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Q3. What are reference levels?

A3. Because direct assessment against the basic restrictions can be difficult, time consuming and costly, reference levels are specified to provide a simpler way of demonstrating that the basic restrictions are not exceeded.

Reference levels are defined by quantities that are relatively easy to measure directly and in general there is commercial equipment available to make such measurements. The reference levels are specified in Section 2 of the ARPANSA Standard.

The reference levels for electric (E) or magnetic (H) field strength are based on the assumption of a "worst case" exposure. The human body, in a radiofrequency electromagnetic field, acts like an antenna and the amount of energy absorbed at a particular frequency depends on the size and shape of the body and its orientation with respect to the specific electric and magnetic field components. The assumptions for the reference levels are:

(a) for a particular frequency, the exposed human is of a size and shape (consistent with size and geometry ranging from babies up to large adults) that produces the maximum absorption of RF energy; and

(b) the orientation and direction of the applied radiofrequency fields is such as to produce maximum absorption of energy in the body.

In general, such "worst case" exposure conditions are rare and exposure at the maximum allowable E and H field levels will usually result in RF absorption levels that are well below the corresponding basic restrictions. Hence exposure to a maximum level consistent with the E or H reference levels will usually include significant additional safety margins above those already incorporated in the basic restrictions.

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⇩**Purpose and regulatory aspects**

Purpose and regulatory aspects ⇧ **Return to subjects**

Q4. What is the purpose of the ARPANSA Standard?

A4. The ARPANSA Standard specifies limits of human exposure to radiofrequency (RF) fields in the frequency range from 3 kHz up to 300 GHz, to prevent adverse health effects. Because the allowable limits of exposure have been formulated so conservatively, the use of RF for medical therapies is not included within the scope of the standard. The ARPANSA Standard also does not deal with other potential hazards of RF fields such as the ignition of explosives or flammable gases, or interference to electronic equipment.

The Standard is available to be adopted into regulations by Commonwealth, State and Territory authorities responsible for regulation of communications and other applications of RF fields. This would enable RF emitting equipment and devices throughout Australia and the associated work practices and public protection arrangements to be controlled in a uniform manner.

ARPANSA has the role of promoting uniformity of radiation safety regulatory practices between jurisdictions, and in that role, ARPANSA is coordinating the development of the National Directory for Radiation Protection (NDRP) through the Radiation Health Committee. In 1999, the Australian Health Ministers' Conference agreed that Codes and Standards adopted in the Directory would be implemented as soon as possible within each jurisdiction's regulatory framework. ARPANSA will be proposing that the Standard be adopted in the National Directory.

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Q5. How will this Standard be enforced?

A5. The CEO of ARPANSA recommends that all relevant Australian authorities and regulatory bodies adopt the ARPANSA Standard through their legal processes. This will usually involve appropriate laws to be enacted and/or regulations amended by relevant Federal, State or Territory Governments. Therefore, where a regulatory body has adopted the ARPANSA Standard, it will be enforced according to applicable regulations and conditions of licence etc. within the relevant jurisdiction. Requirements for proof of compliance will be determined by each jurisdiction.

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Q6. What specific areas of the Standard should I pay particular attention to?

A6. Sections 1 through 5 constitute the main body of the Standard. All of these Sections are mandatory and will be legally required if the ARPANSA Standard is adopted within a relevant Commonwealth/State/Territory jurisdiction.

For additional detail, see the answer to the question: How can I determine compliance with the exposure limits of the ARPANSA Standard?

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Q7. How can I determine compliance with the exposure limits of the ARPANSA Standard?

A7. In order to comply with the ARPANSA Standard it must be established that the relevant basic restrictions are not exceeded. This may be achieved by showing compliance with the reference levels. For electric field (E) and magnetic field (H) reference levels, an appropriate method for spatial averaging is specified in Clause 2.7 of the ARPANSA Standard. Section 4 of the ARPANSA Standard outlines the mandatory requirements for verification of compliance with the basic restrictions and reference levels.

In particular, measurements or evaluations to prove compliance with the Standard must be made by appropriately qualified and experienced persons or authorities.

In addition to meeting the relevant limits for occupational exposure, all of the relevant risk management procedures and other requirements of Section 5 must also be met. In particular, RF workers must be trained in safe work practices, and supervised when appropriate. They must also be trained about the controls in place to manage the potential RF hazard. There must be appropriate procedures in place to ensure that safe systems of work are utilised.

It should be noted that regulatory bodies may have varying criteria to assess compliance. In particular, there may be differences in the requirements for surveys or tests and also in the nature of documentation required for evidentiary proof of compliance. For specific information you should contact your relevant regulatory or advisory authority as listed in Annex 8 of the ARPANSA Standard.

For additional detail, refer to questions under the heading: Application & Interpretation of the Standard.

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I am exposed in a workplace

Q8. What should my employer be doing to ensure that I am protected?

A8. Your employer should evaluate the potential exposure levels from plant and equipment. For workers who could be exposed above the occupational exposure limits, your employer must implement an appropriate risk management strategy as indicated in Section 5 of the ARPANSA Standard.

If you are likely to be exposed at levels above the limits specified for members of the general public, then you must be trained in safe work practices, and provided with appropriate supervision. You must also be trained in the methods to manage the potential radiofrequency hazard.

Note that occupationally exposed women who are pregnant should advise their employers when they become aware of their pregnancy. For further information on this issue, see the answer to the question: What are the considerations/requirements for pregnant workers?

For additional detail, see the answer to the questions: How can I determine compliance with the exposure limits of the ARPANSA Standard? & Is use of a mobile phone for work purposes classified as occupational exposure?

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⇩ Next question - I am a member of the general public

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Q9. Does the Standard require a precautionary approach for public exposure?

A9. Yes - the exposure limits in the ARPANSA Standard include significant safety margins below exposures known to cause adverse effects. The general public exposure limits include additional safety margins over and above those incorporated into the occupational limits.

There is also a mandatory requirement [sub-clause 5.7 (e) of the Standard] for:

> *Minimising, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided this can be readily achieved at reasonable expense. Any such precautionary measures should follow good engineering practice and relevant codes of practice. The incorporation of arbitrary additional safety factors beyond the exposure limits of this Standard is not supported.*

Conditions for demonstrating compliance with the requirements of the ARPANSA Standard, including this mandatory precautionary requirement, will be established by the relevant regulatory body and/or through agreed protocols and codes of practice (eg. ACIF Code C564:2002). The philosophy and application of various precautionary approaches is discussed in Annex 6 of the Standard.

For further specific information on mandatory control measures, see the answer to the question: What are the requirements for general public exposure?

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⇩Application & interpretation of the Standard

Application & Interpretation of the Standard ⇧ **Return to subjects**

Q10. Aside from specific limits of exposure, does the ARPANSA Standard include mandatory practices to ensure a safe environment?

A10. Yes, Section 5 of the ARPANSA Standard is mandatory and it specifies particular practices required to ensure protection in both occupational and general public exposure situations. Occupational exposure is only permitted under controlled conditions where a thorough risk analysis must be performed, and an appropriate risk management regimen implemented, prior to the exposure occurring. More stringent conditions (ie. lower limits of exposure and mandatory elements of precaution) are applied to the exposure of members of the general public.

In relation to occupational exposure, the following subject areas are covered: workplace policy, risk management process, control prioritization, training and supervision, medical assessment, notification of competent authorities, assessment of reference levels, pregnancy, allowable exposures in controlled areas, records, post incident exposure management and provision of information to employees.

For mandatory requirements relating to general public exposure, see the answer to the question: What are the requirements for general public exposure?

Additionally, Section 4 of the Standard deals with verification of compliance with the basic restrictions and includes mandatory requirements for site evaluation, type testing of RF sources and record keeping.

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Q11. How can I assess multiple exposures that involve multiple RF frequencies?

A11. In circumstances where there is simultaneous exposure to multiple frequencies, Section 3 of the Standard provides a methodology for assessing compliance with the basic restrictions and/or reference levels.

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Q12. Non-uniform RF fields can produce significantly different exposure to various body parts, so how do I assess compliance with the limits?

A12. Generally, if an exposure is produced by equipment where radiating antennae (or the parts of the equipment that produce the RF field) are located close to the surface of the body such that exposure occurs in the near-field region, then such exposure will need to be thoroughly assessed. Where practical, the basic restrictions should be used for assessment (eg. mobile phone), however reference levels may be used in some circumstance (eg. dielectric heaters). However, in the RF frequency range between 100 kHz to 2.5 GHz, the compliance of low power mobile or portable transmitting equipment may be assessed against the relevant criteria specified in Schedule 5 of the ARPANSA Standard.

Where the source of the RF fields is not close the body, time averaged E and H field measurements may be compared with the relevant reference levels of Table 7. In general, such time averaged E and H field measurements can be spatially averaged. The implementation of an appropriate spatial averaging scheme is not a simple matter to determine. There are many technical issues that should be considered including: nature of the source (primary or scattered fields), proximity to the sources, dimensions of exposed body parts relative to the wavelength, and the number of sampling points.

However, Clause 2.7 provides an appropriate methodology for the spatial averaging of RF fields for comparison with the time averaged E and H reference levels.

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Q13. How do I determine if a device complies with the limits?

A13. Generally, such assessment is complex and needs to be carried out by qualified persons with relevant expertise and appropriate measurement resources.

However, in the RF frequency range between 100 kHz to 2.5 GHz, the compliance of low power mobile or portable transmitting equipment may be assessed against the relevant criteria as specified in Schedule 5 of the ARPANSA Standard.

All mobile or portable transmitting equipment used for communications purposes in Australia require mandatory assessment/testing and licence approval from the Australian Communications Authority (ACA) [refer www.aca.gov.au/standards/emr/index.htm].

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Q14. What are the requirements for general public exposure?

A14. Relevant control measures for public exposure are specified in Section 5.7 of the ARPANSA Standard. The text of this clause reads as follows:

> Measures for the protection of members of the general public who may be exposed to RF fields due to their proximity to antennas or other RF sources must include the following:
>
> (a) Determination of the boundaries of areas where general public exposure limits levels may be exceeded.
>
> (b) Restriction of public access from these areas where the general public exposure limits may be exceeded.
>
> (c) Appropriate provision of signs or notices complying with AS 1319 (Standards Australia 1994).
>
> (d) Notification to the competent authority, as required, in the event of the exposure exceeding the relevant limits.
>
> (e) Minimising, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided this can be readily achieved at reasonable expense. Any such precautionary measures should follow good engineering practice and relevant codes of practice. The incorporation of arbitrary additional safety factors beyond the exposure limits of this Standard is not supported.

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Q15. What are the requirements for occupational exposure?

A15. Under circumstances where all of the risk management and general protection occupational requirements of Section 5 are met, the occupational exposure limits of Section 2 of the ARPANSA Standard are applicable.

For occupational exposure, the following people must ensure that the hazards associated with exposure to RF fields are managed by a risk management process: employers; owners and operators of RF generating equipment; people in control of workplaces; designers, manufacturers and suppliers of RF generating equipment; self-employed persons. The risk management process must include, in order of priority:

(a) Identification of the hazards. This step should include identification of the primary RF source/s and also sources of re-radiation, where currents are induced on conductive objects, and are potential sources of shock and burns;

(b) Assessment of the risk. This step includes assessment of exposure levels, comparison to the relevant limits and consideration of both the likelihood and severity of the consequence/s of the hazard;

(c) Choice of the most appropriate control measures to prevent or minimise the level of risk. The control/s chosen must not cause other hazards;

(d) Implementation of the chosen control measures. This step must include maintenance requirements to ensure the ongoing effectiveness of the control/s and training on the control measures for workers potentially exposed to RF fields;

(e) Monitoring and reviewing the effectiveness of the control measures. The monitoring and review process must assess whether the chosen controls have been implemented as planned, that the control measures are effective and that the control measures have not introduced new hazards or worsened existing hazards.

Further occupational requirements are specified in Section 5 of the Standard.

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Q16. What are the considerations/requirements for a pregnant worker?

A16. The exposure of a pregnant RF worker is a special case. At the level of the occupational exposure limits, there is no scientific evidence that the foetus is at more risk from RF field exposure than the mother, but the data is limited. However, there is evidence that exposure to field strengths substantially above the occupational exposure limits may cause harm to the foetus. Because the pregnant woman has her physiological systems for heat regulation already under stress, it is considered that the limits for occupational exposure may not provide a sufficient safety factor. Limiting the exposure of a pregnant woman to general public limits will therefore provide an additional safety margin so as to minimise any risk from accidental exposure where the foetus could be exposed to high field strengths.

Therefore, in order to reduce the risk of accidental exposure above occupational limits a pregnant woman should not be exposed to levels of RF fields above the limits of general public exposure. Occupationally exposed women who are pregnant should advise their employers when they become aware of their pregnancy. After such notification, they must not be exposed to RF fields exceeding the general public limits. Pregnancy should lead to implementation of relevant personnel policies. These include, but are not limited to, reasonable accommodation/adjustment or temporary transfer to non-RF work without loss of employment benefits. Additional guidance may be found in the Pregnancy Guidelines produced by the Human Rights & Equal Opportunity Commission (HREOC, 2001) at www.hreoc.gov.au/sex_discrimination/index.html.

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Q17. What limits apply to casual workers, visitors or others who need to transit areas where RF field levels may exceed the general public limits?

A17. Assuming that such persons are classified as members of the general public (also see Glossary definition for RF worker), if they are within a controlled area then they may be exposed to levels within the occupational limits specified in Section 2 of the ARPANSA Standard. Otherwise, where such persons are outside a controlled area, the limits for general public exposure apply.

Refer Glossary definitions for: Controlled Area; General public exposure; Occupational exposure.

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Q18. What persons are permitted to use high power communications transmitters if there is a potential to exceed the exposure limits for the general public?

A18. The ARPANSA Standard, defines two distinct groups of persons who may use such equipment. These categories are:

1. RF workers; and
2. Aware users.

The occupational exposure limits of Section 2 of the ARPANSA Standard apply to both groups.

For additional details refer to Glossary definitions of 'RF worker' and 'Aware user'.

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Q19. Within the Standard, how can I distinguish a mandatory requirement from a recommended practice?

A19. In interpreting the provisions of the ARPANSA Standard, the words 'must' and 'should' have particular meanings. The presence of the word 'must' indicates that the requirement to which it refers is mandatory. The presence of the word 'should' indicates a recommendation - that is, a requirement that is to be applied as far as is practicable in the interests of reducing risk.

All Annexes contain material that is presented for information only, hence, Annexes are non-mandatory.

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Q20. Is use of a mobile phone for work purposes classified as occupational exposure?

A20. No. The use of a mobile phone or similar personal communications device is not regarded as being intrinsic to the nature of the work. Nor would such persons normally fall within the aware user category (refer to Glossary definitions: RF Worker and Aware user). Persons using mobile phones fall within the definition of general public exposure and the regulations of the Australian Communications Authority (ACA) require mandatory compliance with ACA's public exposure standard (refer www.aca.gov.au/standards/emr/index.htm).

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⇩ **Scientific basis of the exposure limits**

Scientific basis of the exposure limits ⇧ **Return to subjects**

Q21. How were the exposure limits derived?

A21. The 1998 Guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz) are the basis for the exposure limits.

In bringing forward its Guidelines, the ICNIRP carefully examined the full range of relevant scientific literature up to 1997. Its work was published in a scientific journal (Health Physics, vol. 74, no. 4, pp. 494-522) after extensive international scientific review.

In establishing the ARPANSA Standard, the approach used by the Institute of Electrical and Electronics Engineers (IEEE, 1999) was also examined – it differs only in some details from ICNIRP – but the ICNIRP Guidelines were seen as more complete and soundly based.

Relevant scientific literature was especially sought and examined with a view to finding evidence that the ICNIRP 1998 exposure Guidelines might need revision on grounds that exposure to levels within the limits could lead to adverse health effects.

Data for effects of RF exposure on living organisms was evaluated by considering the evidence of health effects in humans, and the biological effects in humans and other organisms, as well as effects at a cellular level. In establishing the exposure limits, the need to reconcile a number of differing expert opinions was recognised. The validity of scientific reports was evaluated by considering elements such as; the strength of evidence, reproducibility of effect, existence of an established relationship between occurrence of an effect and the magnitude of exposure (ie. dose response), whether the effect follows an understood mechanism, and the extent of peer review prior to publication. In many cases, all relevant elements could not be assessed.

In particular, relevant scientific reviews (notably those of ICNIRP, 1996; Royal Society of Canada, 1999; and the Independent Expert Group on Mobile Phones [IEGMP], 2000) and reports on various case studies were assessed. This assessment focused on the recent literature reports subsequent to the development of the ICNIRP Guidelines (ie. post 1997) and included consultation with researchers who were asked specific questions within their area of expertise.

In addition to reviews conducted by expert groups or panels, a large body of literature published in peer reviewed journals was relied on. Recent epidemiological studies and laboratory research reports were carefully examined for evidence that would establish a need to modify the basic restrictions or the associated reference levels. In particular, the epidemiological evidence does not support an argument for any particular changes in currently accepted exposure standards (for further information refer Annex 3 of the ARPANSA Standard).

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... continuation of answer A21. on the question: Q21. How were the exposure limits derived?

Having determined the basic restrictions, ICNIRP have applied data from relevant mathematical models to obtain the reference levels. For additional information on "worst case" exposure assumptions used in deriving these reference levels, refer to the answer to the question: What are reference levels?

Relevant spatial and temporal measurement averaging parameters have been reviewed and, where necessary, revised so as to provide an adequate and unambiguous specification of the limits. For further information, refer to the answer to the question: Are there differences between the ARPANSA Standard and the ICNIRP 1998 Guidelines?

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Q22. What is the scientific basis of the exposure limits?

A22. The exposure limits are based on a large body of scientific research data. In brief, they are designed to protect against all adverse effects and to prevent unwanted nuisance effects that may arise through the following mechanisms:

(a) Electrical stimulation of excitable tissues such as nerves and muscles;

(b) Whole body heat stress resulting from the bulk absorption of radiofrequency electromagnetic energy;

(c) Localised heating produced by non-uniform localised absorption of radiofrequency electromagnetic energy; and

(d) Auditory responses associated with short pulses from high power sources (such as ultra-high power military radar systems).

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Q23. What about the possibility of adverse health effects at levels below the limits of the ARPANSA Standard?

A23. Significant safety factors are incorporated into the exposure limits – that is, the limits are set well below the level at which adverse health effects are known to occur. Current data does not establish the existence of adverse health effects for exposure levels below the limits of the ARPANSA Standard. However, if the extensive continuing worldwide research program does uncover any such adverse effects, ARPANSA will certainly review the limits in the ARPANSA Standard.

Additional relevant information can be found in answer to the questions: Will ARPANSA change the exposure limits if future research shows that they need to be modified? and In developing the ARPANSA Standard, were the most recent research reports taken into account and, if so, what conclusions were drawn from such data?

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Scientific basis of the exposure limits ⇧ **Return to subjects**

Q24. Were the limits of the ARPANSA Standard modified to accommodate new technologies such as 3G mobile phones?

A24. No, the ARPANSA Standard was not developed to accommodate any particular technologies or products.

The limits of the ARPANSA Standard are based on the internationally accepted ICNIRP 1998 Guidelines. In this context, ICNIRP does not allow industry representation on its committees. Furthermore, the ICNIRP limits were developed several years before the relevant technical details of such new technologies were known.

For specific detail on the basis and derivation of the ARPANSA Standard, see the answer to the question: How were the exposure limits derived?

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⇩ **Current and future research**

Current and future research ⇧ **Return to subjects**

Q25. In developing the ARPANSA Standard, were the most recent research reports taken into account and, if so, what conclusions were drawn from such data?

A25. A review of the relevant scientific literature on the biological effects of 'low-level' radiofrequency exposure (ie. levels below the limits of the Standard) was undertaken. The particular focus of the review for the ARPANSA Standard was to determine if there were any studies undertaken since the publication of the ICNIRP 1998 Guidelines that might indicate a need to modify the limits.

In addition to earlier studies, around 80 studies relevant to the question of low-level interactions were identified in published peer-reviewed journals after the ICNIRP cut-off date (1997) and these papers were considered in detail. The finding was that exposures leading to SAR values below the basic restrictions do not lead to unambiguous biological effects indicative of adverse physiological or psychological function or to increased susceptibility to disease. Whilst these low-level effects have not been established, they cannot be ruled out and so more research is needed. See Annex 4 of the ARPANSA Standard for complete information and conclusions.

Furthermore, relevant epidemiological studies were also reviewed. The epidemiological methods and the relevant studies are discussed in Annex 3 of the ARPANSA Standard. In relation to this epidemiological data, it was concluded that: "*The epidemiological evidence does not give clear or consistent results which indicate a causal role of low intensity radiofrequency exposures in connection with any human disease. On the other hand, the results cannot establish the absence of any hazard, other than to indicate that for some situations any undetected health effects must be small*". See Annex 3 of the ARPANSA Standard for complete information and conclusions.

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Q26. Are there any specific research programs to investigate possible health effects of exposure to RF fields?

A26. Yes. Since 1996, the Commonwealth Government has provided significant funding for a research and public information program into electromagnetic energy and its effects. The National Health and Medical Research Council (NHMRC, refer www.health.gov.au/nhmrc) oversees the research component of this program. This ensures that funded research in this area is of the highest scientific standard, and that it complements studies being undertaken overseas.

The Australian research coordinated by the NHMRC is part of a worldwide research effort facilitated by the World Health Organization (WHO) into possible health risks of exposure to electromagnetic fields (EMF). The WHO Research Coordination Committee is monitoring studies in electromagnetic field exposure in a range of possible health areas (with particular emphasis on mobile phone exposure).

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Current and future research ⇧ **Return to subjects**

... continuation of answer A26. on the question: Are there any specific research programs to investigate possible health effects of exposure to RF fields?

The WHO International EMF Project commenced in 1996 and the final World Health Organisation assessment report is expected before 2005. The project has been designed in a logical progression of activities and outputs to allow improved health risk assessments, and any environmental impacts of EMF exposure to be made.

Since the establishment of the EMF project by WHO, a literature review has been carried out and an agenda formulated for research needed to permit risk assessments for both cancer and health to be carried out during the first decade of the new millennium. Information about the EMF project, publications arising from it, its activities, minutes of meetings and other details are available on the WHO web site at: www.who.int/peh-emf.

Additional information on specific Australian research projects may be found at: www.health.gov.au/nhmrc/media/99releas/mobile.htm and www.health.gov.au/mediarel/yr2001/mw/mw01012.htm.

⇖ **Return to questions**

Q27. Will ARPANSA change the exposure limits if future research shows that they need to be modified?

A27. ARPANSA is required to protect the health and safety of people, and the environment, from the harmful effects of radiation. ARPANSA will continue to review relevant scientific literature and associated information. Should evidence arise to indicate that the exposure limits do not provide adequate protection, then the ARPANSA Standard will certainly be revised.

⇖ **Return to questions**

⇩ **Comparison between the ARPANSA Standard and other Standards or Guidelines**

Comparison between the ARPANSA Standard and other Standards or Guidelines

⇧ **Return to subjects**

Q28. Why does the new ARPANSA Standard differ from the previous Australian Standard?

A28. Standards development is an evolutionary process and the content of Standards usually reflects both the knowledge and the technological resources available at the time of writing. In particular, as a result of new technologies and greater availability of relevant resources, it is now possible to place more emphasis on the basic restrictions that provide a more precise means of quantifying exposure. Consequently, the new ARPANSA Standard provides an unambiguous distinction between the basic restrictions and the reference levels and clearly establishes their relationship and mandatory application. The previous Australian Standard [AS/NZS 2772.1(Int):1998] placed more reliance on reference levels and did not provide such details.

In some circumstances (such as during near-field exposure to localised sources), it was difficult to obtain a clear technical interpretation of the limits defined by the previous Standard. The ARPANSA Standard gives precise, technically robust and comprehensive limits and it provides clear definition of relevant averaging times for measurement of rms instantaneous peak limits (the previous Standard did not do this).

Through stipulation of additional limiting quantities, the ARPANSA Standard provides significantly improved protection against nuisance auditory effects and other adverse effects that may arise from very high power pulsed or modulated radiofrequency sources.

Additionally, the ARPANSA Standard contains a large amount of explanatory material and supplementary information. For example, in page size alone, the ARPANSA Standard is approximately four times larger than the previous Australian Standard [AS/NZS 2772.1(Int):1998)]. A brief listing of content material is given in answer to the question: What does the ARPANSA Standard contain?

⇖ **Return to questions**

⇩ **Next question**

Comparison between the ARPANSA Standard and other Standards or Guidelines

⇧ **Return to subjects**

Q29. What are the specific differences between the ARPANSA Standard and the previous Australian Standard?

A29. Specific differences are indicated in Table 13 of the Schedule 1 rationale of the ARPANSA Standard. Table 13 is reproduced (with hyperlink enhancements) on the following page. The most notable differences lie in the specification of spatial peak SAR, the time averaged and instantaneous rms electric (E) and magnetic (H) field reference levels and there are additional basic restrictions in the ARPANSA Standard to ensure protection against pulsed or modulated fields.

In respect of the basic restrictions for spatial peak SAR, the previous Australian Standard [AS/NZS 2772.1(Int): 1998] specified measurement averaging over a 1 gram mass of tissue (except for limbs where 10 gram was specified), while the ARPANSA Standard specifies a 10 gram mass for all spatial peak SAR measurements. For spatial peak SAR in the head and trunk, there is also a 25% increase in the magnitude of the limits. In terms of adverse localised heating effects against which the spatial peak SAR limits are designed to protect, adequate safety margins are maintained and such differences are not substantial.

In respect of the time averaged rms electric field (E) and magnetic field (H) reference levels, the previous Australian Standard maintained constant limits for all frequencies above 10 MHz and a measurement averaging time of 6 minutes was applicable. The corresponding reference levels in the ARPANSA Standard remain constant from 10 MHz up to 400 MHz and then gradually increase up to a factor of five at a frequency of 2 GHz after which they remain constant. Additionally, the ARPANSA Standard specifies a measurement averaging time of 6 minutes for frequencies up to 10 GHz, and then decreasing down to 10.2 seconds at 300 GHz. This formulation is consistent with established dosimetry data (eg. see Durney, C.H., Massoudi, H. & Iskander, M.F. 1986) and it also serves to fully protect against any rapid heating that may occur during exposure to high-level transient fields.

Furthermore the ARPANSA Standard contains an improved and robust methodology for the spatial averaging of reference levels. Table 13 outlines other significant differences/improvements in the formulation of the limits.

Also refer to the answer to the question: Why does the new ARPANSA Standard differ from the previous Australian Standard?

⇖ **Return to questions**

⇩ **Table 13**

⇩ **Next question**

TABLE 13 SUMMARY OF DIFFERENCES BETWEEN THE PREVIOUS AUSTRALIAN STANDARD AND THE REQUIREMENTS OF THIS STANDARD

Item	AS/NZS 2772.1(Int):1998	This Standard
Basic restrictions on WBA SAR	Occupational 0.4 W/kg General public 0.08 W/kg	Identical to AS/NZS 2772.1(Int):1998
Basic restriction for instantaneous spatial peak rms current density in the head and torso (3 kHz-10 MHz)	Not Specified	Specified in Table 5
Basic restriction for instantaneous spatial peak SAR in the head and torso	Not specified	Specified in Table 4
Spatial peak SAR	Excludes hands, wrists, feet & ankles Occupational 8 W/kg General public 1.6 W/kg	Head and torso - 10 W/kg occupational General public 2 W/kg Limbs - 20 W/kg occupational General public 4 W/kg
Averaging mass for spatial peak SAR measurements	1 gram, otherwise 10 grams for hands, wrists, feet & ankles	10 grams for all parts of the body (also applies to SA)
Spatial peak SA in the head	Not specified	Specified in Table 3
Spatial peak SAR in the limbs	Restricted to hands, wrists, feet and ankles	Applies to any part of a limb
Frequency range of SAR basic restrictions	3 kHz to 300 GHz (did not reflect full detail of contemporary knowledge)	100 kHz to 6 GHz (basic restrictions are defined by different quantities at other frequencies)
Reference levels for rms contact currents	For occupational exposure: 1.0 x f mA (3 kHz-100 kHz) where f is in kHz. 100 mA (100 kHz-30 MHz) Public exposure levels are not defined	For occupational exposure: 0.4 x f mA (3 kHz-100 kHz) where f is in kHz 40 mA (100 kHz-110 MHz) General public exposure levels are exactly ½ the occupational levels above
Reference levels for rms induced limb currents	As indicated for rms contact currents above	Occupational exposure: 100 mA (10 MHz-110 MHz) General public exposure: 45 mA (10 MHz-110 MHz)
Averaging time for rms contact currents	1 s	1 µs up to 100 µs or 1 pulse cycle (refer note 2 of Table 9)
Time averaged rms E and H & Seq reference levels	Constant E and H levels above 400 MHz	Similar E and H levels between 3 kHz and 400 MHz. Levels increase above 400 MHz. At frequencies above 2 GHz the levels remain constant at 5 times above the 400 MHz level (refer Table 7 and figures 1 and 2). This is, consistent with established dosimetry models and the majority of international standards.
Instantaneous rms E & H reference levels	E field limit only. 1940 V/m for both occupational and general public exposure	Specifies both E and H levels. Lower levels for general public exposure. Conservative formulation matches known biological effects and RF field coupling with the body (refer Table 8 and figures 1 and 2).
Averaging time for instantaneous reference levels	Not specified	Specified in note 3 of Table 8
Method for spatial averaging of reference levels	Incomplete specification	Rigorous methodology (see Clause 2.7)
Method for evaluation of multiple frequency exposures	Outlined only for E^2, H^2 and Seq	Improved specification in Section 3

NOTE: Further information relating to changes in time averaged rms reference levels are provided in Schedule 1 of the ARPANSA Standard under the heading 'Measurement Averaging Considerations'.

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Comparison between the ARPANSA Standard and other Standards or Guidelines

⇧ **Return to subjects**

Q30. Are there differences between the ARPANSA Standard and the ICNIRP 1998 Guidelines?

A30. Yes, there are some differences, despite the fact that the ARPANSA Standard is based on the Guidelines developed by ICNIRP (ICNIRP, 1998). In establishing the ARPANSA Standard, ARPANSA has followed the original intent of the ICNIRP Guidelines. However, the ICNIRP Guidelines do not constitute a technical Standard and in some circumstances, their application may be unclear. Further, it is necessary that various Australian regulatory bodies are able to readily interpret and implement the Standard. Consequently, the ICNIRP specifications have been reworked in order to provide a sturdy and unambiguous technical framework. It was, however, not considered appropriate to substantially modify ICNIRP specifications unless there was a reasonable scientific justification for doing so.

⇖ **Return to questions**

Q31. What are the specific differences between the ARPANSA Standard and the ICNIRP 1998 Guidelines?

A31. The most notable differences between the ICNIRP 1998 Guidelines are indicated as follows:

The ICNIRP 1998 Guidelines are health exposure ‘guidelines’ - not a ‘technical Standard’, eg. refer www.icnirp.de/Documents/Use.htm. As such, the ICNIRP Guidelines lack rigorous technical definitions and cannot be easily and unambiguously applied by relevant regulatory authorities. The ARPANSA Standard includes all relevant technical definitions and the content is clear and unequivocal. In addition to the exposure limits, the ARPANSA Standard also includes mandatory requirements on verification of compliance with the Standard (Section 4), measures for protection of the general public and management of risk in occupational exposure (Section 5).

A list of specific technical differences between the ICNIRP Guidelines and the limits of the ARPANSA Standard is indicated in Table 12 in Schedule 1 of the ARPANSA Standard.

⇖ **Return to questions**

⇩ **Next question**

Comparison between the ARPANSA Standard and other Standards or Guidelines

⇧ Return to subjects

Q32. Will the new limits change exposure levels from mobile telephones and their associated base stations?

A32. **Exposure from mobile phones**

If the ARPANSA Standard is adopted by the Australian Communications Authority (ACA), it would be possible for mobile phones to be marketed in Australia with a spatial peak SAR of 2 W/kg averaged over 10 gram of tissue, instead of the present limit of 1.6 W/kg averaged over 1 gram. The difference between these two values is not material in terms of localised heating in brain tissue. Both limits include a significant safety factor with the maximum temperature rise in brain tissue for the ARPANSA Standard level being 0.1°C.

It should be noted that all modern digital mobile phone handsets employ adaptive power control whereby the RF output power of the handset is continually adjusted to a level consistent with the minimum output power required for communication with the controlling base station. In this context, there is data to show that mobile phones used in a city operate at full power less than 5% of the time and spend around 20% of the time at 1% of full power (Wiart, J. et al. 2000).

Exposure from base stations

ARPANSA has completed detailed and extensive survey measurements of environmental levels of radiofrequency radiation (RFR) in the vicinity of mobile phone towers throughout Australia. A detailed summary report (Line et al. 2000) of these measurements can be found within the ARPANSA web site at www.arpansa.gov.au./base_stns.htm. The ARPANSA survey results clearly establish that the radiofrequency radiation (RFR) from mobile phone towers makes only a minor contribution to total environmental RFR that arises primarily from other communications sources. Depending on location, the RFR from mobile phone towers is generally less than 3% of all RFR from other contributing sources including AM and FM radio, television, paging systems and emergency services.

Further, the exposure levels from all combined radiofrequency sources as measured adjacent to the mobile phone towers are generally much less than 2 microwatts per square centimetre. Such RFR levels are below 1% of maximum allowable public exposure levels of the ARPANSA Standard.

In view of the above and other technological considerations (such as the need to minimise interference), the general environmental levels from communications sources, including mobile telephone base stations, are not likely to be altered or affected by the limits of the ARPANSA Standard.

⇖ **Return to questions**

⇩ **Additional information & resources**

Additional information & resources

⇧ Return to subjects

Q33. Where can I get additional information about the effects of radiofrequency health effects and related subjects?

A33. The ARPANSA Standard contains relevant references and there are Annexes with supporting information. However, additional information related to the ARPANSA Standard and its implementation (including web links to other external resources) may be found on the ARPANSA web site at www.arpansa.gov.au. Further information relating to specific radiofrequency and other electromagnetic exposure issues is also available on the ARPANSA web site.

The ARPANSA web site will be progressively updated with new information as it becomes available.

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Q34. What specific information is available on the ARPANSA web site?

A34. The following information relating to the ARPANSA Standard is available on the ARPANSA web site at www.arpansa.gov.au:

The ARPANSA Standard

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2002, 'Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz'. [see References for details]

Supporting Documents

1. An Explanatory Question & Answer Guide to the ARPANSA Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz. GHz. [ie. this document and also a printable version]
2. Human auditory perception resulting from exposure to high power pulsed or modulated microwave radiation - specification of appropriate safety limits.
3. Measurement averaging considerations on appropriate specification of exposure limits for radiofrequency electromagnetic fields.
4. Abstracts on research into bio-effects of rf at low levels of exposure.
5. Management of radiofrequency radiation overexposures.
6. Neurological case studies.
7. Research into bio-effects at low levels of exposure.
8. Case reports: neurological effects of rfr in humans.

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Additional information & resources ⇧ **Return to subjects**

... continuation of answer A34. on the question: What specific information is available on the ARPANSA web site?

Relevant Links

1. Durney, C.H., Massoudi, H. & Iskander, M.F. 1986, Radiofrequency Radiation Dosimetry Handbook, 4th edn, United States Air Force Research Laboratory Technical Report USAFSAM-TR-85-73, Brooks Air Force Base, Texas USA. www.brooks.af.mil/AFRL/HED/hedr/reports/
2. The RF Radiation Safety Handbook (Ronald Kitchen, Pub. Butterworth-Hienemann Ltd. 1993) provides a practical description when performing RF surveys for a variety of applications. The same book also describes the various commercial instruments and personal RF dosimeters. Further information on this handbook may be found by searching the publisher's web site.
3. Heynick L. N., Polson P. 1996, 'Human exposure to radiofrequency radiation: A comprehensive review of the literature pertinent to air force operations", (AL/OE-TR- 1877 1996-0035), Radiofrequency Radiation Division, Occupational and Environmental Health Directorate, Armstrong Laboratory, Brooks Air Force Base, Texas 78235-5324 USA, 1996.
4. National Occupational Health and Safety Commission (NOHSC), 'Risk management: preventative approach to improved work productivity'.
5. National Occupational Health and Safety Commission (NOHSC), 'Overview of the risk management process'.
6. National Occupational Health and Safety Commission (NOHSC), 'Risk management for manufacturers'.
7. National Occupational Health and Safety Commission (NOHSC), 'Risk management in occupational health and safety'.
8. Queensland Division of Workplace Health and Safety 2000, 'Advisory Standard: Risk management'.
9. Queensland Division of Workplace Health and Safety 2000, 'Safe use in industry of radiofrequency generating plant'. www.whs.qld.gov.au
10. Queensland Division of Workplace Health and Safety 2000, 'Guarding of radiofrequency PVC Welding Machines (Health and Safety Alert)'.
11. Queensland Division of Workplace Health and Safety 2000, 'An Intervention to Improve the Control of Risks Associated with Radiofrequency Generating Plant'.
12. Commission of the European Communities 2000, 'Commission adopts communication on precautionary principle', Brussels.
13. Stewart W. 2000, 'Mobile phones and health', Independent expert group on mobile phones, NRPB, Didcot, UK.

... continued next page

... continuation of answer A34. on the question: What specific information is available on the ARPANSA web site?

14. WHO 2000, 'Electromagnetic fields and public health cautionary policies', March.
15. Australian Communications Industry Forum (ACIF), 2002, 'Industry Code C564:2002 Deployment of Radiocommunications Infrastructure', PO Box 444, Milsons Point, NSW. [ISBN 1 74000 1850] [This ACIF Code is available for download through the ACIF web site at www.acif.org.au/ or via the direct document link at www.acif.org.au/ACIF/files/C564_2002.pdf.]

Public Consultation Documents

- March 2001, public comment draft of the ARPANSA Standard.
- Summary of general comment on public comment draft ARPANSA Standard including ARPANSA response .
- Summary of specific comment on draft ARPANSA Standard including ARPANSA response.
- November 2001, public comment draft Regulatory Impact Statement (RIS) on the ARPANSA Standard.
- Summary of comment on draft RIS including ARPANSA response.
- Final RIS document on the ARPANSA Standard.

Further Information

The Mobile Phone System and Health Effects

Levels of Radiofrequency Radiation from GSM Mobile Phone Base Stations

Prediction Methodologies for Radiated Electromagnetic Energy (EME) Exposure Levels from Mobile Phone Base Station Antennas

Committee on Electromagnetic Energy Public Health Issues (CEMEPHI)

The following CEMEPHI publications are available from the above link:

Government action on electromagnetic energy public health issues.

Electromagnetic energy and its effects.

About mobile phones.

About mobile phone networks.

Potential interference of mobile phones with pacemakers, hearing aids and other devices.

What about telecommunications towers, and are there any health effects?

Levels of radiofrequency radiation from GSM mobile phone base stations.

... continued next page

Additional information & resources ⇧ **Return to subjects**

... continuation of answer A34. on the question: What specific information is available on the ARPANSA web site?

Radiation and Health Information Sheets

Mobile Telephones and Health Effects

Marine Radars Mounted on Small Craft

Mobile Communication Antennas: Are They a Health Hazard?

Radiation Emissions from Microwave Ovens

Video Display Terminals and Cancer

Radiation Emissions from Video Display Terminals

Forthcoming information

The ARPANSA web site will be progressively updated with new information as it becomes available. In particular, it is intended that the following specific topics will be included.

1. Considerations for non-humans species.
2. Data on human tissue properties.
3. Additional information on pulsed exposure limits
4. Information on relevant safety factors.

Specific information requests may also be directed to the Information Officer, ARPANSA, Lower Plenty Road, Yallambie, Victoria, 3085 or by e-mail arpansa@health.gov.au.

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Additional information & resources ⇧ **Return to subjects**

Q35. Where can I get my radiofrequency survey equipment calibrated?

A35. ARPANSA provides a calibration service for the calibration of radiofrequency hazard meters, personal dosimeters, etc.

Refer to www.arpansa.gov.au/calib.htm for further details.

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Q36. What are the relevant regulatory or advisory bodies in Australia and how can I contact them?

A36. The contact details of relevant Australian regulatory or advisory bodies are listed in Annex 8 of the ARPANSA Standard. For the most up to date list, the reader is advised to consult the ARPANSA web site at www.arpansa.gov.au.

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⇩ **References**

⇩ **Glossary**

References

⇧ **Return to subjects**

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2002, 'Radiation Protection Standard: Maximum Exposure Levels to Radiofrequency Fields — 3 kHz to 300 GHz', Radiation Protection Series Publication No. 3, ARPANSA, Yallambie Australia.
[Printed version: ISBN 0-642-79400-6 ISSN 1445-9760]
[Web version: ISBN 0-642-79402-2 ISSN 1445-9760]
[The web version is available for download from: www.arpansa.gov.au. The printed version is available from Ausinfo – refer: www.ausinfo.gov.au]

Durney, C.H., Massoudi, H. & Iskander, M.F. 1986, 'Radiofrequency Radiation Dosimetry Handbook', 4th edn, United States Air Force Research Laboratory Technical Report USAFSAM-TR-85-73, Brooks Air Force Base, Texas USA.
[Refer www.brooks.af.mil/AFRL/HED/hedr/reports/]

ICNIRP 1998, 'Guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)', *Health Phy*sics, vol. 74, no. 4, pp. 494-522.
[Refer www.icnirp.de]

Institute of Electrical and Electronics Engineers (IEEE) 1999, 'IEEE Standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz', *IEEE Std C95.1*.
[Refer www.ieee.org]

Independent Expert Group on Mobile Phones 2000, 'Mobile phones and health', c/o *National Radiological Protection Board*, Chilton, Didcot, UK.
[Refer www.iegmp.org.uk]

Line, P., Cornelius, W. A., Bangay, M. J., Grollo, M., 2000, 'Levels of Radiofrequency Radiation from GSM Mobile Telephone Base Stations', Technical Report 129, Australian Radiation Protection and Nuclear Safety Agency, Yallambie Australia. [ISSN 1443-1505]
[Refer www.arpansa.gov.au./base_stns.htm]

Royal Society of Canada, RSC.EPR 99-1. Royal Society of Canada 1999, 'A review of the potential health risks of radiofrequency fields from wireless telecommunication devices', *An Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada*, Ottawa, Royal Society of Canada, RSC.EPR 99-1. Ottawa, Canada.
[Refer www.rsc.ca/english/index.html]

Standards Australia/Standards New Zealand 1998, 'Radiofrequency fields. Part 1: Maximum exposure levels—3kHz to 300 GHz', AS/NZS 2772.1(Int), Standards Australia, Sydney Australia.

Wiart, J., Dale, C., Bosisio, A. V., le Cornec, A. 2000, 'Analysis of the Influence of the Power control and Discontinuous Transmission on RF Exposure with GSM Mobile Phones', *IEEE Transactions on Electromagnetic Compatibility*, vol. 42, no. 4, 376-85.

⇩ **Glossary**

Glossary

⇧ **Return to subjects**

Aware user
Australian Communications Authority (ACA)
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
Competent Authority
Continuous wave (CW)
Controlled area
Dosimetry
Duty factor
E - refer Electric field strength
Electric field strength
Equivalent power flux density (Seq)
Far-field – refer RF field
General public exposure
GHz - refer Radiofrequency (RF)
H – refer Magnetic field strength
Hz - refer Radiofrequency (RF)
Instantaneous
International Commission on Non-Ionizing Radiation Protection (ICNIRP)
kHz - refer Radiofrequency (RF)
Magnetic field strength
Medical exposure
MHz - refer Radiofrequency (RF)
Modulated field
Near-field – refer RF field
Occupational exposure
Public exposure – refer General public exposure
Power flux density
Radiofrequency (RF)
Radiation Health Committee (RHC) – refer ARPANSA
Radiation Health & Safety Advisory Council (RHSAC) - refer ARPANSA
Reasonable accommodation/adjustment RF field
RF worker
Root mean square (rms)
SA (specific absorption)
SAR (specific absorption rate)
Spatial peak
Spatial peak SA
Spatial peak SAR
WBA SAR (Whole body average specific absorption rate)

⇩ **How to navigate this document**

Glossary

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Aware user

A person who is appropriately trained to use two-way radios and other portable wireless devices (see Schedule 5, clause S5.2) which expose the user to levels likely to exceed the basic restrictions for general public exposure. Appropriate training includes awareness of the potential for exposure and measures that can be taken to control that exposure. Persons in the aware user group may include, but are not limited to, the following categories:

(a) Emergency service personnel.

(b) Amateur radio operators.

(c) Voluntary civil defence personnel.

Also refer Glossary definitions for: Controlled area; General public exposure; Occupational exposure; RF worker.

Australian Communications Authority (ACA)

The ACA is the Federal Government authority that regulates radiofrequency communications throughout Australia (refer www.aca.gov.au) The ACA is within the Communications, Information Technology and the Arts portfolio.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

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Glossary

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Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a Federal Government agency incorporated under the Health portfolio. ARPANSA is charged with responsibility for protecting the health and safety of people, and the environment, from the harmful effects of radiation (ionizing and non-ionizing). Specifically, ARPANSA is responsible for:

- Promoting uniformity of radiation protection and nuclear safety policy and practices across jurisdictions of the Commonwealth, the States and the Territories;
- Providing advice to Government and the community on radiation protection and nuclear safety;
- Undertaking research and providing services in relation to radiation protection, nuclear safety and medical exposures to radiation; and
- Regulating all Commonwealth entities (including Departments, Agencies and Bodies Corporate) involved in radiation or nuclear activities or dealings.

Refer www.arpansa.gov.au/org.htm for further details.

In addition to the above functions, ARPANSA has the role to publish Radiation Protection Standards. In particular, the Australian Radiation Protection and Nuclear Safety (ARPANS) Act 1998 establishes the Chief Executive Officer (CEO) with relevant statutory powers.

The ARPANS Act also establishes the Radiation Health and Safety Advisory Council (RHSAC) and the Radiation Health Committee (RHC). A relevant function of the RHC is to advise the CEO and RHSAC on matters relating to radiation protection, including the formulation of standards for consideration by the Commonwealth, States and Territories. Similarly, the RHSAC provides expert advice to the CEO on the adoption of such standards.

Competent authority

The relevant regulatory or advisory authority within the applicable Commonwealth/State/Territory jurisdiction (refer Annex 8 of the ARPANSA Standard).

Continuous wave (CW)

An electromagnetic wave that is neither pulsed or modulated, ie. radiofrequency emission that has both a constant frequency and a constant amplitude.

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Glossary

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Controlled area

A controlled area is an area or place in which exposure to RF fields may reasonably be expected to exceed general public limits, and with the following characteristics:

(a) The area must be under the supervision of a competent person who must ensure that exposures cannot exceed occupational levels;

(b) The area may only be entered by persons who are made aware that they are doing so, and of the need for RF safety;

(c) There must be documentation or signage to clearly indicate:

  (i) areas above occupational limits;

  (ii) areas above general public limits.

Also refer Glossary definitions for: Aware user, General public exposure; Occupational exposure; RF worker.

Dosimetry

Measurement, or determination by calculation, of internal electric field strength or induced current density or specific absorption (SA) or specific absorption rate (SAR), in humans or animals exposed to electromagnetic fields.

Duty factor

The ratio of pulse duration to the pulse period of a periodic pulse train. For example, a CW transmission corresponds to a duty factor of 1.0.

Electric field strength (E)

The rms magnitude of the electric field vector, *(*E) expressed in volts per metre (V/m).

Equivalent power flux density (S_{eq})

The magnitude of the power flux density that corresponds with an electromagnetic wave propagating as a plane wave through free space (refer Schedule 4 of ARPANSA Standard).

General public exposure

All exposure to RF fields received by members of the general public. This definition excludes occupational exposure, exposure of aware users, and medical exposure. It is recognised that some persons may need to transit controlled areas, and this is permitted under adequate supervision.

Also refer Glossary definitions for: Aware user, Controlled area; Medical exposure; Occupational exposure; RF worker.

For specific mandatory requirements relating to general public exposure, refer to the answer to the question: What are the requirements for general public exposure?

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Glossary

⇧ Return to subjects

Instantaneous

Adjective used to describe particular parameters that must be measured or evaluated over a very short time interval (typically 100 microseconds or less).

Related temporal terms are: CW, duty factor and rms.

International Commission on Non-Ionizing Radiation Protection (ICNIRP)

ICNIRP is an international scientific body with affiliations to various international standards bodies and organisations including the World Health Organization (WHO). ICNIRP rules establish scientific integrity and require that all committee members are independent experts who may not be members of commercial or industrial organisations. All ICNIRP publications appear in the peer reviewed scientific journal 'Health Physics'.

The ICNIRP 1998 Guidelines were established to provide protection against known adverse effects of exposure to electromagnetic fields.

Refer: www.icnirp.de.

Magnetic field strength (H)

The rms magnitude of the magnetic field vector *(*H) expressed in amperes per metre (A/m).

Medical exposure

Exposure of a person to RF fields received as a patient undergoing medical diagnosis or recognised medical treatment, or as a volunteer in medical research. Medical exposure lies outside the scope of the ARPANSA Standard (refer Glossary definitions General public exposure).

Modulated field

A radiofrequency field, the amplitude, phase or frequency of which varies with time. For example, broadcast signals of AM radio, FM radio and television are all modulated fields.

Occupational exposure

Occupational exposure is defined as exposure of a RF worker (as defined) to RF fields when on duty.

Also refer Glossary definitions for: Aware user, Controlled area; General public exposure; RF worker.

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Glossary

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Power flux density

The rate of flow of radiofrequency electromagnetic energy through a unit area normal to the direction of wave propagation; expressed in watt per square metre (W/m^2).

Refer also to the related term: Equivalent power flux density ($S_{eq)}$

Radiofrequency (RF)

A term used to describe the oscillation frequency of an electric (E) or magnetic field (H) [ie. electromagnetic field], where the frequency is within the range 3 kHz to 300 GHz.

NOTE: Frequency is measured in cycles per second and its fundamental unit of measurement is the Hertz (Hz). Suffixes are as follows:

1 Hz = one cycle per second;
1 kHz = one thousand cycles per second;
1 MHz = one million cycles per second;
1 GHz = one thousand million cycles per second.

Reasonable accommodation/adjustment

The variation of usual employment practices or the work environment, when necessary, possible and reasonable, to enable an employee to continue working in safety. Examples of such employees could include those who are pregnant and those with implants.

For more information on pregnant workers, refer to the answer to the question What are the considerations/requirements for a pregnant worker?

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Glossary

⇧ Return to subjects

RF field

A radiofrequency (RF) electromagnetic field.

A RF field may be characterised by distinct exposure regions, as follows:

(a) *Reactive near-field*—that region of the field immediately surrounding the antenna wherein the reactive field predominates. The commonly accepted distance to the reactive near-field boundary is $\lambda/2\pi$ m, λ being the wavelength in metres.

(b) *Radiating near-field*—that region of the field, which extends between the reactive near-field region and the far-field region, wherein radiated fields predominate and the angular field distribution is dependent upon distance from the antenna.

(c) *Far-field*—that region of the field of the antenna where the angular field distribution is essentially independent of the distance from the antenna. If the antenna has a maximum overall dimension D, the far-field region is commonly taken to exist at distances greater than $2D^2/\lambda$ or 0.5λ, whichever is the greater, from the antenna.

NOTE: The formulae given above are generally conservative and are based on considerations of antenna pattern formation, ie. the angular distribution of the radiated energy is essentially independent of the distance from the antenna in the far-field.

RF worker

A person who may be exposed to RF fields under controlled conditions, in the course of and intrinsic to the nature of their work. Such persons are subject to the requirements of Section 5.1 of the ARPANSA Standard.

Also refer Glossary definitions for: Aware user, Controlled area; General public exposure; Occupational exposure.

Root mean square (rms)

The square root of the mean of the square of a time variant function, F(t), over a specified time period from t_1 to t_2. It is derived by first squaring the function and then determining the mean value of the squares obtained, and taking the square root of that mean value, ie.

$$F_{rms} = \sqrt{\frac{1}{t_2 - t_1}\int_{t_1}^{t_2}[F(t)]^2\,dt}$$

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SA (specific absorption)

The energy absorbed per unit mass of biological tissue during a RF pulse. It is expressed in joule per kilogram (J/kg). SA is the time integral of the specific absorption rate during a pulse.

Also see the related Glossary definitions: SAR, spatial peak SA, spatial peak SAR and WBA SAR.

SAR (specific absorption rate)

SAR is an acronym for 'specific absorption rate' and it is the rate at which energy from RF fields is absorbed in a given mass of body tissue. The measured SAR level provides a direct gauge of the heating from exposure to electromagnetic radiofrequency fields. Metabolic processes within the body are predominant in determining the temperature of body tissue. However, depending upon the level of exposure, RF fields may produce an observable increase in tissue temperature which can be directly related to SAR. SAR is usually measured in units of watts (W) per kilogram (kg) - written as ' W/kg ' or ' $W \cdot kg^{-1}$ '. Depending on the RF frequency involved and the mode of equipment operation (ie. CW or pulsed), evaluation to the basic restrictions (predominantly SAR) is usually required in circumstances where the radiofrequency source (eg. a radiating antenna) is quite close to the body.

Also see the related Glossary definitions: spatial peak SAR, WBA SAR and SA.

Spatial peak

A quantity to be measured over a small region of the body and not the whole of the body. For example, refer spatial peak SAR as distinct from WBA SAR.

Spatial peak SA

The specific absorption (SA) measured over a small region of tissue (10 gram) in the head. Spatial peak SA is used to assess rapid heating effects from ultra-short high power pulses (eg. from high power military radar equipment) associated with a low duty factor. The level of the SA basic restriction is set at a level that will prevent nuisance auditory effects and other possible adverse effects that may be associated with high power pulse exposures. It is also noteworthy that, for high peak power pulses, the basic restrictions of the ARPANSA Standard effectively mandate much lower time averaged levels than would be otherwise permitted by the basic restrictions for WBA SAR and spatial peak SAR, where longer time period averaging is applicable.

Also see the related Glossary definitions: spatial peak, SAR and WBA SAR

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Spatial peak SAR

The specific absorption rate (SAR) measured over a small region of tissue in the body. Spatial peak SAR is used to assess localised heating of body tissue that results from non-uniform localised exposure to various parts of the body. Basic restrictions on spatial peak SAR protect against excess heating of body parts. In this regard, spatial peak SAR measurements are used to assess mandatory compliance of mobile phones and other mobile or portable transmitters prior to obtaining licence approval by the Australian Communications Authority (www.aca.gov.au/standards/emr/index.htm).

Also see the related Glossary definitions: SAR, WBA SAR and SA.

WBA SAR (Whole body average specific absorption rate)

The SAR averaged over the whole mass of the body. WBA SAR is a measure of heating arising from RF absorption in the body as a whole and it serves to identify whether or not persons might be subject to heat stress. Note that the SAR basic restrictions have significant safety margins in this regard.

Also see the related Glossary definitions: SAR, spatial peak SAR and SA.

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