EMF EXPOSURE STANDARDS IN NEW ZEALAND

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Abstract

Recommendations for limiting exposures to EMF* in New Zealand are based on ICNIRP guidelines1. The ICNIRP guidelines form the basis of the New Zealand radiofrequency field exposure Standard NZS 2772.1:1999, which covers the frequency range 3 kHz – 300 GHz. The Standard also provides guidance on verification of compliance, and requires exposures to be minimised, provided that this can be achieved at modest expense.

The Standard is not cited in any legislation, and so has no formal legal status. However, the Ministry of Health recommends strict application of the Standard as a means of controlling exposures to RF fields, and the implementation of low or no cost measures to minimise exposures. The Ministry for the Environment has recommended that compliance with the Standard be a requirement in local authority planning rules for radio transmitters.

There is no Standard or similar document covering frequencies below 3 kHz. The Ministry of Health recommends compliance with the ICNIRP guidelines at these frequencies too, and several local authorities have incorporated ICNIRP guidelines in planning rules concerning power lines and other electrical installations.

Background to the New Zealand RF field exposure Standard

The National Radiation Laboratory (NRL), a unit of the Ministry of Health responsible for administering ionising radiation protection legislation, has since the 1970s been the government agency providing advice to government, industry and the public on possible health effects from EMFs. In the absence of any national Standard, NRL advice was based on overseas recommendations such as the 1982 ANSI and 1988 INIRC/IRPA exposure limits.

Public interest and concern in New Zealand as elsewhere about possible health effects of exposure to EMFs developed over the 1980s. This concern came to a head in 1990 with proposals to expand a major transmitter site just west of Auckland, and led to the Minister of Broadcasting directing Standards New Zealand (then called the Standards Association of New Zealand) to prepare a New Zealand radiofrequency field exposure Standard.

As an interim measure, the new RF Standard committee set up by Standards New Zealand adopted the existing Australian RF exposure Standard (AS 2772.1:1990) as NZS 6609.1:1990†. This Standard was based on the 1982 ANSI C95.1 Standard, but made some significant changes, including:

- Reduced limits for non-occupational exposures – Non-occupational exposure limits were set at one-fifth of the occupational levels, in accordance with the IRPA 1998 proposals.
- Exposure limit constant above 30 MHz – Whereas the ANSI exposure limit increased at frequencies greater than 300 MHz, the AS 2772/NZS 6609 limits for occupational and non-occupational exposures remained flat up to 300 GHz. According to the Standard’s rationale, this was because of WHO references to injuries to rabbit eyes caused by short term exposures (less than one hour) to RF fields at 35 and 107 GHz at power flux densities ranging from 50 to 6000 W/m². On the other hand, it has also been suggested that the limits at these frequencies were negotiated between parties with differing views on where they should be set‡.
- Dual limits below 9.5 MHz – Dual occupational limits were set at frequencies below 9.5 MHz. If there was no possibility of RF burns and shock, the limits were the same as the ANSI values. In other situations, lower limits were applied to prevent shocks and burns.
- Reduced averaging time – The averaging time for exposures was reduced from six minutes to one minute. The reason presented in the rationale was that:

   “The committee was concerned that because this [six minute] averaging time allowed relatively high exposures at the beginning of the period, even when followed by low exposures, such high exposures could lead to a high possibility of athermal effects being manifest. It agreed that a shorter averaging time was prudent, and adopted a value of 1 min.”

In this paper, “EMF” means electromagnetic fields in the frequency range 0 – 300 GHz, consistent with the WHO definition.

† A list of New Zealand RF Standards, with complete references and the Standard they were based on, is presented in Table 2 at the end of this paper.
**ALARA requirement for non-occupational exposures** –

In addition to exposure limits for non-occupational exposures, the Standard stated:

“...because the effects of such exposures to electromagnetic fields are only imperfectly understood, it is recommended that the levels of all electromagnetic fields to which people are non-occupationally exposed, should be kept as low as reasonably achievable.” (italics in the original)

The use of a phrase introduced specifically for ionising radiation protection, where it has a particular meaning and clear scientific basis, was unfortunate due to the risk of diluting its meaning, and perhaps giving an impression that there might be a similarity between the effects of ionising and radiofrequency radiations. It is clear from the Standard’s rationale that the intention of this clause was to require exposures to be minimised, rather than suggest any analogy with ionising radiation.

As part of the process of harmonising Standards with Australia, the Australian and New Zealand committees were amalgamated in 1991 to work on a joint RF field exposure Standard. In 1998 this committee issued an interim Standard (AS/NZS 2772.1(Int):1998), valid for one year, based on the 1988 IRPA guidelines but with limits lower than IRPA at frequencies greater than 400 MHz. The draft of a final Standard was released for public comment in December 1998. This version was based on the 1998 ICNIRP guidelines, and included clauses to aid implementation and verify compliance. There was also a clause requiring operators to minimise exposures to the public.

In the final committee vote on the joint Standard, there were insufficient votes in favour from representatives of either country. It is clear that part of the reason for the negative votes was the move away from a “flat” limit above 300 MHz, and the change in averaging time from one to six minutes.

In accordance with Standards’ procedures, efforts were made to resolve differences. The New Zealand committee members, representing the bodies listed in Table 1, managed to agree on changes which, when put to a further ballot of the New Zealand members, received sufficient votes to be adopted. The resulting Standard is New Zealand Standard 2772.1:1999 *Radiofrequency Fields Part 1: - Maximum exposure levels - 3 kHz to 300 GHz.*

**Overview of NZS 2772.1:1999**

The New Zealand RF field exposure Standard (“the Standard”) is based closely on the ICNIRP 1998 guidelines, and all basic restrictions, reference levels, averaging times, treatments of pulsed and multi-frequency exposures etc are taken directly from ICNIRP. (Indeed, the ICNIRP guidelines form Appendix A of the Standard.)

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<th>Table 1. Composition of the NZ RF Standard committee</th>
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<td>Adopt Radiation Controls Inc</td>
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<td>Broadcast Communications Ltd</td>
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<td>Local Government NZ</td>
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<td>Ministry of Commerce</td>
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<tr>
<td>National Radiation Laboratory (Ministry of Health)</td>
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<tr>
<td>New Zealand Association of Radio Transmitters</td>
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<tr>
<td>New Zealand Institute of Occupational and Environmental Medicine</td>
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<td>Telecom New Zealand Ltd</td>
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The Standard includes several clauses intended to aid implementation and verification. Amongst these are the following:

**Spatial averaging** – in order to take account of the fluctuations in field strength caused by interference and other effects, the Standard prescribes how exposures may be spatially averaged.

**Verification of compliance** – the Standard specifies the measurements required to verify compliance. This includes consideration of near and far fields, type testing, and mobile and portable transmitters. Clarifying how compliance should be verified, especially in respect of time averaging exposures, was one of the changes which led to final adoption of the Standard.

**Protective measures** – the Standard outlines the types of measures which should be used to ensure protection for both occupational and public exposures.

Amongst the controls for protection of the general public is clause (10(d)) which requires:

“Minimizing, as appropriate, RF exposure which is unnecessary or incidental to achievement of service objectives or process requirements, provided that this can be readily achieved at modest expense.”

The basis for this clause is presented in the Foreword to the Standard, which states:

“There is a currently a level of concern about RF exposure, which is not fully alleviated by existing scientific data. It is acknowledged that data regarding biological effects, at levels below those determined in this Standard, are incomplete. However, as these data are neither clear nor consistent, these have not been used in setting levels in the ICNIRP guidelines or this Standard. It should be further noted that it is not possible to logically prove with certainty that any environmental agent will not cause an adverse health effect. This is an inherent limitation of any process,
including the scientific method, that relies on inductive reasoning.

Research is continuing in many countries into possible effects on health arising from RF exposure. In recognition of this, the committee will continue to monitor the results of this research and, where necessary, issue amendments to this document. Generally, it is therefore sensible in achieving service or process requirements to minimise unnecessary or incidental RF exposure.”

The exact wording of this clause, and the discussion in the Foreword, was debated extensively by both the joint and New Zealand committees, and it carries over the “as low as reasonably achievable” requirement from NZS 6609. A note below clause 10(d) comments:

“Although ICNIRP considers that the basic restrictions and reference levels in this Standard provide adequate protection, it is recognised that community concerns over RF exposure may be able to be addressed by further minimisation of exposure in accordance with the requirement of item (d).”

#### Legal status of the Standard

The Standard is not cited in any New Zealand law or regulations, and so has no explicit legal standing. However, the New Zealand Ministry of Health recommends strict application of the Standard as the basis for controlling exposures, on the grounds that:

- The ICNIRP guidelines incorporated in the Standard are based on a recent and comprehensive evaluation of the research literature.

- The ICNIRP conclusions and guidelines are supported by other independent reviews published by competent and experienced panels.

- The Standard includes clauses to assist with implementation and demonstration of compliance.

The Ministry also supports the implementation of low or no cost measures to avoid or reduce exposures, as envisaged in clause 10(d) of the Standard. Effectively, this means that if different options are available when a transmitter is being planned, then those which result in the lowest exposures should be preferred, all other things being equal. For example, this could be by choosing an antenna which minimises transmissions in directions where coverage is not required, and using the minimum power necessary to achieve the required coverage. It may involve a trade-off between competing objectives: for example, raising an antenna further off the ground would decrease exposures, but may make it more visually intrusive. If two equally suitable sites are available, the one resulting in lowest exposures should be chosen.

The Ministry considers that such low or no cost measures are appropriate for a number of reasons, including the acknowledged gaps in research and understanding in some areas. The measures should not be seen as undermining the ICNIRP guidelines, but as a means to take account of the remaining uncertainties in our understanding of the science, and the assumptions inherent in the ICNIRP and other risk assessments.

On the advice of the Ministry of Health, National Guidelines issued by the Ministry for the Environment (MfE) recommended to local authorities that compliance with the New Zealand RF field exposure Standard be included in local planning rules relating to radio transmitters. The MfE Guidelines were produced at the request of central government in order to assist local authorities, many of which felt poorly equipped to assess the health arguments arising from the introduction of new radio technologies (principally cellular). Community groups and the telecommunications industry were consulted extensively during development of the guidelines, which provide advice to these parties as well as local authorities.

Although the MfE Guidelines are not binding on local authorities, they include a discussion of relevant decisions from the Environment Court (the appeal court for planning matters, whose decisions can have some precedent value) which in 1999 determined that the Standard should not be undermined without good reason. Many local authorities are now following the MfE advice, or have based their rules on previous versions of the Standard. While some members of the public still consider that more restrictive exposure limits should be applied, the publication of clear guidance from the two Ministries has helped clarify which issues may fruitfully be raised at planning hearings, and has probably resulted in several decisions not to proceed with appeals to the Environment Court.

Under the Health and Safety in Employment Act, employers are responsible for identifying and controlling workplace hazards. There is no explicit requirement to comply with the Standard but the NRL, which often provides advice on such matters to both individual employers and the Occupational Safety and Health service of the Department of Labour, recommends its application here too. In this context, it is important to distinguish between “true” occupational exposures (that is, exposures to people who are exposed in the course of their work, are aware of the exposures and also of any safety precautions that might be necessary), and incidental exposures of other staff who should properly be considered as members of the public.

Major employers in businesses where RF exposures can occur are generally well aware of possible hazards and take appropriate measures to identify areas of high exposure, control access, limit exposures and train staff. The situation with smaller businesses using RF heating or
welding equipment is not so clear. A survey carried out in the late 1980s found a high percentage of RF welders exposed operators to field levels well above reference levels. Since then, many of the welders producing high exposures have been withdrawn or modified. Most welders in NZ are supplied and serviced by one company, which considers itself legally obliged to check exposures from any equipment it handles. However, no further work has been carried out to determine whether the problem of high exposures has been eliminated.

**Other frequencies**

There are no New Zealand Standards or other documents covering frequencies below 3 kHz. NRL advice has normally been to follow ICNIRP guidelines and since the late 1980s, for example, has recommended IRPA/INIRC (and more recently ICNIRP) guidelines for exposures to power frequency fields. Some local authorities have incorporated the ICNIRP guidelines applying at 50 Hz to planning rules governing power lines and other electrical installations.

**Discussion**

At the time the 1999 Standard was introduced, some argued that the increase in exposure limits at frequencies above 400 MHz would lead to higher public exposures. In practice there is no evidence that this has happened. At these frequencies, maximum exposures in public areas were already considerably below the limits in previous versions of the Standard, and there is no reason to believe that operators then or now were constrained by the exposure limits. Occupational practices and exposures, however, have changed in response to changes in the Standard. (In some situations, occupational compliance is now more difficult than previously, due to the disappearance of some short term relaxations present in the old NZS 6609.)

There are no hard and fast rules to determine whether a proposed transmitter satisfies the clause 10(d) requirement to minimise exposures. For some applications, such as cellular phone base stations (cellsites), the technology itself often requires that transmitter power be minimised in order to prevent radio interference. There have certainly been examples of cellular network operators making adjustments to proposed antenna locations in order to reduce exposures, and even locating cellsites away from optimal sites which were within or very close to residential areas. As part of the planning process, some sites have been subjected to very close scrutiny to test whether they satisfy clause 10(d).

A concern frequently expressed during preparation of the MfE Guidelines was that they could not take account of any future research which might lead to a change in the exposure recommendations. In response to this concern the Ministry of Health undertook to broaden the scope of an existing interagency committee which monitors research on extremely low frequency fields to include RF fields as well. The new terms of reference of that committee require, amongst other things, that it inform the Director General of Health of any developments which affects policies, guidelines and advice promulgated by the Ministry of Health and Ministry for the Environment.

In common with many small countries, it would be difficult for New Zealand to develop EMF exposure Standards independently from scratch. It is invaluable to have comprehensive and credible guidance available from organisations such as ICNIRP to form the basis of such Standards.

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<tr>
<th>Table 2</th>
<th>New Zealand radiofrequency field exposure standards, and their bases</th>
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<tr>
<td><strong>Standard</strong></td>
<td><strong>Standard used as a basis</strong></td>
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<tr>
<td>AS 2772.1:1990</td>
<td>American National Standards Institute. Safety levels with respect to human exposure to radiofrequency electromagnetic fields, 300 kHz – 100 GHz. The Institute of Electrical and Electronics Engineers, New York NY10017, ANSI Committee C95.1, 1982.</td>
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<tr>
<td>Adopted as NZS 6609.1:1990 <em>Radiofrequency fields Part 1</em> - Maximum exposure levels 100 kHz – 300 GHz</td>
<td>IRPA (1988). Guidelines on limits of exposure to radiofrequency electromagnetic fields in the frequency range from 100 kHz to 300 GHz. Health Physics, 54:115-123</td>
</tr>
<tr>
<td>NZS 2772.1:1999 <em>Radiofrequency fields Part 1</em> - Maximum exposure levels 3 kHz - 300 GHz</td>
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**References**


