

Melbourne Office: Lower Plenty Road, YALLAMBIE, VIC 3085 Tel +61 3 9433 2211 Fax +61 3 9433 2353

email: arpansa.secretariat@health.gov.au

Regulatory Impact Statement

Radiation Protection Standard

Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz

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1. Background and Issues

- 1.1 In 1998 Standards Australia and Standards New Zealand jointly published an interim Standard [AS/NZS 2772.1(Int):1998] setting maximum exposure limits for public and occupational exposure to electromagnetic radiation in the frequency range 3 kHz to 300 GHz. This interim standard superseded Australian Standard AS 2772.1-1990, *Radiofrequency fields Part 1: Maximum exposure levels -3 kHz to 300 GHz*, which had been the basis for standards and practices to limit public and occupational exposure to electromagnetic radiation hazards.
- 1.2 The interim standard was a temporary measure after several attempts by the responsible Australian and New Zealand Joint Standards Committee (TE/7) to update AS 2772.1-1990 failed due to a lack of consensus. The interim standard eventually expired on 30 April 1999 as the Australian members of TE/7 failed to reach consensus on the TE/7 draft. Standards Australia later abandoned the project to develop a new standard to replace AS/NZS 2772.1(Int):1998.
- 1.3 However, the New Zealand members of TE/7 were able to agree on a new standard and Standards New Zealand published NZS 2772:Part1:1999 to specify exposure limits comprising basic restrictions and associated derived reference levels for both public and occupational exposure within the frequency range 3kHz to 300 GHz. The New Zealand standard was based on the last TE/7 draft and the scientific research that went into the International Commission on Non-Ionizing Radiation Protection¹ (ICNIRP) guidelines published in 1998 under the title “*Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)*” (ICNIRP:1998).
- 1.4 Meanwhile, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and the Australian Communications Authority (ACA) had to continue to reference the expired interim standard [AS/NZS 2772.1(Int):1998] in their regulations. This was not a satisfactory state of affairs and to ensure that an updated standard was available in Australia, ARPANSA and ACA agreed that a new Australian standard, based on health criteria, was required to limit human exposure to radiofrequency (RF) radiation. It was also agreed that ARPANSA would develop the standard.
- 1.5 A working group was established by ARPANSA’s Radiation Health Committee (RHC) to draft a set of maximum exposure levels for RF fields in the frequency range 3 kHz to 300 GHz. In selecting the working group members, ARPANSA consulted widely with a range of relevant groups to achieve a spread of interests and expertise. The working group included members with expertise on electromagnetic radiation bio-effects, dosimetry and measurement techniques, medical expertise on epidemiology and occupational health and safety aspects, and knowledge of technical standards. Community and union representation was also included.
- 1.6 Like Standards New Zealand, the ARPANSA working group used the TE/7 draft as the starting point. While the TE/7 draft included new scientific findings and compliance verification techniques developed from 1990 to 1996 as well as the scientific findings

¹ ICNIRP is an international scientific body with affiliations to various international standards bodies and organisations including the World Health Organisation (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’.

used for ICNIRP:1998, the draft ARPANSA standard developed for public consultation from March to May 2001, drew extensively from both ICNIRP:1998 and more recent post-1998 research, which enabled the proposed ARPANSA standard to be not only consistent with ICNIRP:1998 but also more specific than the international guidelines².

- 1.7 The proposed ARPANSA standard sets limits for human exposure to RF fields in the frequency range 3 kHz to 300 GHz. It includes:
 - (a) Basic restrictions for both occupational and general public exposure involving all or part of the human body.
 - (b) Indicative reference levels for measurable quantities derived from the basic restrictions.
 - (c) Approaches for verification of compliance with the proposed standard.
 - (d) Requirements for management of risk in occupational exposure and measures for protection of the general public.
- 1.8 The working group reviewed the scientific literature extensively. Annexes to the proposed standard include a summary of the review of epidemiological studies of exposure to RF and human health and research into bio-effects at levels below the limits specified in the proposed ARPANSA standard.
- 1.9 The basic restrictions were derived by examining the RF exposures that cause established health effects. The rationale for the derivation of the basic restrictions and the associated reference levels is provided in Schedule 1 of the proposed standard. However, there is also concern among the community about levels below the limits specified in the standard. Data regarding biological effects at levels below the limits specified in the proposed ARPANSA standard are incomplete. The health implications at these levels of RF exposure are not conclusive and such data could not be used for setting the levels of the basic restrictions in the proposed standard. The standard does, however, include a precautionary statement designed to limit unnecessary exposures of the public to RF fields.
- 1.10 Research is continuing in many countries into possible health effects of RF exposure. ARPANSA's Radiation Health Committee will continue to monitor the results of this research and, where necessary, issue amendments to the proposed standard.
- 1.11 In drafting the proposed ARPANSA standard, the working group was mindful of the fact that the sophisticated and complex applications of RF range from the telecommunications and broadcasting industries through to small businesses using RF welders. While public concern about human exposure to RF has focussed on mobile phones and mobile phone base stations, it is important to note that the proposed standard applies across the RF spectrum and to the full range of activities that use RF radiation. These include:
 - (a) The telecommunications and radiocommunications industry covering mobile handsets, base stations, cordless handsets, cradles, satellite handsets, two-way radios and TV and radio towers. The size of this industry is evident from the fact that in the area of mobile phones alone, as at July 2001 there were more than 11

² There are no internationally adopted standards defining limits of exposure to radiofrequency radiation. However, the European Union (Council of the European Union 1999), has a recommendation for the adoption of ICNIRP:1998 and many European countries and New Zealand have standards or recommendations conforming to ICNIRP 1998.

million mobile phone connections. In addition as at January 2001 there were 21 licensed telecommunication carriers, 250 registered manufacturers and importers of hand held devices and 150 registered manufacturers and importers of radiocommunications devices³. According to the ACA it is not easy to work out the exact number of licensees of radiocommunications devices due to the existence of class licenses.

- (b) Medical applications using radiofrequency emitting devices. For example, Magnetic Resonance Imaging, Microwave Diathermy and Shortwave Diathermy.
 - (c) Industries using RF devices for heating and welding. For example, induction heating in metal industries, plastic welding in the automotive industry and the manufacture of stationery, swimming pool covers and protective clothing. RF heating applications also include glue curing in the manufacture of picture frames and furniture.
- 1.12 The proposed standard applies wherever and whenever occupational groups and the general public (of any age or health status) may be exposed to RF fields, which includes continuous wave, pulsed and modulated electromagnetic fields at single or multiple frequencies within the 3 kHz to 300 GHz range.
- 1.13 The proposed standard applies where RF fields are produced or radiated, either deliberately or incidentally, by the operation of equipment or devices. Manufacturers/suppliers, installers, employers/service providers or users of all relevant devices and installations are responsible to ensure that the device or installation is operated in compliance with the requirements of the proposed standard. The differences between the proposed ARPANSA standard and the interim expired standard and ICNIRP:1998 are dealt with under Section 7 (Impact Analysis) below.
- 1.14 The proposed standard does not apply where persons are exposed to RF fields as part of a recognised medical procedure. However, it does apply to persons operating the radiating equipment and others who are in the vicinity during the procedure. The proposed standard does not apply to other potential hazards of RF fields, such as the ignition of explosives or flammable gases, or to interference to other electronic equipment.
- 1.15 Relevant Australian occupational health & safety and environment laws impose obligations on employers, designers, manufacturers and suppliers of plant or equipment, to ensure that their activities, or their plant and equipment, do not pose undue risks to the health and safety of their employees or third parties. In effect, such laws require all relevant parties to continually assess and improve the safety and health impact of their activities, irrespective of what, if any, government action is taken.

2. The Problems

Health hazards

- 2.1 Exposure to high levels of RF fields has been shown to produce adverse health effects in exposed individuals. With the increasing use of devices using the RF spectrum there is a need to ensure the protection of workers and the general public from such effects.

³ Source: Australian Communications Authority.

- 2.2 There is also continuing concern over the health effects of chronic exposure to RF fields at levels below the limits specified in the proposed standard. Such effects have not been conclusively identified. However, the potential risks to health and safety of chronic exposure to RF fields at levels below the limits specified in the proposed standard have not been ruled out.

Market failure

Information Asymmetry

- 2.3 Employers, workers, consumers and the public do not have any up-to-date publicly available credible information to satisfy themselves that their health and safety is being adequately protected from RF fields.
- 2.4 The interim standard AS/NZS 2772.1(Int):1998 expired in April 1999 and Standards Australia has abandoned plans to review it. Existing limits set by the ACA apply only to the telecommunication industry and although ARPANSA references the interim standard, this only applies to Commonwealth entities. In the long-run public access to the interim (expired) standard may prove difficult.
- 2.5 The interim standard was also technically inadequate. It had not taken into account recent scientific research, did not provide a complete set of limits (especially in regard to pulsed or modulated fields), had only crude provisions for spatial averaging which were unsuited to protect persons working with RF welders and heaters.

Externalities

- 2.6 Externalities are side effects that impose costs on the community but the person who caused the side effects does not have to bear the cost of the effects. The costs on the community include the burden imposed on the public health system as well as loss of income, work cover, counselling and possible legal costs.
- 2.7 Externalities arise due to the effects of radiofrequency fields around transmitters and other equipment that utilise radiofrequency technology on people and equipment nearby. An example of areas where such externalities may arise is the development of residential areas close to high power AM radio transmitters, which could lead to interference with some domestic electromedical equipment and other devices that are sensitive to RF fields.

3. Desired Objectives

- 3.1 Reduce the risks of any adverse effect of exposure to RF fields in a cost effective manner by ensuring that exposures of occupational groups and the public to RF fields are restricted to safe levels.
- 3.2 Ensure that safe levels of RF exposures are derived on the basis of established international guidelines and findings of scientific research.
- 3.3 Foster public confidence in the measures taken to protect the health and safety of occupational groups, consumers and the community from the adverse effects of exposure to RF fields.

4. Threshold Question –Is there a need to intervene?

- 4.1 This section discusses the “do nothing” option. This would maintain the status quo, which effectively is the absence of any standard as the interim AS/NZS 2772.1(Int):1998 expired in April 1999. At the end of this section a conclusion will be reached as to whether there is a need for intervention.

RF hazards

- 4.2 RF hazards to health and safety take the form of electrical burns and shocks and heating effects on cells and tissues. At some frequencies RF exposure can also result in auditory effects. The major concern is that of heating effects and its impact in the body’s cooling system as well as the consequences that flow from it. In addition, scientists are also investigating whether there is a risk of cancer from RF fields. However, the scientific findings on this issue are conflicting and there is no established mechanism of how cancer could result from RF fields.
- 4.3 The ability to cope with heat stress varies with different organs and tissues. The limbs and outer layers of the body are better adapted to tolerate higher temperature fluctuations to cope with wide changes in environmental conditions. However, internal organs are less tolerant of large deviations from core body temperature. The brain and the eyes also require particular attention.
- 4.4 Any disease that can interfere with the body’s thermo-regulatory system, such as multiple sclerosis, may make an affected individual more sensitive to the effects of environmental heat stress. Some medication may also decrease the homeostatic capacity of the individual.

Risks of RF hazards

- 4.5 The Working Group that developed the proposed standard considered extensive overseas epidemiological studies and some Australian studies on the effects of RF radiation on human health. Epidemiological studies measure the association between an exposure and an outcome, with the results usually expressed as a relative risk with associated confidence levels, that indicate if the findings are statistically reliable.
- 4.6 While the health and safety risks associated with exposure to high-level RF fields is clear, the review of literature on the epidemiological studies in the field, led the working group to conclude that there is no clear or consistent result which indicates a causal role of low intensities of RF exposures in connection with any human disease. However, this does not establish the absence of any hazard, other than to indicate that for some situations any undetected health effects must be small.
- 4.7 The working group stated that it is impossible to prove with absolute certainty the absence of an effect from any exposure to RF radiation. To prove with certainty that RF energy is completely safe is impossible, as to do so requires proof of the absence of any association between exposure to RF and any one of a number of health outcomes.
- 4.8 The conclusion from the above discussion is that the risk of the hazards from RF fields is not unlikely. While the consequences of the hazards of exposure to RF fields above the limits specified in the proposed Standard are well documented, the hazards from exposure to RF fields at levels below the limits specified in the Standard are uncertain.

This argues for arrangements that limit unnecessary public exposures to RF fields where this can be achieved reasonably.

Market failure

Information Asymmetry:

- 4.9 The expiry of the interim AS/NZS 2772.1(Int):1998 in April 1999 means that there is now no current Australian Standard. This situation is unsatisfactory as manufacturers, importers and sellers of equipment or services that emit RF radiation may not ensure that exposure levels are within the permissible levels or that equipment that emits RF radiation is appropriately sited. This is particularly of concern to the community in respect of mobile telephones and mobile telephone towers.
- 4.10 The interim standard was also technically inadequate. It had not taken into account recent scientific research, did not provide a complete set of limits (especially in regard to pulsed or modulated fields), had only crude provisions for spatial averaging which were unsuited to protect persons working with RF welders and heaters, and did not mandate the application of a precautionary approach for general public exposure to encourage minimal exposure consistent with the lowest power levels required to achieve service objectives or process requirements. Unless a standard is established, workers, consumers and the general public would not be able to obtain reliable publicly available information, with which they can evaluate if the possible RF radiation they may be exposed to is within permissible levels. This problem is particularly significant now as there is increasing concern over the effect of RF radiation from mobile phones.
- 4.11 There is, therefore, a need for a standard to be developed, established, maintained and enforced. There is also a need for a body to undertake the role of advising stakeholders and providing information and clarification so that stakeholders can be assured that the RF fields that they may be exposed to is being kept within permissible levels. There is also a need to ensure that the permissible levels of exposure to RF fields are subject to periodic scientific reviews based on the findings of latest research.
- 4.12 The fact that there is no standard on which governments can base future laws and regulations is also of concern.

Externalities:

- 4.13 Uncontrolled levels of RF radiation can be harmful to workers, consumers and the public. The social costs that can result from uncontrolled radiation levels could affect a large number of people. Relying on market mechanisms for affected parties to directly negotiate with the source of these externalities would involve transaction costs that may not be reasonable for consumers and members of the public to bear. A standard that restricts radiation exposure levels to regulate manufacturers, importers and sellers of equipment or services that emit RF radiation would ensure that potential social costs from externalities are minimised.
- 4.14 It is not appropriate to internalise these costs by relying on civil law, since in dealing with health and safety issues it is far preferable to prevent such exposure rather than to rely on remedial action after the event.

Conclusion

- 4.15 The “no action” option would result in the continuation of the current situation, with no reliable standard. The hazards and risks of exposure to RF fields above the limits

specified in the Standard and the uncertainty associated with RF fields below the limits specified in the Standard point to the need for some form of intervention to ensure the protection of public health and safety.

- 4.16 The potential social costs from the problems of information asymmetry and externalities are legitimate reasons for intervention. It must be noted that the number of consumers potentially affected is so high (there are at least 11.5 million users in Australia in just the mobile phone industry) that it is both unreasonable and impractical to expect consumers to bear the transaction costs of collective bargaining if the problem is left for resolution through market mechanisms.
- 4.17 The existing body of health and safety laws do not specifically deal with the problems of RF radiation. The significance of the impact of uncontrolled RF exposures to health and safety is too great to leave the issue to be dealt with under the common law.
- 4.18 A recent report into a National Competition Policy review of radiation protection legislation of the Commonwealth, States and Territories (May 2001) recommended that all jurisdictions are to incorporate nationally consistent provisions into their radiation protection legislation to regulate non-ionising radiation, which includes RF radiation.

5. Options

- 5.1 Having concluded that there is a need to intervene, the remaining options are as follows:
 - (a) **Option 1** – Self-regulation by the industry.
 - (b) **Option 2** - Adopt an international standard [the ICNIRP:1998 Guidelines] without adopting an Australian radiation protection standard
 - (c) **Option 3** - Adopt the proposed “Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz”.

6. Identifying Affected Parties

- 6.1 The main stakeholder groups affected by the proposed standard are
 - (a) The telecommunications and radiocommunications industries.
 - (b) Industries using RF devices for heating and welding.
 - (c) Commonwealth, State and Territory governments.
 - (d) Consumers of RF devices.
 - (e) The community.

7. Impact Analysis

Option 1 - Self-regulation

Benefits:

- 7.1 Cost savings will accrue as governments need not develop a standard; need not write or amend regulations to reference the standard; and need not allocate resources to ensure that industry complies with the standard.

- 7.2 A purely industry-based solution may enable industry to respond to problems through innovative outcomes-based risk management approaches.

Costs:

- 7.3 A self-regulatory model will require pro-active action by the industry to organise itself efficiently and effectively and respond with suitable standards and/or codes of practice. However, the telecommunication and radiocommunications industries and the various industries that use RF heating and welding are not homogeneous. Hence it may be difficult for different sectors to produce a consistent proposal for the entire industry. This could lead to a multitude of sector-specific standards, which might create confusion and uncertainty. It is noteworthy that no industry proposal has emerged since the interim standard expired in April 1999.
- 7.4 The RF heating and welding industry does not have a peak industry body that can organise itself to participate in the development of a standard for self-regulation. In fact RF heating and welding devices are used in many small businesses, which are not sufficiently organised to develop their own standard or code of practice.
- 7.5 A peak body under a self-regulatory model would have to monitor international scientific research on RF fields and new developments, especially in the area of RF fields below the limits specified in the proposed Standard. This involves liaison activities with international organisations such as ICNIRP and other national agencies. Such liaison work requires time and resources, which an industry peak body may lack.
- 7.6 Given the hazards of exposure to RF fields above the limits specified in the Standard and the uncertainty of health effects of RF fields below the limits specified in the proposed Standard, there is a need to ensure that any intervention has, as its primary objective, the protection of public health and safety. Any measure to protect public health and safety from the adverse effects of RF fields necessarily involves prescribing limits to exposure levels and limiting unnecessary exposure. However, this may conflict with commercial objectives to maximise returns. It may be possible to leave it to the industry to resolve consumer concerns through safety measures motivated by the threat of potential or actual legal action. However this does not provide certainty to workers, consumers and the community that their health and safety is being protected by preventive measures.
- 7.7 Governments may have no control over safe emission levels and this may be detrimental to public health and safety. The need for effective regulatory oversight is especially significant in the area of radiation protection as the adverse effects of exposure may not be immediately evident and may have long term consequences on occupational groups, consumers and the community.

Option 2 - Adopt an International Standard without adopting an Australian Radiation Protection Standard

Benefits:

- 7.8 No need to develop another standard and the associated administrative and enforcement costs can be avoided by governments.
- 7.9 ICNIRP:1998 Guidelines are given credibility due to ICNIRP being made up of an independent group of scientists, whose findings and guidelines are published in the peer-reviewed journal *Health Physics*.

- 7.10 Adoption of an international standard provides consistency with other countries, such as New Zealand, and a number of European countries that have adopted standards based on ICNIRP, giving benefits to trade and commerce in devices and equipment that use RF fields.
- 7.11 ICNIRP:1998 gives a more comprehensive set of limits than was the case for the previous Australian interim standard.

Costs:

- 7.12 The main international document (ICNIRP: 1998) is written as a guideline rather than as a standard intended for direct adoption. Hence it is not precise in some areas, and in particular some of the basic restrictions are only inferred, not explicitly specified, and there is no specified pulse averaging time. This could have cost implications both for regulators and industry in determining compliance. There is no need for mandatory compliance and as such it is inadequate for purposes of compliance monitoring and enforcement.
- 7.13 ICNIRP 1998 does not provide any basis for considering limitation of unnecessary exposure to RF fields.
- 7.14 ICNIRP:1998 is based on information available up to 1997, and, in the RF field, a considerable amount of research has been published since 1997.
- 7.15 The updating of the Guidelines would be the responsibility of ICNIRP and any urgent review in the light of new and compelling scientific research may not be possible in time to protect public health and safety in Australia.
- 7.16 ICNIRP: 1998 covers the frequency range 0 kHz to 300 GHz, thereby including the ELF section of the electromagnetic spectrum. This area of the spectrum has different issues than for RF and a different body of research literature is relevant. ARPANSA and the Radiation Health Committee believe that the frequency range of 3 kHz to 300 GHz is the most appropriate frequency range to be used in a standard on RF fields and have planned to commence the development of a separate standard for the 0 -300 kHz frequency range.

Option 3 - Adopt the proposed “Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz”

Benefits:

- 7.17 Provides the highest degree of certainty to workers, consumers and the public that their exposure to RF radiation will be within established mandatory permissible limits, which have been based on established health effects from due consideration of international scientific research. Keeping RF exposure to within the basic restrictions set in the standard will accord protection for occupational groups and the general public.
- 7.18 The continued monitoring of scientific developments in the RF field by ARPANSA and its Radiation Health Committee, ensures that new scientific data would be considered in a timely fashion to ensure that the proposed standard remains up-to-date and relevant.
- 7.19 Public confidence in RF radiation protection in Australia will be enhanced as occupational groups and the public will feel assured that a national body (ARPANSA)

has in place a system for the evaluation of international scientific findings to update a standard that will be implemented in all Australian jurisdictions

- 7.20 Regulatory agencies will be able to address information asymmetry issues as they would have a nationally uniform standard, the information in which can be used as the basis to provide reliable health and safety information on the health effects of RF fields.
- 7.21 The changes from the previous interim standard to the ARPANSA standard do not impact on the telecommunications industry as they do not impose more restrictive limits than was the case under the interim (expired) standard. The changes are within proven public health and safety parameters following consideration of the most recent research literature, and hence will not result in permitting products that are detrimental to consumers or the community. In addition, industry representatives in the ARPANSA working group have determined that the majority of manufacturers or importers of telecommunications equipment such as mobile phones, would not need to modify products to meet the requirements of the proposed ARPANSA standard.
- 7.22 In relation to the induction heating industry, while some of the comments arising in the submissions raise issues of the cost or impact of the proposed standard, the comments actually refer to the 1990 standard, not the expired 1998 interim standard. In fact, there is very little difference between the requirements of the 1998 interim standard and the draft standard in relation to the frequencies at which induction heaters operate. Hence, it is expected that the adoption of the proposed standard would have little, if any, cost implications for this industry.
- 7.23 As mentioned previously, the limits specified in the proposed ARPANSA standard are based on ICNIRP: 1998. The primary basic restriction of 0.4 watts/kilogram (W/kg) whole body average SAR for occupational exposure and 0.08 W/kg for public exposure in the proposed ARPANSA standard is the same as that specified in ICNIRP:1998. Compared to ICNIRP:1998 the proposed ARPANSA standard now specifies basic restrictions and averaging times where these had not been specified by ICNIRP:1998. In addition, unlike ICNIRP:1998, the proposed ARPANSA standard mandates the precautionary approach for public exposure and risk management for occupational exposure, procedures for spatial averaging of reference levels and for verification of compliance with the exposure limits.
- 7.24 The proposed standard introduces several significant technical improvements over ICNIRP:1998. These are now summarised in Table 12 of the proposed standard and include:
- Changing the upper frequency for a number of basic restrictions from 10 GHz to 6 GHz, which could otherwise allow excessive heating of tissue near the skin at frequencies approaching 10 GHz. This change would have no effect on the communications industry, which does not operate in that frequency range, but potentially provides protection from some radar equipment, satellite technologies and microwave links.
 - Inclusion of a clear and concise method for spatial averaging of reference levels is a significant advance.
 - Improvements to the numerical precision of reference levels. The rounding used in ICNIRP:1998 caused artificial bias favouring some frequencies ahead of others, and causing discontinuities at the changeover frequencies between

basic restrictions. The proposed standard removes this problem to provide a smoother transition between frequencies.

- The specification of an averaging time for pulses, which was not included in ICNIRP:1998.

7.25 It is clear that the community has concerns about RF exposure, and that telecommunication companies devote considerable resources to dealing with public issues, both related to siting of base stations and to mobile phone handsets. The inclusion of precautionary statements in the proposed standard provides a logical and rational framework for this inevitable debate to take place. Some of the terms used in the precautionary statement will in due course be better defined in codes of practice (such as that currently being developed by ACIF) or through the courts, however it is considered better to give a framework to the issue in the proposed standard, rather than leave the matter completely undefined.

7.26 A regulatory approach with an established standard will ensure that proper sanctions could be in place to deal with breaches and will negate the need for the public or community groups to incur transaction costs to deal with issues under the common law.

7.27 It is consistent with ICNIRP:1998, which has been adopted by New Zealand (with the addition of some technical definition and a precautionary statement). The European Union (Council of the European Union 1999) has a recommendation for the adoption of ICNIRP:1998 and many European countries have adopted ICNIRP:1998. This will benefit trade and commerce in devices and equipment that use RF fields. Although the proposed ARPANSA standard does not have the promotion of international trade as its aim, the proposed ARPANSA standard, being consistent with ICNIRP:1998, will provide trade benefits for Australian manufacturers, importers and exporters.

Costs:

7.28 Quantifiable data on how much the industry spent to comply with the previous standards has not been made available. However, it can be assumed that industry would have to spend resources to comply with the proposed standard. This may involve human resources for compliance monitoring and reporting and infrastructure for testing and certification. However, as the standard is to control activities for which prudential systems should already be largely in place under previous standards, any additional costs are not expected to be large.

7.29 The telecommunications industry has expressed a concern that the inclusion of precautionary statements in the standard will introduce additional unknown costs and is not justified. However, precautionary statements, including a requirement to demonstrate adequate precaution, are in the 1999 New Zealand standard without having had such consequences.

7.30 Industry concern about the costs of the precautionary approach has been addressed in part by a change of emphasis in the precautionary statement included in the draft. It has been made clear that the precautionary approach applies to public exposure rather than occupational exposure, which was one of the concerns, by moving the clause from the

start of section 5 into the public exposure section. In addition, the wording has been changed (as follows) to be more specific about what the precautionary approach applies to:

“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:

...(e) Minimizing, 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.”

- 7.31 The RF induction heating industry expressed concern at the possible costs of demonstrating compliance with the new standard. However, their submissions did not take account of the fact that demonstration of compliance with the basic restrictions can be achieved by calculation, which was not the case for the interim standard. Hence it may be easier for this industry to demonstrate compliance than in the past.
- 7.32 As such, the proposed standard should not impose additional compliance costs that are disproportionate to the benefits of prescribing RF exposure limits.
- 7.33 Jurisdictions already regulating RF exposure are unlikely to incur additional administrative and enforcement costs. For example, the Australian Communications Authority, ARPANSA Regulatory Branch and the Queensland Division of Workplace Health and Safety do not believe that adopting the proposed standard will change their compliance monitoring costs. There may be some cost associated with contributing to continued review of the proposed standard to take into account new research findings, and some of the smaller jurisdictions not currently regulating RF exposure may require increased human resources to monitor compliance.

8. Summary of Impact Analysis

OPTION	IMPACT ON			LIKELY BENEFIT / COMMENT
	INDUSTRY	PUBLIC	GOVERNMENT	
OPTION 1 Self-regulation	Costs in writing and maintaining industry code. Unlikely that industry segments would agree on one standard.	No certainty if adequate industry standard will be established. Market failure may lead to higher social costs.	Will have to step in if industry standard is not acceptable. May have to deal with social costs of market failure.	No certainty that that appropriate exposure levels would be adopted. Public benefit uncertain. May lead to detriment to public health and safety.
OPTION 2 Adopt international guidelines	Guidelines may not be suitable for some local industries.	Public confidence will suffer as guidelines may or may not be complied with. Market failure issues may not be resolved.	Reliance only on international guideline will not fully address public health and safety and local requirements and will expose government to criticism.	Objective will not be achieved as ICNIRP:1998 is not a standard and cannot be enforced.
OPTION 3 Adopt the proposed ARPANSA standard	Costs may increase due to compliance, monitoring and risk management. Workers benefit from permissible exposure levels.	Would lead to public confidence in regulation. Avoids or minimises potential social costs from market failure.	Will incur costs to administer, review and enforce standard but can effectively regulate RF exposure for public benefit.	Certainty in achieving objective. Addresses potential market failure problems. Standard can be enforced. Exposure levels can be reviewed effectively by ARPANSA through Radiation Health Committee arrangements.

9. Consultation

- 9.1 The first level of consultation took place between ARPANSA and the ACA about the need for a standard and who should produce it when the Standards Australia process was abandoned. The communications industry indicated that it wanted a standard to provide certainty for the industry and agreed ARPANSA should develop the standard.
- 9.2 The next level of consultation took place within the working group that was established under the auspices of ARPANSA's Radiation Health Committee to draft a set of maximum exposure levels for RF fields in the frequency range 3 kHz to 300 GHz. The working group members were selected after consulting a range of relevant groups to achieve a spread of interests and expertise. The working group included members with expertise on electromagnetic radiation bio-effects, dosimetry and measurement techniques, medical expertise on epidemiology and occupational health and safety aspects, and knowledge of technical standards. Community and union representatives were also included.
- 9.3 The proposed draft ARPANSA standard was made available for public consultation from 5 March 2001 to 11 May 2001, with late submissions being accepted up to 1 June 2001. A total of 67 submissions were received. None of the respondents objected to the need for a standard for RF radiation levels or argued that the proposed standard would

be anti-competitive. Instead, the submissions related mainly to the permissible levels of RF exposure and technical issues within the standard. In particular, concern was expressed that the new levels would allow for higher emissions from mobile phones. Two of the 67 respondents raised the issue of compliance costs.

- 9.4 The draft RIS was released for public consultation on 26 October 2001 for four weeks. Eighteen submissions were received. A wide range of stakeholders responded including community groups, the communications industry, members of the induction heating industry, trade unions, consumer groups, a city council, consultants and the NSW Environment Protection Agency.

Comments on the precautionary approach varied depending on the respondents. While community and consumer groups demanded a higher degree of application of the precautionary approach, industry groups were wary of the implications of this additional requirement, which was neither in the interim (expired) standard nor in ICNIRP: 1998.

- 9.5 Respondents from the induction heating and RF welding industries criticised the proposed standard for taking a broad-based approach that favoured the communications industry and for taking little account of the practical implementation problems faced by the induction heating and RF welding industries. They argued that assessing compliance with the Basic Restrictions would be impractical in an industrial environment. Their concerns, however are based to some extent on comparing the proposed standard with the 1990 standard, rather than with the 1998 interim standard, and do not take account of the fact that compliance may actually be easier to demonstrate than in the past, by calculation.
- 9.6 The community view is that costs should not be considered when issues of public health and safety are involved.
- 9.7 Community groups were concerned that the different spatial peak magnitude and averaging mass from the Interim Standard allowed an effective increase in the maximum output power of a mobile phone handset. These new levels in the proposed ARPANSA standard are in accord with ICNIRP:1998. It should be noted that all mobile phone handsets employ adaptive power control. This means that the RF output power of the handset is continually adjusted to the minimum RF power required for communication with the base station. Consequently, for the majority of users, the RF power output is unlikely to increase. However, in circumstances where there is poor reception between a mobile phone handset and the controlling base station, it is theoretically possible for the RF output power of the handset to increase to a factor of two times above previous theoretical maximum levels. For mobile phone use the limit in the proposed ARPANSA standard is unlikely to result in any perceptible localised heating of tissue. The maximum temperature rise is expected to be about 0.1° C.
- 9.8 Four of the 18 submission commented on compliance costs, with one of the four stating that there would be no increase in compliance costs. Of the other three, the first expressed concern about possible unknown costs of the precautionary approach, and the other two dealt with compliance costs to the induction heating industry. However, none of these three submissions provided any direct evidence for their claims that compliance costs will increase. As described in the preceding paragraphs, the emphasis of the precautionary statement in the proposed standard has now been changed and implementation of precautionary approaches in other countries, such as New Zealand, have not had the claimed effect, The concerns of the induction heating industry appear

to relate, at least in part, to their comparison of the proposed standard with the 1990 standard rather than the 1998 interim standard.

10. Recommended Option

10.1 Option 1 is not suitable for the following reasons:

- (a) The objective of the regulatory intervention is to reduce the risk of adverse health effects from exposure to RF fields and thereby ensure public health and safety and promote public confidence in the safety systems in place. A self-regulation option will not satisfy public concerns that all issues have been adequately addressed by the industry.
- (b) The potential for exposure to RF fields is neither a low risk event nor of low significance. There is also considerable uncertainty over the risks of exposure to RF fields below the limits specified in the proposed Standard. As such, there is a need for government intervention.
- (c) The market has shown little initiative to fix the problem itself. This is evident from the fact that although the interim standard expired in March 1999, none of the industry players have initiated any action for self-regulation.
- (d) The industry is mainly divided into the telecommunication, radiocommunication, and small businesses using RF devices for heating and welding. There is doubt if the industry can agree on a single overarching health-based standard that can be easily enforced.
- (e) However, governments will never be able to fully divest their responsibility to monitor compliance and take action to remedy non-compliance or prevent market failures. Any economic benefit that a self-regulation model offers to governments may be negated by public backlash if governments fail to take an active role in dealing with health and safety issues, especially those that concern radiation health and safety.

10.2 Option 2 is not suitable as it would be the mere adoption of guidelines which, as described earlier, do not unambiguously specify all of the required basic restrictions, and hence would be difficult to enforce. ICNIRP:1998 could be used by the industry but these guidelines were last updated in 1997 and do not take account of recent research. There are also practical problems regarding the availability to the industry of further updates to the ICNIRP Guidelines. Furthermore ICNIRP:1998 was meant for use by countries to develop their own standards, rather than for direct adoption as a national standard⁴. Even countries such as New Zealand, which has adopted a standard based on ICNIRP, saw the need to add more technical definition and a precautionary statement to its standard.

10.3 The recommended option is Option 3 for the following reasons:

- (a) The communication industry, which is the largest user of RF fields, is already bearing the cost of complying with ACA requirements, which incorporate, in part, the levels in the interim standard. Option 3 formalises many of these requirements. As such compliance costs are unlikely to increase. Mobile phone

⁴ See www.icnirp.de/documents/use.htm, ICNIRP Statement 'Use of ICNIRP EME Guidelines', March 31 1999.

exposure standards are not being made more restrictive and, as such, there will be little or no cost impact on the mobile phone industry. It must be noted that only two of the 67 submissions on the proposed ARPANSA standard and three of the 18 submissions on the RIS commented that compliance costs will increase.

- (b) The RF heating and welding industry is wary that the implementation of the standard would involve higher compliance costs through the need to modify products, provide shielding. However, ARPANSA notes that there is very little change in the ARPANSA standard at the frequencies used in induction heating and welding and as such there would be no additional cost involved higher than that which the industry would have borne had it complied with the interim (expired) standard.
- (c) The RF heating and welding industry is also concerned that it would be difficult to measure the Basic Restriction Levels in the workplace and the limits of the proposed standard (3 kHz to 300 GHz) does not cover the range of frequencies at which it operates, which can go down to as low as 400 Hz. The industry has been informed that the Radiation Health Committee has agreed to develop a standard for extremely low frequencies covering 0 to 300 kHz and a sector specific Code of Practice for the industry. It is also expected that Standards Australia will develop a standard on measurements. It is expected that these measures would alleviate the concerns of the industry expressed in their comments on the RIS.
- (d) Option 3 provides the most certainty in terms of the protection of public health and safety from high-level exposure to RF fields and minimises the likelihood of information asymmetry or externalities. It ensures the application by industry of a standard that sets limits, which are designed to prevent established adverse health effects of heating, electrostimulation and auditory effects.
- (e) Option 3 also deals with the effects of RF exposure below the limits in the proposed standard by making express reference to the precautionary principle as a supplementary means for the industry to further widen the margins of safety for public exposure. . The proposed standard also recommends that it is generally sensible to minimise exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this does not introduce other risks and it can be readily achieved at modest expense.
- (f) In response to industry concerns about compliance costs from the precautionary approach, the standard has been re-written so that the precautionary approach now applies only to public exposure and not occupational exposure, for which the standard mandates the application of risk management principles.
- (g) Even the limits established in the proposed standard include precautionary elements. For example, limits for the general public are lower than those for occupational groups, and there is special treatment of pregnant workers. The proposed standard also mandates the need for a documented risk assessment process in the workplace to afford further protection to occupational groups.

11. National Competition Policy Statement

- 11.1 Under the NCP agreements, there is a need for every regulatory proposal to satisfy the two- fold test of whether the benefits of the restrictions in the proposal outweigh the costs and whether the restrictions are necessary to achieve the objective of the proposal.

11.2 The proposed standard prescribes RF exposure levels and as such constitutes restrictions on the permissible levels of RF fields.

11.3 The benefits of the recommended option are as follows:

- (a) Members of the public can be confident that appropriate exposure limits have been set to protect public health and safety.
- (b) Industry can meet permissible levels of exposure that can be objectively measured. This ensures that social costs due to externalities are minimised.
- (c) Persons and industries using RF-emitting equipment can access a nationally accepted standard that provides detailed rationale for exposure limits. Potential information asymmetry problems may be avoided or minimised.
- (d) Enforcement by governments will be made easier as actions or omissions can be compared to an accepted standard that is referenced in regulations.
- (e) A nationally accepted standard will ensure that the industry can work with a common set of requirements. This benefits inter-state trade and commerce.
- (f) The proposed standard is based on ICNIRP:1998. As such, there will be consistency with other national standards of countries such as New Zealand and many European countries. The USA standards (based on IEEE, 1999), although different, are based upon like considerations and are broadly similar to both ICNIRP:1998 and the proposed standard.

11.4 The costs of the recommended option are as follows:

- (a) Industry will have to bear the cost of compliance monitoring and risk management. (It should be noted that similar compliance costs would have existed under the interim expired standard).
- (b) Governments will incur administrative costs for monitoring and enforcement activities. These costs have also largely existed under the previous interim standard.

11.5 On balance, the benefits of the restrictions imposed by the proposed standard outweigh the costs and the restrictions imposed by the proposed standard are necessary to protect public health and safety.

12. Implementation and Review

12.1 The proposed standard will be published by ARPANSA as a Radiation Protection Series publication. All regulators in the Commonwealth, State and Territory, who manage activities that involve the use RF radiation, will be expected to adopt the standard by express reference in their regulations.

12.2 ARPANSA's Non-ionizing Radiation Branch continually reviews research literature on radiofrequency fields and will ensure that any issues that could necessitate review of the standard are reported to the Radiation Health Committee. Review of the standard would be undertaken promptly if there are identified problems in implementation or if international or national radiation protection objectives change, or if there is new information from Australian or international research into the effects of radiofrequency fields. In any case, the standard will be reviewed through the ARPANSA Radiation

Health Committee after a maximum of 10 years from its commencement to ensure it is still relevant to the radiation protection needs of the community.

13. References

Standards Australia, AS/NZS 2772.1 (Int): 1998, *Radiofrequency radiation. Part 1: Maximum exposure levels – 3 kHz to 300 GHz*

ICNIRP 1998, *Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz)*, Guidelines of the International Commission on Non-ionizing Radiation Protection, *Health Physics*, vol. 74, no. 4, pp. 494-522.

IEEE Standard 1999, *IEEE Standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz*, IEEE Std C95.10

ARPANSA, *National Competition Policy Review of Radiation Protection Legislation – Final Report*, May 2001 (see www.arpansa.gov.au).