The Parliament of the Commonwealth of Australia

Inquiry into Electromagnetic Radiation

Report of the Senate Environment, Communications,

Information Technology and the Arts References Committee

May 2001

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TERMS OF REFERENCE

On 8 December 1999 the Senate referred the following matters to the Environment, Communications, Information Technology and the Arts References Committee for inquiry (to commence not before 31 March 2000) and report by 31 October 2000 (subsequently extended to 4 May 2001):

(a) an examination of the allocation of funding from the Commonwealth's $4.5 million fund for electro-magnetic radiation research and public information;

(b) a review of current Australian and international research into electro-magnetic radiation and its effects as it applies to telecommunications equipment, including but not limited to, mobile telephones;

(c) an examination of the current Australian Interim Standard [AS/NZS 2772.1 (Int): 1998], as it applies to telecommunications;

(d) an examination of efforts to set an Australian Standard dealing with electro-magnetic emissions;

(e) an examination of the merits of the transfer of the responsibility for setting a new Australian standard for electro-magnetic emissions to the Australian Radiation Protection and Nuclear Safety Agency.

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Senator Aden Ridgeway (AD, NSW) appointed for arts issues
Senator Vicki Bourne (AD, NSW) appointed for the inquiry into the online delivery of ABC material

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ACRONYMS AND GLOSSARY

1G	First generation of mobile phones; analogue voice systems
2G	Second generation of mobile phones; use digital technology
3G	Third generation of mobile phones; designed to mix data and voice communications
ACA	Australian Communications Authority
ACIF	Australian Communications Industry Forum
ALARA	As Low As Reasonably Achievable
AMPS	Advanced mobile phone system (analogue)
AMTA	Australian Mobile Telecommunications Association
ANSI	American National Standards Institute
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CDMA	Code Division Multiple Access
CEMEPHI	Committee on Electromagnetic Energy Public Health Issues
CRADA	Cooperative Research and Development Agreement
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTIA	Cellular Telephone Industry Association (USA)
CTN	Consumers' Telecommunications Network
DCITA	Department of Communications, Information Technology and the Arts (Commonwealth)
Eμ-pim-1 mice	A strain of genetically modified mice engineered to be susceptible to a particular type of cancer
ECG	Electrocardiogram
ECTA	Electrical Compliance Testing Association
EEG	Electroencephalogram
EHS	Electro-hypersensitivity

ELF	Extremely Low Frequency
EM	Electromagnetic
EME	Electromagnetic emissions
EMF	Electromagnetic fields
EMI	Electromagnetic interference
EMR	Electromagnetic radiation
Epidemiology	the study of the various factors influencing the occurrence, distribution, prevention, and control of disease, injury, and other health-related events in a defined human population.
FDA	Food and Drug Administration (USA)
Frequency	The number of complete cycles of an electromagnetic wave in a second. Unit: hertz, abbreviation: Hz. 1 Hz = 1 cycle per second
GMA	Geomagnetic activity
GSM	Global System for Mobile Communication
Hertz	1 hertz (1 Hz) is one cycle per second of a wavelength; 1000 Hz = 1 kilohertz (1 kHz); 1000 kHz = 1 megahertz (1MHz); 1000 MHz = 1 gigahertz (1 GHz).
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICRP	International Commission on Radiological Protection
IEEE	Institute of Electrical and Electronics Engineers
IEGMP	Independent Expert Group on Mobile Phones (UK) (authors of the Stewart Report)
INIRC	International Non-ionizing Radiation Committee
in vitro	in glass
in vivo	in a living body, as opposed to *in vitro*

IRPA	International Radiation Protection Association
mG	milliGauss (old unit of measurement of magnetic fields)
Microwatt	A unit of power equal to one millionth (10^{-6}) of a watt (abbreviation: μW)
Milliwatt	A unit of power equal to one thousandth (10^{-3}) of a watt (abbreviation mW)
MOU	Memorandum of Understanding
NATA	National Association of Testing Authorities
NCI	National Cancer Institute (USA)
NHMRC	National Health and Medical Research Council
NIR	non-ionizing radiation
NRPB	National Radiological Protection Board (UK)
ODC	ornithine decarboxylase – an enzyme
power density	The measure of the radiated power of radiofrequency radiation reaching a surface. Sometimes called "power flux". The most common unit for this parameter is milliwatts per square centimetre (mW/cm^2). Also common is watts per square metre (W/m^2), where 1 W/m^2 = 0.1 mW/cm^2 = 100 $\mu W/cm^2$
power flux density	The rate of flow of radiofrequency energy per unit surface area expressed in watts per square metre (W/m^2) The basic dosimetric quantity for RF fields above 10 GHz is the intensity of the field measured as power density in watts per square metre (W/m^2) or for weak fields in milliwatts per square metre (mW/m^2) or microwatts per square metre ($\mu W/m^2$).
RF	Radiofrequency
SAR	Specific absorption rate
SRDC	Strategic Research and Development Committee – an NHMRC Committee
SW	Short wave
TDMA	Time Division Multiple Access

TE/7	Standards Australia technical committee responsible for setting standards for human exposure to electromagnetic radiation
Tesla	Magnetic fields are measured in tesla (T), millitesla (mT) or microtesla (μT). In some countries the old unit called the Gauss (1 G = 100 μT, or 1 μT = 10 mG) is still used for measuring magnetic fields
TIO	Telecommunications Industry Ombudsman
W/kg	Watt per kilogram (measurement of Specific Absorption Rate)
WAP	Wireless Application Protocol
Watt	A measure of power (that is, energy per unit time) eg: 1 Watt = 1 Joule/second
WLL	Wireless Local Loop
WHO	World Health Organization
WTR	Wireless Technology Research (operation of the CTIA)

EXECUTIVE SUMMARY

Introduction

While radio waves and other forms of electromagnetic energy have been in use for decades, the recent dramatic increase in the use of the microwave portion of the spectrum for wireless technology such as mobile phones, the proliferation of mobile phone towers and antennas and accompanying anecdotal and scientific evidence showing biological and possible health effects associated with this technology, have led to increased public concern about their safety.

The Committee found interpretation of the results of studies of electromagnetic radiation and its effects on living systems to be highly complex, contradictory and contentious.

The Committee's understanding of the implications of scientific research findings was made difficult by the variable and complex nature of genes, immune and other biological systems, debate about the importance of replication of studies, the vexed question of the influence of the telecommunications industry in the design, funding and interpretation of studies and the lack of consensus about implications for health and safety.

The Committee has found that while adverse health effects are not agreed upon, the existence of biological effects associated with radiofrequency radiation is now recognised.

For these reasons the Committee Chair recommends a rigorous precautionary approach in all areas of the deployment of wireless technology, that radiofrequency (RF) emissions be kept As Low As Reasonably Achievable (ALARA), and that the expired interim exposure Standard not be adapted to the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines.

The research

The science on which the current non-ionising radiation standards is based, relates to the capacity of heating to cause adverse health effects and, while these 'thermal effects' are said to be understood, interpretation of studies showing biological effects of non-thermal exposure to electromagnetic radiation remains contentious and knowledge about the mechanism which causes those effects is still limited.

Studies examining the relationship between radiofrequency radiation and biological and health effects have been extensively reviewed in Australia and overseas, but the conclusions made in these reviews have been uncertain and in many respects, contradictory with different conclusions drawn about whether or not the scientific evidence was sufficiently reliable as a basis for sound judgments on exposure levels.

While the CSIRO said too little relevant research had been carried out, the European Commission took the approach there was no convincing evidence to suggest a long term public health hazard. The World Health Organization (WHO) said there were no known health hazards associated with radiofrequency. The Royal Society of Canada and the Stewart Reports concluded that although biological effects had been demonstrated, there was no evidence of documented health effects but they did not rule out the possibility that they existed.

One of the most contentious issues with regard to the validity afforded scientific studies is the question of replication. Industry argued that studies cannot be regarded as reliable evidence unless replicated but the Committee heard evidence of difficulties in attracting funding for replication studies, lack of interest in such work, unforeseen variables, particularly with regard to the genetic make-up of animals, changes and sometimes improvements in the methodology and the argument that the weight of evidence is as important as the confirmation of individual studies.

Whilst industry, the WHO and government submissions argued that the science was inconclusive, others said that the majority of peer-reviewed, published scientific research showed effects from non-ionising radiation including DNA damage, heat shock protein response, changes in the movement of substances across cell membranes, changes in the blood brain barrier, oncogene change, melatonin reduction and altering of calcium ion signalling.

In animals, studies have shown chromosome aberrations, increases in double and single strand DNA breakages, increases in the promotion of certain cancers in genetically predisposed mice, severe depression of the immunological and endocrinological responses of young chickens, changes in temperature regulation, changes to calcium ion mobility in the brains of cats and rabbits, changes to the proliferation rate of cells, alterations to enzyme and nervous system activity and behavioural change, at low level exposure to radiofrequency radiation.

The body of scientific research, whilst substantial, was criticised by the Stewart Report as inconsistent, inadequate, based on single experiments rather than a consistent series of hypothesis-driven investigations. Dr Neil Cherry argued that the evidence of biological evidence was solid and consistent but that much of it had not been sighted, summarised or integrated. The Royal Society of Canada Report said that studies showing observed biological effects that it reviewed were well-designed, had appropriate positive and/or negative controls, contained valid RF exposure parameters, included appropriate statistical evaluation of the significance of the data and had been observed to occur by more than one investigator.

Possible mechanisms

Professor Litovitz said his work using electromagnetic fields to protect against damage due to heart attacks and to treat cancer and inflammation led him to the theory that, through a signal transduction, electromagnetic signals reach the surface of the cell or receptor and send a signal to the nucleus which proceeds to undergo various biochemical processes and, in particular, alters the levels of protective proteins.

Dr Peter French suggested that continual use of a mobile phone could potentially induce the chronic expression of heat shock proteins which can lead to increased metastasis, initiation and promotion of cancer and resistance to anti-cancer drugs. He said the mechanism by which microwaves may cause protein unfolding, leading to heat shock response, could be a resonance of the microwave field with the protein or water in the cell but that this was as yet only a hypothesis.

Dr Neil Cherry said it had been demonstrated that oscillating signals interfere with the brain and can change the EEG, and therefore calcium ions, by resonant absorption.

The Committee Chair is persuaded that without an understanding of biological mechanism(s) responsible for observed effects it is not possible to accurately establish safety limits.

Whilst some witnesses argued for the need to clearly distinguish between the evidence for adverse health effects from exposure to radiofrequency radiation such as that from mobile phones and extremely low frequencies (ELF) (primarily 50/60 Hz) such as those from powerlines, others said that the cell's characteristic response was the same. Many studies cited during the inquiry related to ELF and report observed effects from exposure to ELF on the reproductive system, blood changes, ECG, heart rate, blood pressure, body temperature, melatonin and cancer.

Cancer

The development and promotion of cancer ranks in the general public's mind as a real health risk associated with mobile phones, but again, the scientists and reviewers disagree about the evidence.

The Stewart Report said studies of brain cancer provided inconsistent results, and others commented that there were inherent selection biases, numbers too small to be reliable and that better designed studies tended to show no association.

The CSIRO pointed out that one animal study often cited as negative was analysed by separating out each type of cancer whereas the overall incidence of primary malignancies between the exposed and the control group showed a fourfold increase.

The Telstra-funded study in 1997 on mice genetically predisposed to lymphoma showed a doubling in the incidence of the cancer in the group exposed to mobile phone frequencies.

Studies done on human exposure to analog mobile phones have shown no short term effect but researchers have recommended that further research is undertaken to account for longer induction periods, particularly for slow-growing tumours and for the differences between analog and digital mobile phones.

Cases which examined cerebral tumours, found no association between cancer and the duration of mobile phone use but tumours did occur more frequently on the side of the

head to which the phone was customarily held. In one study temporal lobe cancers occurred more frequently on the opposite side of the head.

Other health effects

An Australian study of 40 people who identified health effects from mobile phone use showed symptoms including dull pain, an unpleasant warmth or heating, as well as ache, throb, sharp pain and pressure. Most respondents felt the sensation less than five minutes after commencing the call, but for others the sensation built up as the day progressed. For some the sensation lasted less than an hour after ceasing calls, for others it lasted for many hours. The author of the study, epidemiologist Dr Bruce Hocking, said this was the first clear indication of a health effect on humans attributable to a mobile phone.

There was disagreement about the implications of studies showing effects on the cardiovascular system, brain function and the immune and neurotransmitter systems but it was agreed that further research should be conducted in these areas.

Ten epidemiological studies have found significant miscarriage from EMR exposure across the spectrum from ELF and SW to RF/MW. The Scandinavian study of physiotherapists found significant prematurity, congenital malformation, still-birth and cot death but reviewers said that the numbers exposed to microwave equipment were too small to provide reliable risk estimates.

A Greek study of mice placed at various locations in relation to a RF transmission tower showed the low exposure group became infertile after five generations and the high exposure group after three generations. This study was said by reviewers to be inconclusive because it did not include matched control groups or take into account other environmental factors. The potentially greater sensitivity of children to the effects of electromagnetic radiation, was also the subject of disagreement amongst scientists and reviewers. Ionising radiation and some chemicals are known to have the greatest effect in causing brain and nervous system cancer in rats when administered early in life during which time the nervous system is developing but this has not yet been established for mobile phone exposure.

The implications for children of greater absorption of RF because of thinner skulls and brain tissue containing more ionic fluid and therefore higher conductivity were disputed. The Stewart Report recommended that children be discouraged from using mobile phones for non-essential calls and that the industry refrain from promoting the use of mobile phones by children, however the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) disputed the conclusion that led to the recommendation saying that whilst it was true that children are likely to be exposed for a much longer time than adults, in the absence of any knowledge of an injury mechanism, there is no reason to believe that children will be inherently more vulnerable than any other age group.

Given the increasing use of mobile phones by young children and teenagers, the Committee considers that research into the effects of mobile phone technologies on

young people should be treated as a priority and that material should be developed to advise parents and children of the potential risks associated with mobile phone use.

Mobile phone towers and base stations

There were differing claims about the risks of exposure to mobile phone base stations and transmitters. Submissions expressed concern about the continuous and involuntary nature of the exposure however it was generally accepted that radiation from mobile phone towers is potentially less harmful than mobile phone emissions and ARPANSA argued that mobile phone base stations contribute only a small amount of RF compared with radio and television transmission.

In spite of this and the controversy surrounding results of the Hocking study which found a 60 per cent increase in leukaemia in children living close to TV towers, the Committee is persuaded that a precautionary approach should be taken in siting base stations.

The Committee also notes the report of the UK's National Radiological Protection Board indicating evidence of a slightly increased risk of leukaemia in children living near high voltage powerlines.

Minimising the risk

The Committee Chair was disturbed at the lack of industry and government attention to developing lower-emission mobile phone technology or consumer advice about minimising exposure. The Committee found that the effectiveness of shielding devices and hands-free kits was at best unclear, that no standards or other regulations existed for these devices, and that whatever guarantees there were of mobile phone compliance with current standards, these became null and void with the use of such devices.

The Committee was concerned to find that there was no complaints or referral system in place for consumers experiencing health effects. Although some scientists and mobile phone manufacturers said it would be difficult to collect useful data, the Committee Chair supports the CSIRO's proposal for a 'register of health effects to systematically investigate and record reports of adverse health effects from mobile phone use' and an industry code of practice for handling complaints.

Funding of research and public information

Under its first term of reference, the Committee examined the allocation of funding from the Commonwealth's $4.5 million radiofrequency electromagnetic emissions fund for research and public information (the RF EME program). This program consists of three components: an Australian research program, a contribution to the World Health Organization Electromagnetic Field Project, and a public information program.

The major criticism of the research program was that funds were inadequate. Of the $4.5 million RF EME program, $3.4 million was allocated for Australian research,

$131,000 spent to June 2000 on public information and $US50,000 per annum on the WHO International EMF Project. The $4.5 million was collected from a one per cent levy on radiocommunications licences over a five year period which ends in 2000-01.

The RF EME program has funded six studies to date (including one a completed pilot study) which are detailed in Chapters 2 and 3.

The National Health and Medical Research Council (NHMRC) has the responsibility for awarding grants for this program and the Committee examined the funding allocation and criticisms that scientists who had found health effects of electromagnetic radiation were overlooked for funding, the length of time taken to get research results, the fact that the public information program had proceeded ahead of the research and accusations that there was an industry bias in the allocation of funds.

Submissions argued that in the light of identified gaps in knowledge of health effects, the need for replication, the cost of research, particularly animal studies, the value of the mobile phone industry, the significant revenue earned by government from the industry and the large number of people exposed, that a much larger sum should be available on an ongoing basis.

Counter arguments were made by the NHMRC to the effect that the program was consistent with amounts awarded in other areas of medical research, that a higher level of government funding would mean other projects would not be funded. It said that setting priorities for research spending was ultimately a social or political decision.

The NHMRC had reservations about the small number of researchers in this field being available to take up significantly more grants but acknowledged that one-off funding did not encourage specialisation.

There was general agreement on the need for research funding to be at arms-length from industry and whilst generally finding no fault with the NHMRC's processes, the Committee Chair was critical of the fact that Motorola employee, Dr Ken Joyner, is a member of the NHMRC's Radiofrequency Electromagnetic Energy Expert Committee and involved in the grant awarding process. Despite assurances that this role is a non-voting one, the Committee Chair is of the view that it is nonetheless an influential role and that for the sake of public confidence in the program, all members should be quite independent of industry.

The RF EME program was criticised as piece-meal, too scattered across institutions and lacking in structure and strategic planning.

The Committee Chair is not in a position to judge the quality or relevance of current research but does accept that more money should be available for research and recommends that a levy of $5.00 be raised from each mobile phone user annually, the bulk of which should fund a structured program of research and a specialised research unit set up within the CSIRO for this purpose. The Committee Chair also recommends maintaining the NHMRC administered research program at $4 million per annum from the levy.

Details of the World Health Organization Electromagnetic Fields Project are outlined in Chapter 2.

Public Information

The Committee heard from witnesses that lack of information on the potential risks associated with electromagnetic radiation and the failure to provide information on research findings denied the public the opportunity to make informed decisions.

The Committee holds the view that the Public Information Program has not been successful in informing the public, evidenced by the fact that many do not believe the information that is provided by government and its agencies. The Committee recommends that the Committee on Electromagnetic Energy Public Health Issues (CEMEPHI) website is regularly updated to reflect ongoing developments in research and standard setting.

The Committee found the so-called low-impact facility determination especially to be a cause of community dissatisfaction. Although radiation from mobile phone towers is considered to be potentially less harmful than mobile phones, the continuous exposure from towers, and the involuntary nature of that exposure have generated considerable public concern.

The Committee Chair recommends that the Government review the Telecommunications (Low-impact Facilities) Determination 1997 and ensures that a robust precautionary approach is included in the new Code of Conduct currently being devised by the Australian Communications Industry Forum (ACIF).

The Committee considers that other approaches to improve community understanding and participation should be facilitated, including conferences discussing research on the health effects of radiofrequency radiation and a centralised complaints mechanism for members of the public to report perceived health effects from mobile phones, the data from which can be used in determining research funding priorities.

Australian Standard

The Committee's terms of reference (c), (d) and (e) relate to the Australian Standard which deals with human exposure to electromagnetic emissions as it applies to telecommunications. Chapter 4 maps the history of standard setting in Australia and examines in particular the proposal to relax the Australian standard for exposure in line with the ICNIRP Guidelines and the refusal of the responsible Standards Australia TE/7 Committee to agree to that proposal, and the subsequent transfer of that responsibility to ARPANSA.

Central to the question of the adequacy of our standards was whether or not they dealt with non-thermal emissions. Dr Michael Repacholi advised that the scientific studies on which our standards are set were observations made in the 1970's of behavioural change in primates exposed to heat-emitting devices.

During the 1950's, dosimetry – the science of measuring exposure – was developed for non-ionising radiation and the concept of specific absorption rate (SAR) established. SAR is the rate of absorption of radiofrequency energy in a unit mass of tissue. A SAR of 4 watts per kilogram was settled on as a level of exposure that could result in a rise in core body temperature of up to $1^{o}C$.

Evidence presented suggested that this was a relatively basic idea of preventing core body temperature increases, given the complexity and variability of the resonant properties of the human body, and that the development of standards since that time had been somewhat arbitrary and inadequate in dealing with the effects which could be observed but which could not be explained by thermal effects.

The 1985 Australian Standard did however take a more conservative approach to setting exposure levels than the American National Standards Institute, choosing lower exposure levels for the higher and lower frequency ranges and an averaging time of one minute for all exposure conditions rather than the US six minute averaging time. This approach was said to acknowledge the possibility of harmful non-thermal effects.

Witnesses suggested that since 1985 the Australian Standard has come under sustained industry pressure to revert to much higher levels of exposure; to delete references to fundamental principles of radiation safety; to minimise any explicit references to harmful effects; and to delete the previous acknowledgment of the existence of non-thermal effects on living organisms.

A periodic review of the 1990 Standard was begun in 1993 but the TE/7 Committee would not agree to proposals put forward by industry to significantly increase allowable exposure limits. Nevertheless, an Interim Standard was introduced in 1998, based on International Radiation Protection Association SAR guidelines but covering an extended frequency range down to 3 kilohertz.

The Interim Standard was criticised as establishing exposure limits to suit mobile phones that failed to comply with previous public safety exposure standards.

Industry generally advocated that Australia's standards should be in harmony with world wide standards but the CSIRO observed that the 1985 Australian Standard was in place for more than 12 years and had not inhibited the introduction of new technologies and that furthermore, lower standards could have the effect of encouraging technological excellence.

The Committee Chair concurs with the CSIRO's view that relaxations of the 1985 Australian limits over much of the frequency range and averaging measurements over six minutes do not represent progress in dealing with non-thermal effects and are not warranted.

The Committee Chair also agrees that the standards should continue to include the precautionary principle and the principle that all possible efforts should be made to keep exposures as low as reasonably achievable (ALARA) below prescribed limits.

The Committee Chair is critical of the decision to transfer the standard setting process to ARPANSA, preferring the process used by Standards Australia and in particular, the involvement of the CSIRO and community representation and a voting system which provides for public health protection to be given appropriate weight against industry considerations. The Committee Chair notes that voting procedures in the ARPANSA working group are unclear and, in any case, lack of consensus will cause the Standard to be referred to the Radiation Health Committee for ratification which the Committee Chair regards as inappropriate.

Chapter 4 also deals with concerns about the designation of mobile phone towers as so-called low-impact facilities on the basis that the impact relates to visual and not planning, heritage, or health considerations. It examines proposals for labelling of phones, criticisms of testing and compliance frameworks for phones and shielding devices, occupational standards, and criticisms relating to the composition and processes of the ARPANSA Working Group set up to formulate the new standard.

Senator Lyn Allison
Chair

RECOMMENDATIONS

Recommendation 2.1

The Committee Chair recommends that, particularly in the light of recent reports on the links between powerlines, radio towers and leukaemia, additional research into extremely low frequencies and TV/radio tower exposure should be encouraged.

Recommendation 2.2

The Committee Chair recommends that precautionary measures for the placement of powerlines be up-graded to include wide buffer zones, and undergrounding and shielding cables where practicable.

Recommendation 2.3

The Committee recommends that based on a growing body of research that provides evidence of biological effects, the Commonwealth Government considers developing material to advise parents and children of the potential risks associated with mobile phone use.

Recommendation 2.4

The Committee recommends that shielding and hands-free devices are tested, labelled for their effectiveness and regulated by standards.

Recommendation 2.5

The Committee Chair recommends that the Government review the Telecommunications (Low-impact Facilities) Determination 1997, and as a precautionary measure, amend it to enable community groups to have greater input into the siting of antenna towers and require their installation to go through normal local government planning processes.

Recommendation 2.6

The Committee recommends the development of an industry code of practice for handling consumer health complaints.

Recommendation 2.7

The Committee recommends the establishment of a centralised complaints mechanism in ARPANSA or the Department of Health for people to report adverse health effects associated with mobile phone use and other radiofrequency technology, and for the data from this register to be considered by the NHMRC in determining research funding priorities.

Recommendation 2.8

The Committee recommends that the Commonwealth Government consider sponsoring conferences on the health effects of radiofrequency radiation along similar lines to that conducted on gene technology.

Recommendation 2.9

The Committee Chair recommends that a study into *p53* mice be listed as an area of research for which future research applications should be encouraged.

Recommendation 3.1

The Committee Chair recommends that the equivalent of $5 for each mobile phone in use be collected annually for this purpose (approximately $40 million) and that the rate be reviewed after a period of five years.

Recommendation 3.2

The Committee Chair recommends that funding for maintaining the NHMRC-administered research program be provided at $4 million per annum of the $40 million and that the balance be used by the CSIRO to establish a structured program of research and set up a specialised research unit for this purpose.

Recommendation 4.1

The Committee Chair recommends that the radiofrequency standard be defined and administered by a process similar to that used by Standards Australia.

Recommendation 4.2

The Committee Chair recommends that the level of 200 microwatts per square centimetre in the expired Interim Standard (AS/NZS 2772.1(Int):1998) be retained in the Australian Standard.

CHAPTER 1

INTRODUCTION

Reference to the Committee

1.1 On 8 December 1999, on the motion of Senator Allison, the Senate referred an inquiry into telecommunications and electromagnetic emissions to the Environment, Communications, Information Technology and the Arts References Committee, not to commence before 31 March 2000 and for report on the 31 October 2000. The reporting date was subsequently extended to 4 May 2001. The full terms of reference may be found at page iii.

Conduct of the inquiry

Advertising the inquiry

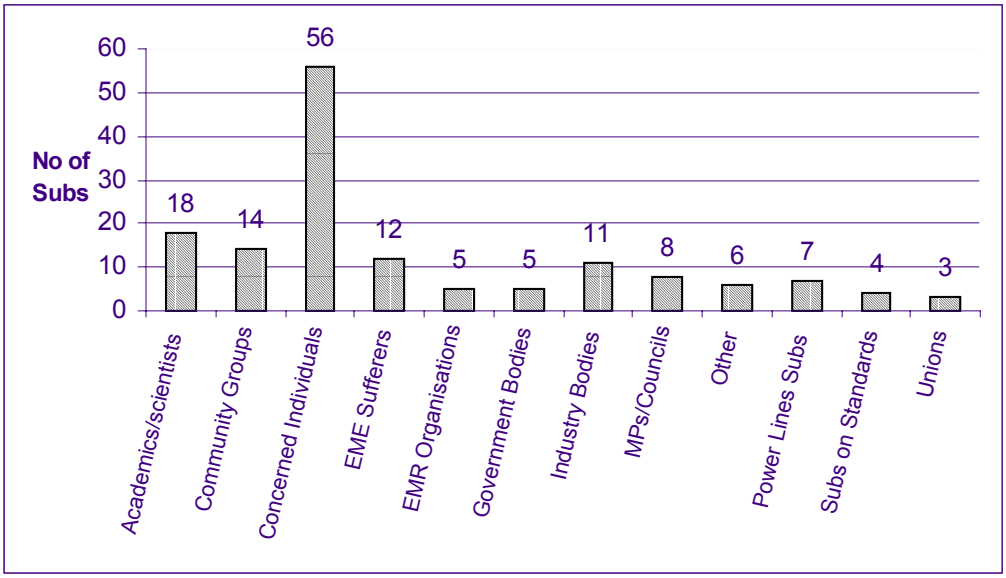
1.2 The Committee advertised the inquiry on 15 April 2000 in each state and territory capital city newspaper and *The Weekend Australian*, with the nominated closing date for submissions of 16 June 2000. Details of the inquiry were also placed on the Committee's homepage on the Internet.

Evidence to the inquiry

1.3 The Committee received 149 written submissions and a number of attachments and supplementary submissions which were published (except for the four whose authors made a request for confidentiality) and are publicly available through the Committee secretariat. The Committee also received follow up material from evidence, details of which are listed at Appendix 1.

Figure 1.1

Origin of written submissions



Course of the inquiry

1.4 The Committee conducted six public hearings as part of the inquiry, in: Canberra on 31 August 2000, 8 September 2000, 7 November 2000 and 2 March 2001, in Melbourne on 22 September 2000; and in Sydney on 16 November 2000.

1.5 During the course of the hearings, the Committee took evidence from 13 organisations, 7 Commonwealth Government Agencies and Councils and heard evidence from 16 individual witnesses. Details are listed at Appendix 2.

1.6 Hansard recorded 411 pages of evidence. The transcripts of evidence are available at: http://www.aph.gov.au/hansard/senate/commttee/comsen.htm

1.7 During the course of the hearings the Committee also received a number of tabled documents. These are listed at Appendix 3 and available on request from the Committee secretariat.

1.8 Senate Committee procedures provide that where evidence 'adversely reflects' on a person or an organisation (for example, by accusing them of deliberate lies or illegal acts), that person or organisation should have a reasonable right of reply. In a number of cases in this inquiry the Committee pointed out 'adverse' reflections to the affected parties and invited reply. The replies are part of the public evidence of the inquiry (unless the Committee accepted a request for confidentiality) and are noted in Appendix 3.

Acknowledgments

1.9 The Committee wishes to thank all those who contributed to the inquiry by preparing written submissions, providing additional information and material where requested and appearing at public hearings.

Terminology and background

Introduction

1.10 Mobile phone usage has increased rapidly over the past decade with around 8 million Australians owning mobile phones.[1] This figure is part of an increasing global trend, with roughly 25 million mobile phones in circulation in Britain (April 2000),[2] 51.5 million phones in Japan (1999), and the 85.2 million in China (2000) forecast to rise to 240 million by 2005. The rapid adoption of this relatively new technology has also meant there has been some uncertainty about the health implications of the proliferation of mobile phones and the supporting infrastructure. The Committee's terms of reference for this inquiry serve to provide a structure for an inquiry into the health effects and appropriate standards for electromagnetic radiation in the telecommunications sector.

What is electromagnetic radiation?

1.11 Electromagnetic radiation refers to the energy emissions generated from the interaction of an oscillating electric field and a magnetic field. The electromagnetic spectrum (see Figure 1.2) has various divisions based on frequency and wavelength, the main one being between ionising and non-ionising frequencies. Electromagnetic radiation may be regarded as waves in the air that transmit energy but can also be controlled through amplitude, pulsing, etc., to transmit speech, TV images and so forth. Hertz (cycles per second) are used to express the range or spectrum of frequency of the waves. Kilohertz, megahertz and gigahertz (10^3, 10^6 and 10^9 hertz, respectively) are measurements at the higher frequencies. The greater the frequency, the shorter the wavelength and the greater the energy transmitted.[3]

1.12 A significant division in the electromagnetic spectrum is the frequency above 10^{16} hertz, where waves become ionising in nature. This means the waves are capable of knocking electrons out of atoms to form ions. X-rays, ultraviolet rays and gamma rays are examples of ionising radiation. Ionising radiation is known to be carcinogenic. Electromagnetic radiation with longer wavelengths than X-rays do not have sufficient energy to cause ionisation. Areas within this region of the

1 Australian Mobile Telecommunications Association (AMTA), Submission 19, p 1.

2 Independent Expert Group on Mobile Phones (IEGMP), *Mobile Phones and Health*, 2000, Chiltern, p 1.

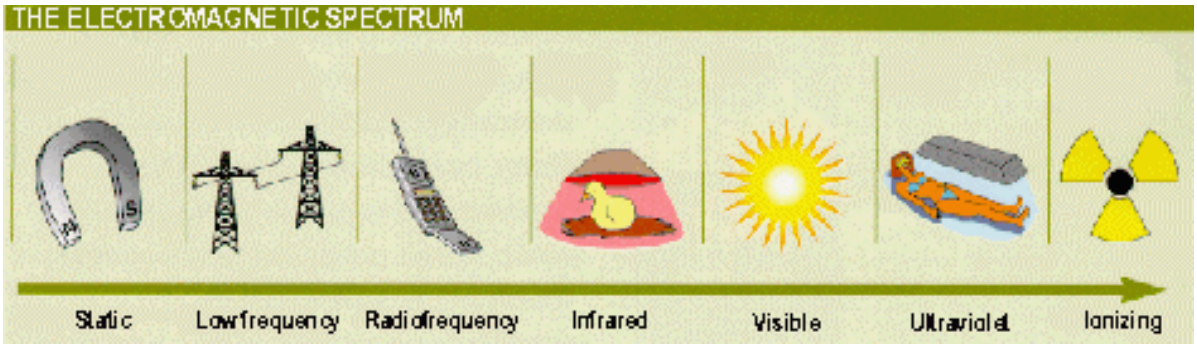
3 R. Panter, 'Electromagnetic Radiation from Mobile Phones, Mobile Phone Towers and TV Towers: Health Aspects' *Australian Parliamentary Library - Current Issues Brief 26 1996-1997*, Canberra, p 2.

electromagnetic radiation spectrum are collectively known as non-ionising forms of radiation.[4]

1.13 The non-ionising range of electromagnetic frequencies can be divided into static electric and magnetic fields, extremely low frequency (ELF) electric and magnetic fields, intermediate frequency fields and radiofrequency fields, which can be further subdivided into radiofrequencies and microwave frequencies. For the purposes of this report, the term electromagnetic radiation (EMR) is used to refer to radiofrequency (RF) radiation and the two terms are used interchangeably.

Figure 1.2

The Electromagnetic Spectrum[5]



1.14 Figure 1.2 illustrates some natural and artificial sources of electromagnetic emissions that exist at different frequencies in the electromagnetic spectrum. Whilst there are radio, television, radar, mobile phones and microwaves in the radiofrequency field, the Committee's inquiry has predominantly focused on the telecommunications aspect of RF, ie, mobile phones and mobile phone towers. The Committee received a large number of submissions concerned with other aspects that shall be discussed later in this chapter.

1.15 Figure 1.3 (below) shows the division of the electromagnetic spectrum into four portions:[6]

- The ionising radiation portion, where direct chemical damage can occur (eg X-rays).
- The non-ionising portion of the spectrum, which can be subdivided into:

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4 ARPANSA, 'The Mobile Phone System and Health Effects' http://www.health.gov.au/arpansa/mph_sys.htm (8 June 2000) p 5.

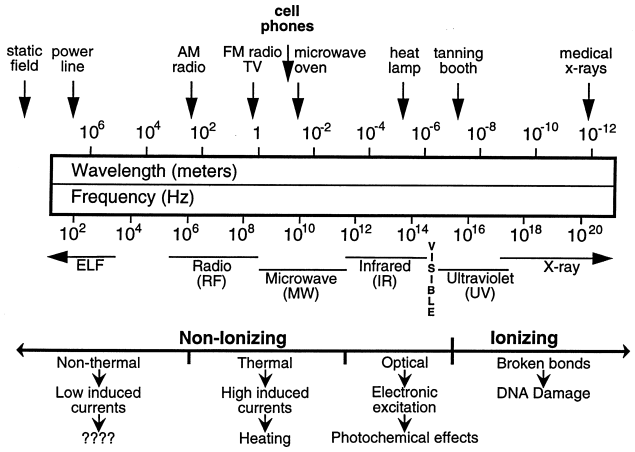
5 WHO Fact Sheet, 'What is electromagnetic radiation?' http://www.who.int/peh-emf/publications/what_is_EMF/section1.htm

6 Dr Moulder, Submission 60, p 14.

- the optical radiation portion, where electron excitation can occur (eg visible light);
- the portion where the wavelength is smaller than the human body, and heating can occur (eg microwave ovens, mobile phones, broadcast TV, FM radio); and
- the portion where the wavelength is much larger than the human body, and heating seldom occurs (eg AM radio, power-frequency fields, static fields).

Figure 1.3

The Electromagnetic Spectrum[7]



Common terms used for mobile phones

1.16 Throughout the report a number of terms have been used interchangeably for mobile phones. These include: *cellular phones*, *cell phones*, *radio telephones* and *wireless phones*.

Exposure to radiofrequency radiation

1.17 The use of a mobile phone involves transmission between the phone and a nearby base station, both of which emit RF radiation. In both cases the level of exposure generally declines with increasing distance from the source. When using a handset, exposure will primarily apply to the side of the head against which the mobile phone is being used or the part of the body nearest to the phone during hands-free use.

1.18 A European Commission Report in 1996 referred to emissions from mobile phones as the following:

> The electric and magnetic fields surrounding a radiotelephone handset near a person's head are complicated functions of the design and operating

7 Dr Moulder, Submission 60, p 14.

> characteristics of the radiotelephone and its antenna, and since the distances involved are less than one wavelength, exposure is in the near-field. In this region, electric and magnetic fields do not have a plane-wave character, but vary considerably from point to point.[8] This means that the charge and current distribution on the antenna and radiotelephone handset are important. This is in contrast to the situation of base stations, where plane-wave approximations can be generally applied, characterised by a locally uniform distribution of electric and magnetic field strengths in planes transverse to the direction of propagation (far-field region).[9]

1.19 For the general population, whole body exposure to mobile phone base station emissions occurs at levels of intensity considerably lower than those from handsets.

1.20 There are different types of *cells* (areas) that exist for base stations to communicate with mobile phones. These cells may be *macrocells*, *microcells* and *picocells*, based on their size and the power output of the antenna. *Macrocells* provide the main basis for the base station network. Base stations for macrocells have power outputs of tens of watts and communicate with phones up to roughly 35 kilometres away. *Microcells* are used to improve the main network through infill, especially where there is a high volume of calls. Places such as airports, railway stations and shopping centres site microcells and they are increasing in number as demand for mobile phones grows. The range of microcells is a few hundred metres and their base stations emit less power than those for macrocells. The third type of cell used is the *picocell.* These base stations are generally situated inside buildings and they have a lower power output than that of microcells (a few watts).[10] Both microcells and picocells are used to supplement reception for macrocells.

1.21 The fact that the radiofrequency fields produced by the base stations at points of public access are less than any national or international radiofrequency exposure standard, has not apparently reduced the concern of many members of the public.[11] Factors such as high visibility, and therefore their effects on views and property values, and the involuntary nature of the exposure to the technology, in contrast to mobile phones, which are operated at the discretion of the user, may be contributors to public concern.

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8 UNEP/WHO/IRPA (1993). 'Electromagnetic fields (300 Hz-300 GHz)'. Geneva: World Health Organization, Environmental Health Criteria, p 137.

9 EC (1996), *Possible health effects related to the use of radiotelephones: Proposals for a research programme by a European Commission Expert Group,* p 16.

10 Independent Expert Group on Mobile Phones (IEGMP), *Mobile Phones and Health*, 2000, Chiltern, pp 1-2.

11 AF McKinlay, ed (1996), *Non-ionizing radiation: sources, exposure and health effect*s. Luxembourg: Office for Official Publications of the European Communities. In EC (1996), *Possible health effects related to the use of radiotelephones: Proposals for a research programme by a European Commission Expert Group,* p 16.

Specific Absorption Rate

1.22 The Specific Absorption Rate (SAR) is the rate of absorption of radiofrequency energy in a unit mass of tissue. It represents the energy actually absorbed and as such is an indicator of the measure of the dose of radiofrequency energy.

Biological vs health effects

1.23 Throughout the evidence received by the Committee there are references to biological and health effects associated with exposure to electromagnetic radiation. Evidence of a 'biological' effect may not represent a 'health' effect, be it positive or adverse. The Royal Society of Canada report defined 'biological effects' as 'physiological, biochemical or behavioural changes induced in an organism, tissue or cell', while 'health effects' were 'biological changes induced in an organism that may be detrimental to that organism'.[12]

1.24 When considering the possible health effects of exposure to electromagnetic radiation, the Committee has adopted the approach taken by the Stewart Inquiry, which adopted the World Health Organization's definition of health as being 'the state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity'.

Thermal, athermal and non-thermal effects

1.25 While the 'thermal' or heating effects of certain electromagnetic energy levels are accepted as having adverse health effects, there is some evidence to suggest biological and health effects are occurring at non-thermal levels. The Royal Society of Canada defines these terms as:

> *Thermal effects* often occur when sufficient RF energy is deposited to cause a measurable increase in the temperature of the sample in question (eg more than 0.1ºC).
>
> *Athermal effects* are those occurring when sufficient energy is deposited to nominally cause an increase in the temperature of the sample, but no change in temperature is observed due to endogenous [internal] temperature regulation or exogenous [external] temperature control.
>
> *Non-thermal effects* are those occurring when the energy deposited in the sample is less than that associated with normal temperature fluctuations of the biological system being studied.
>
> Terms such as 'thermal', 'non-thermal', and 'athermal', as applied to the biological effects of RF exposure, are relative and it is not possible to identify specific zones of exposure dose at which effects belong in one or

12 Royal Society of Canada (1999), *A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunications Devices*, Ottawa, p 15.

> another of these categories. The level of energy deposition that would cause a thermal effect varies depending on a number of exposure factors, including: the biological specimen exposed (eg cell culture, small animal, large animal, human), the frequency of the RF field, the polarization of the field, and the control of the ambient temperature around the specimen.[13]

Additional issues raised in submissions to the inquiry

1.26 Community concerns about the siting of mobile phone towers and other telecommunications structures are not confined to fears about potential adverse health effects. The Committee notes that a number of submissions referred to the visual impact of the mobile phone facilities,[14] and high voltage powerlines,[15] noise emissions from overhead high voltage powerlines,[16] invasion of privacy,[17] and the effect on property values.[18]

1.27 Submissions also queried the increasing application of switch mode technology in home appliances and the impact on levels of electromagnetic emissions was also an area of concern.[19]

1.28 The Committee received some submissions that raised issues that were not directly relevant to the current terms of reference, including the regulation of MRIs and X-rays,[20] the effect of electromagnetic fields and radiation on the navigational ability of birds and whales,[21] the possible impact of digital radiation on apiculture,[22] labelling for electrical appliances to warn of possible health risks from electromagnetic fields,[23] the environmental impact from the installation of high power lines,[24] and the inclusion of the subject of non-ionising radiation and living systems on the curriculum of major Australian universities.[25]

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13 Royal Society of Canada (1999), *A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunications Devices*, Ottawa, p 15.

14 See for example Ms Helen Joyce, Submission 35, p 1; Mr JW Purchase, Submission 46, p 1; Mr Nick McKillop, Submission 63, Attachment 5; Gwenda and Tom Spencer, Submission 82, p 1; Mr John Hyde, Submission 137, p 1

15 Mr John Allen, Submission 65, pp 1-2.

16 Mr John Allen, Submission 65, pp 1-2.

17 Gwenda and Tom Spencer, Submission 82, p 1; Mrs B Humphries, Submission 145, p 2.

18 Ms Helen Joyce, Submission 35, p 1; City of Melville, Submission 42, p 1; Ms Sonia Venditti, Submission 76, p 3.

19 Ms Gillian Summerbell, Submission 62, p 1

20 Mr Stephen O'Rourke, Submission 6, p 1.

21 Mr William Lowe and Ms Iris Detenhoff, Submission 47, p 1; Mr Alan K Tunnah, Submission 139, p 2.

22 Sunshine Coast Environment Council Inc, Submission 55, p 1. Apiculture is beekeeping.

23 Ms Heather Anne Meyer, Submission 123, p 1.

24 Karawatha Forest Protection Society Inc, Submission 124, p 1.

25 Electromagnetic Awareness Network, Submission 142, p 2.

1.29 Submissions also suggested a moratorium on the placement of new mobile phone towers until further research is conducted,[26] or for the duration of this Committee's inquiry.[27] A moratorium on the use of new mobile phones and related devices for general consumers to enable the health risks to be adequately researched was also recommended.[28]

1.30 Several submissions suggested that government and local councils should take out comprehensive insurance in case of litigation in the event that electromagnetic radiation is proven to cause health effects,[29] while others raised the question as to whether telecommunications companies are required to have insurance in the event that a class action is taken against them in relation to the alleged health effects resulting from exposure to electromagnetic radiation.[30]

26 Mr Roger M Lilley, Submission 85, p 2; Mr Richard Giles, Submission 112, p 2.

27 Betty Shelley (for the Greenslopes Holland Park Concerned Residents Group), Submission 87(a), p 2.

28 Mr Richard Giles, Submission 112, p 2.

29 Ms Michelle Cossey, Submission 10, p 1; Ms Annie Carn, Submission 15, p 1. See also Mr William Lowe and Ms Iris Detenhoff, Submission 47, p 1; Ms Helen McKillop, Submission 67, p 2; Ms Ruth Parnell, Submission 94, p 2; Telecommunications Officers Association Branch of CEPU, Submission 66(a), p 1.

30 Ms Michelle Cossey, Submission 10, p 1; Ms Annie Carn, Submission 15, p 1. See also Mr William Lowe and Ms Iris Detenhoff, Submission 47, p 1; Ms Helen McKillop, Submission 67, p 2; Ms Ruth Parnell, Submission 94, p 2; Telecommunications Officers Association Branch of CEPU, Submission 66(a), p 1.

CHAPTER 2

RESEARCH ON THE HEALTH EFFECTS OF ELECTROMAGNETIC RADIATION

Introduction

2.1 While radio waves and other forms of electromagnetic energy have been in use for decades, the recent dramatic increase in the use of mobile phones, the visible proliferation of mobile phone towers and antennas and accompanying anecdotal and scientific studies showing biological and possibly health effects associated with these structures, have led to increased public concern about the safety of mobile phones and other telecommunications technologies. Many studies have been conducted to examine the relationship between radiofrequency radiation and biological and health effects, however to date, the results have been inconclusive.

2.2 Several recent expert reviews provide an analysis of the relevant scientific literature, with last year's UK Stewart Report considered the most comprehensive so far. Other reviews include those conducted by the CSIRO in 1994, the European Commission in 1996, the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in 1996 and 1998, the World Health Organization in 1998, and the Royal Society of Canada and the UK House of Commons Select Committee on Science and Technology in 1999. The conclusions and recommendations from these reviews will be referred to throughout this chapter.

2.3 The Committee received submissions and evidence from a number of scientists and health professionals, as well as community organisations and individuals. Some claimed that there is ample evidence of biological and/or adverse health effects associated with non-thermal levels of exposure to electromagnetic radiation, while others concluded that no clear relationship has been established.

2.4 This chapter provides a summary of the scientific research covered by recent major reviews, as part of a discussion of the evidence presented to this Committee based on the observations and research of witnesses and submitters to this inquiry. It concludes with an overview of current Australian and international research in this field.

Exposure to electromagnetic radiation – if biological effects are shown, what are the health implications?

2.5 Exposure to non-ionising radiation, at exposure levels sufficient to cause heating above 1ºC, is known to cause adverse health effects.[1] Knowledge about and

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1 Referred to by various submissions, for example, CSIRO, Submission 95, p 3; Australian Mobile Telecommunications Association (AMTA), Submission 19, p 7; Australian Communications Authority (ACA), Submission 100, p 10; Mobile Manufacturers Forum (MMF), Submission 75, p 4.

acceptance of the effects of non-thermal exposure to electromagnetic radiation remains limited and contentious.

2.6 As stated earlier, a number of expert reviews of the literature have been conducted, which have drawn the following conclusions in relation to the health effects of non-ionising radiation, including radiofrequency radiation:

CSIRO, 1994[2]

> This report concluded that there was insufficient reliable scientific evidence on which to base sound conclusions about safety of radio frequency (RF) exposures in telecommunications. It stated that 'because of its equivocal nature, the data base for RF emissions has limited value. It may be dangerous to make general statements on safety based on lack of evidence of harmful effects when so little relevant research has been carried out'.

International Commission on Non-ionizing Radiation Protection (ICNIRP), 1996[3]

> Most of the established biological effects of exposure to RF fields are consistent with responses to induced heating resulting in rises in tissue or body temperature of greater than 1°C … In contrast, non-thermal effects are not well established and currently do not form a scientifically acceptable basis for restricting human exposure for frequencies used by hand-held radio telephones and base stations.

European Commission, 1996[4]

> Overall, the existing scientific literature encompassing toxicology, epidemiology and other data relevant to risk assessment, while providing useful information, provides no convincing evidence that radiotelephones[5] pose a long-term public health hazard.

World Health Organization, 1998[6]

> … no known health hazards were associated with exposure to RF sources emitting fields too low to cause a significant temperature rise in tissue.

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2 CSIRO, *Status of Research on Biological Effects and Safety of Electromagnetic Radiation: Telecommunications Frequencies*, June 1994, p 10 (CSIRO Report).

3 International Commission on Non-ionizing Radiation Protection, 'Health Issues related to the use of hand-held radiotelephones and base transmitters', *Health Physics*, 70, pp 587-593, 1996 at pp 588, 592.

4 European Commission, *Possible health effects related to the use of radiotelephones: proposals for a research programme by a European Commission Expert Group*, Brussels, EC, 1996, p 23 (EC Report).

5 Mobile phones.

6 Michael H Repacholi, 'Low-Level Exposure to Radiofrequency Electromagnetic Fields: Health Effects and Research Needs', *Biolectromagnetics*, 19, 1998, abstract, included in The World Health Organization, Submission 56, Submission Vol 4, p 806, (Repacholi, 1998).

ICNIRP, 1998[7]

> Epidemiological studies on exposed workers and the general public have shown no major health effects associated with typical exposure environments. This is consistent with the results of laboratory research on cellular and animal models, which have demonstrated neither teratogenic[8] nor carcinogenic effects of exposure to athermal levels of high-frequency.

Royal Society of Canada, 1999

> The Royal Society Expert Panel on Radiofrequency Fields noted that there were 'a number of observed biological effects of exposure of cells or animals to non-thermal levels of exposure to RF fields', but had found 'no evidence of documented health effects in animals or humans' relating to this exposure. However, it also expressed the view that 'many of the studies in humans and animals addressing the potential for adverse health effects do not have sufficient power to rule out completely any possibility of such effects existing'.[9]

UK Independent Group on Mobile Phones Report (Stewart Report), 2000

> The Stewart Report (*Mobile Phones and Health*) noted that while there has been little research into the safety of mobile phone and base station emissions, there was some peer-reviewed literature from human and animal studies and substantial non-peer-reviewed information, which refer to the potential health effects caused by exposure to RF radiation from mobile phone technology. It concluded that the balance of evidence suggests that exposure to radiofrequency radiation below National Radiological Protection Board (NRPB)[10] and International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines 'do not cause adverse health effects to the general population', but noted that '[t]here is now scientific evidence … which suggests that there may be biological effects occurring at exposure levels below these guidelines'. The Stewart Report concluded that 'it is not possible at present to say that exposure to RF radiation … is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach'.[11]

2.7 Animal studies have provided evidence of significant responses to radiofrequency radiation, including changes in temperature regulation, endocrine

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7 International Commission on Non-ionizing Radiation Protection, 'Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300GHz), *Health Physics*, 74(4), pp 494-522, 1998 at pp 507-508.

8 Resulting in birth defects.

9 Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada, *A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices*, March 1999, pp 110, 111 (Royal Society of Canada Report).

10 In the UK.

11 Independent Expert Group on Mobile Phones, *Mobile Phones and Health*, p 3 (Stewart Report).

function, cardiovascular function, immune response, nervous system activity, and behaviour; however, the significance of biological responses at low exposure levels and their relationship to health effects are either not agreed with or not well understood.

2.8 The Telstra Repacholi *et al* study in Adelaide is one of those which has shown a significant increase in cancer incidence for mice genetically predisposed to lymphoma, and this study is currently being 'confirmed' and is referred to later.

2.9 The Committee was informed that a growing body of research provides evidence of biological effects. This was the conclusion of the Royal Society of Canada Report, which said:

> It is clear to the panel that there are a number of observed biological effects of exposure of cells or animals to non-thermal levels of exposure to RF fields. These observed biological effects meet the common standards for scientific observation in that the experiments were well-designed, had appropriate positive and/or negative controls, contained valid RF exposure parameters, included appropriate statistical evaluation of the significance of the data, and have been observed to occur by more than one investigator …[12]

2.10 Despite this, the Australian Communications Authority stated that 'the evidence for production of harmful biological effects at relatively low levels of exposure (that is, field intensities lower than those that would produce measurable heating) is ambiguous and unproven.[13]

2.11 The World Health Organization (WHO) draws a distinction between effects on health, which it defines as 'the state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'[14] and biological effects which are 'a physiological response that may or may not be perceptible to the exposed organism'.[15] In his paper on exposure to low level radiofrequency fields, Dr Michael Repacholi, Coordinator, Occupational and Environmental Health, WHO, stated:

> Biological systems respond to many stimuli as part of the normal process of living. Such responses are examples of biological effects. It is questionable whether reported 'effects', even if substantiated, can be considered to represent evidence of a hazard simply because the significance of the effect for the organism is not understood.[16]

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12 Royal Society of Canada Report, p 110.

13 Australian Communications Authority (ACA), Submission 100, Submission Vol 8, p 1618.

14 *Official Committee Hansard*, Canberra, 31 August 2000, p 3 [Repacholi].

15 Michael H Repacholi, 'Low-Level Exposure to Radiofrequency Electromagnetic Fields: Health Effects and Research Needs', *Biolectromagnetics*, 19, 1998, pp 1-19, included in The World Health Organization, Submission 56, Submission Vol 4, p 811 (Repacholi, 1998).

16 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 811.

2.12 Professor Litovitz, Professor Emeritus of Physics at the Catholic University of America, said on the question of whether or not electromagnetic fields caused health effects:

> If they cause biologic effects, there is the possibility – not necessarily, but there is the possibility – that there will be health effects. A biologic effect does not mean a health effect, but you cannot get a health effect without a biologic effect.[17]

2.13 Approaches to interpreting experimental results and determining when a biological response should be considered to constitute a health hazard include:

- any field-induced response is undesirable and should be avoided;
- exposure should be avoided if a physiological response in an organism is measurable; and
- where no discomfort or pain is experienced, the stimulus producing a response should be considered harmless.[18]

2.14 To establish that a biological response has health implications, Dr Repacholi says a number of conditions need to be satisfied, including determining whether the biological or psychological changes are reversible, whether effects are additive, or whether there are adequate compensation mechanisms to respond to the effects.[19] Dr Repacholi offered the view that where dose-response relationships have not been established, it is difficult to extrapolate results between different frequency ranges and exposure levels, making it important to repeat experiments at different exposures.[20] Dose assessment is also important in epidemiological and human studies, because of differences between 'near field' and 'far field' exposure.[21]

The role of epidemiology, *in vitro* and *in vivo* studies

2.15 When assessing the literature, it is worth noting that *in vitro* studies provide insights into the mechanisms underlying biological effects, whereas *in vivo* studies of animals and humans are considered to provide more convincing evidence of biological

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17 *Official Committee Hansard*, Melbourne, 22 September 2000, p 145 [Litovitz].

18 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 811.

19 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 812.

20 See for example Dr Michael Repacholi's explanation re the Adelaide mouse study: 'The problem is that we only looked at one exposure, and to give a result credibility you like to see that increasing exposure will increase the effect. The dose response is something where, when you look at toxicology, you want to see that increasing the dose of chemical, for example, increases the effect: you get higher incidences of the cancer or whatever. My study was not able to test that because it only had one point' (*Official Committee Hansard*, Canberra, 31 August 2000, p 4).

21 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, pp 812-813.

effects that may have implications for adverse health consequences for people.[22] However, the most direct information on the risks of adverse human health effects come from epidemiological studies. Dr Repacholi commented:

> Most of the known human carcinogens were first identified as such by epidemiological studies; for this reason such evidence should not be taken lightly, even if the findings are unexpected or are inconsistent with other evidence … Epidemiological studies are important for monitoring public health impact of exposure, particularly from new technologies.[23]

2.16 This view is supported by medical practitioner and specialist in occupational medicine, Dr David Black, who noted that '[e]pidemiology is frequently misunderstood, and often wrongly criticised as being limited to showing associations but never proving causation'.[24]

2.17 In his submission, Dr Black describes some of the criteria of causation for epidemiological studies. It also identifies the different types of evidence relevant to human health studies. These range from experimental studies, which he says while providing some of the strongest evidence of cause and effect, could not be applied to human populations when the effect is harmful, and have limitations when the results from animal studies are applied to humans because of species differences; cohort and case-control studies, which compare groups which do and do not exhibit the effect, considered to be less precise than experimental studies and requiring a number of consistent studies before a conclusion can be drawn; ecological studies which are considered weaker than the two previously described because they study exposure between population groups rather than individuals, and are generally used for formulating or refining hypotheses for case-control or cohort studies; and finally, individual case studies, descriptive studies, anecdotal evidence etc, which are rarely proof of a definitive relationship but may suggest the need for further research.[25]

2.18 Dr Black also said the use of statistical significance to describe scientific results is also defined as indicating 'the way the data has fallen but does not take into account reasons for this that are not related to true cause and effect, such as bias, confounding or statistical variation', and therefore 'statistical significance' *per se* should not be confused with 'causation'.[26]

2.19 Dr John Moulder, Professor of Radiation Oncology at the Medical College of Wisconsin, USA, when discussing cancer risk assessment, observed:

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22 However, the Committee notes the Stewart Report's comments that cellular studies may be more carefully controlled and assessed than animal studies, although difficult to extrapolate results to humans (Stewart Report, p 46).

23 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 822.

24 Dr David Black, Submission 93, p 16.

25 Dr David Black, Submission 93, pp 18-19.

26 Dr David Black, Submission 93, pp 16-20.

> When the epidemiological evidence for an association between a physical agent and cancer is weak and/or the link is biophysically implausible, laboratory studies are critical for risk evaluation. If there is strong cellular (*in vitro*) and/or animal (*in vivo*) evidence that an agent is carcinogenic, it can make even weak epidemiology evidence for an association credible. Conversely, if appropriate laboratory studies are done and these studies fail to show any consistent evidence for carcinogenic activity, then we tend to dismiss weak epidemiological evidence, particularly if the association is biophysically implausible.[27]

Replication

2.20 One of the most contentious issues with regard to the way in which evidence from scientific studies is interpreted and afforded credibility is the question of replication, confirmation or verification.

2.21 The Mobile Manufacturers Forum argued:

> … the results of any individual study cannot be considered sufficient to establish or refute a possible human health risk. Individual studies must be validated and replicated before they can be relied on, and the determination of whether a potential health hazard exists requires a weight of evidence that evaluates all relevant, credible and valid data.[28]

2.22 Professor Mark Elwood, epidemiologist and public health expert, stated:

> I want to emphasise only one methodological principle relating to most of these studies, and that is a general principle of epidemiology and, indeed, of science; that is, when you do a study which finds an unexpected and new finding which has not been reported before, it is very difficult within that study to assess whether that finding is meaningful or whether it is due to chance variation. The only real way to assess it is to set up a second, independent study to test it.[29]

2.23 Dr Moulder argued that the failure to replicate results may be indicative of flaws in the original study:

> … [the fact] that you cannot confirm and replicate it implies that there is something at least slightly wrong with the original – not necessarily totally wrong but something did not happen the way the authors think it happened. At the first stage of an attempt to confirm, where you have somebody reporting something and somebody else saying they cannot confirm it, you really cannot necessarily believe either study … Sometimes it is not clear

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27 Dr John Moulder, Submission 60, p 10. A description of the process of identifying carcinogens is included in this submission at pp 9-12.

28 MMF, Submission 75, p 6.

29 *Official Committee Hansard*, Melbourne, 22 September 2000, p 130 [Elwood].

> and you basically have to wait for more people to attempt to do it and you end up making what is basically a weight of evidence argument.[30]

2.24 Dr Neil Cherry from Lincoln University, New Zealand, reported in his submission that Dr Repacholi had informed an industry sponsored press conference that there was no evidence that GSM cellphones were hazardous to health:

> At the conference he [Dr Repacholi] presented his paper on the Telstra funded project that showed that GSM cellphone radiation at quite low non-thermal levels, doubled the cancer in mice. When challenged by the conference chairman, Dr Michael Kundi, Dr Repacholi said that a study is not evidence until it is replicated. The conference rejected this. A study is evidence. Replication provides confirmation and establishment.[31]

2.25 Dr Cherry also pointed out that in replication work there can be unforseen variables:

> It was shown in the calcium ion efflux work of Dr Blackman that biological effects in the laboratory can vary with the local magnetic fields, with temperature and with a number of other factors.[32]

2.26 Professor Litovitz advised the Committee:

> There have been a large number of publications, and certainly over 100 have reported non-thermal biologic effects at exposure levels below that considered safe by most government standards. If there have been that many publications, you can ask the question: why is there controversy? If all of these papers are out there and every scientist is correct, why is there such a controversy and why is there so much argument? The answer is that the papers do not all agree. For almost every paper you see on biologic effect, you will see papers that say 'I didn't see anything. I see a big effect, but I didn't see anything.'
>
> … So I ask myself: is this field of biomagnetics a junk science field? Are these scientists out there who see effects at low levels all incompetent, or worse? The answer is that lack of replication – that is to say, two scientists disagreeing – is not limited to bioelectric magnetics but rather it is a general problem in toxicity, it is a general problem in biology. … Let us take drug X, whose name is not important. We ask this question: does this drug induce deformed limbs in Norway rats? The results are as follows. In one set of experiments, those treated with the drug show 60 percent deformed limbs, those untreated eight per cent. You have to conclude from that

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30 *Proof Committee Hansard*, Canberra, 2 March 2001, p 317 [Moulder]; See also *Official Committee Hansard*, Canberra. 31 August 2000, p 4 [Repacholi]; *Official Committee Hansard*, Sydney, 16 November 2000, p 198 [Fist].

31 Dr Neil Cherry, Submission 146, p 6.

32 *Proof Committee Hansard*, Canberra, 2 March 2001, p 332 [Cherry].

> experiment that this drug is a teratogen, that is to say it causes abnormal embryos. … This is not a story, this is a publication.
>
> The difference between these experiments is that they were both using Norway rats, but there are all kinds of Norway rats – just like we are all people but we are genetically enormously different, and we are genetically enormously different in our susceptibility to various kinds of stress. So even though you go out and buy these rats that does not mean you have identical rats. The drug that was used in this experiment was called thalidomide, which, as you well know, was an enormous disaster. It was a disaster because it was only studied in one strain and was not studied in the other.
>
> The difference in genetic susceptibility of the test animals was never taken into account, and this experiment was only done after 10,000 children were born without limbs. So this lack of replication does not mean that there is no scientific validity. It means that science is complicated; it means that biology is complicated, and that the human system is complicated – and even rats are complicated.[33]

2.27 Professor Litovitz also cited an experiment in the US in which six laboratories with identical equipment tested chick embryos to see if magnetic fields caused abnormalities:

> … When these six laboratories' results came back, two said yes, two said absolutely no, and four said, 'We might see something.' … Six months later we made a measurement again and found no effect. … As we went through the three-year period, we found an enormous genetic compound in the response of chick embryos to electromagnetic fields. … It is not that you [the laboratory] did something wrong; it is the genetics. They were working with different genetic material.[34]

2.28 The Committee queried whether the Vernon-Roberts study (see *Australian research* below) could be considered a true replication of the 1997 Adelaide mouse study, given the modifications that have been made to the original methodology. Dr Repacholi, from the World Health Organization and member of the Adelaide mouse study team advised:

> … in initial studies they may have done something that is not particularly helpful or there is a better way of doing it. If the result is a true result it should still occur in the animal. There is no reason to expect that you are still exposing the animal to radiofrequency fields using the same pulsing regimes, maybe different times, different orientations, but if there is going to be an effect it should still occur. We were very careful in reviewing the follow-up study in Adelaide, and there is another study being done in

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33 *Official Committee Hansard*, Melbourne, 22 September 2000, pp 145-146 [Litovitz].

34 *Official Committee Hansard*, Melbourne, 22 September 2000, p 146 [Litovitz].

> Europe, to make sure that, yes, what was done in the original study is going to be either confirmed or not confirmed in these studies.[35]

2.29 In referring to the Adelaide mouse confirmation study, Dr Thomas Magnussen, CEO of the EMX Corporation, said:

> … but there are significant differences between the two experiments. For instance, Repacholi's first experiment ran for 18 months. The new one is going to run for 24 months. The way the animals are exposed is quite different in the two experiments. The genetics can never be the same. When we are talking about biological experiments, it is virtually impossible to make a replication.[36]

2.30 The Consumers' Telecommunications Network commented that there was insufficient evidence to conclude that there are no potential health risks associated with radiofrequency radiation.[37]

2.31 Dr Black said that in science it is impossible to prove a negative, and thus it will not be possible to claim that there are no health effects, only that the evidence suggests that such a scenario would be highly unlikely, as illustrated by the following statements:

> … it is frequently stated by people who are concerned that the application of [radiofrequency] technology should not proceed until there is proof of the absence of any adverse effect. The answer to this can only be that there will never be such proof about RF, or for that matter anything else …
>
> It is also equally true that it is theoretically impossible to provide absolute unarguable proof of an association.
>
> The only conclusion which can be drawn from an understanding of the principles of epidemiology and of the assessment of scientific data is that whilst it is possible to prove an association with substantial and convincing certainty, it is impossible to prove an absence of an association in such a compelling way.[38]

2.32 Before outlining the research that is currently under-way both in Australia and overseas into electromagnetic radiation and its effects as it relates to telecommunications equipment, this section summarises what is known so far about the biological and health effects of electromagnetic radiation.

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35 *Official Committee Hansard*, Canberra, 31 August 2000, p 11 [Repacholi].

36 *Official Committee Hansard*, Melbourne, 22 September 2000, p 152 [Magnussen].

37 *Official Committee Hansard*, Sydney, 16 November 2000, p 213 [Consumers' Telecommunications Network].

38 Dr David Black, Submission 93, pp 21-22. See also *Proof Committee Hansard*, Canberra, 2 March 2001, pp 322-333 [Moulder]; *Official Committee Hansard*, Canberra, 31 August 2000, p 4 [Repacholi].

2.33 Expert reviews referred to at the beginning of this chapter have relied upon existing literature and a number of witnesses have concluded from scientific abstracts that there are potential health effects of EMR.

2.34 Mr Stewart Fist, journalist, claims to have the largest website collection of abstracts of scientific research publications and says that about 60 per cent of them show effects from non-ionising radiation.[39]

2.35 The World Health Organization website includes a database of current and published research into the biological and health effects of radiofrequency radiation.[40]

2.36 Some witnesses expressed the view that while this information is a valuable resource in understanding the science, it was an inadequate substitute for a working knowledge of the material. The CSIRO's submission to this inquiry commented on its own limitations in relying on research by others:

> CSIRO is maintaining a watching brief, although it appreciates the limitations of attempting to evaluate research without the benefit of involvement and participation. Independent, authoritative scientific information is provided in response to enquiries from Government and the community.
>
> The absence of involvement in scientific research into biological effects of EMR is a recognised limitation in any assessment of the state of research. It is only possible to fully understand the complexities of sophisticated biological procedures through experience gained from working at the bench. Unfortunately, this level of expertise and understanding is lacking, or indeed absent, in many of the participants of committees or working groups that try to make assessments of the veracity of scientific research.[41]

Is the scientific evidence inconclusive?

2.37 The most recent expert reviews of the relevant electromagnetic radiation literature suggest that the results in this area are inconclusive.[42]

2.38 Industry submissions generally argued too that the science was inconclusive. Hutchison Telecommunications, said in its submission:

> … the world's leading experts and key health advisory bodies state that there is no substantiated evidence to suggest a link between the use of

39 *Official Committee Hansard*, Sydney, 16 November 2000, p 193 [Fist].

40 See who.int/peh-emf/database.htm

41 CSIRO, Submission 95, p 7.

42 See above, para 2.6.

> mobile phones and long term public health risks, but we acknowledge there is public concern on this issue.[43]

2.39 Nokia Mobile Phones, Australia, said:

> … a substantial amount of scientific research conducted all over the world over many years, demonstrates that radio signals within established safety levels emitted from mobile telephone[s] and their base stations present no adverse effects to human health.[44]

2.40 Motorola Australia, said:

> … the scientific evidence does not demonstrate a risk to public health from wireless phones.[45]

2.41 In his submission, Mr Neil Boucher, said:

> Most of the 'research' that has been carried out on the health effects of electromagnetism are top down studies. That is people are assembled, with largely medical and statistical qualifications (and usually with little or no knowledge of electromagnetism itself), to look for epidemiological evidence of some health effect. The fact that nothing conclusive has been found to date testifies both to the relative insignificance of any effect (if it exists) and to the futility of the methods employed.[46]

2.42 The Australian Communications Authority (ACA) submitted that radiofrequency devices that operate in accordance with recognised human exposure standards do not pose a health risk.[47]

2.43 The Committee notes the observations in the Stewart Report:

> We were struck by certain inconsistencies and inadequacies in the scientific literature on the biological effects of RF radiation. Many studies in this field have been exploratory and preliminary in nature, and claims of effects have sometimes been based on single experiments rather than a consistent series of hypothesis-driven investigations. In some cases, study design and statistical analysis have been inadequate, and apparent effects may have been artefactual or due to random variation. Indeed, the field is troubled by failures to replicate previous studies and by a lack of theoretical explanation of some effects that have been claimed. There may also be biases arising from selective publication and non-publication of results.

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43 Hutchison Telecommunications, Submission 91, p 1.

44 Nokia Mobile Phones, Australia, Submission 68, p 1.

45 Motorola Australia, Submission 78, p 1.

46 Mr Neil Boucher, Submission 118, p 2.

47 ACA, Submission 100, p 2.

> Finally, even for effects that appear to be well substantiated, the biological significance and the implications for health are often unclear.[48]

2.44 Not all witnesses were of the view that the evidence was inconclusive. Dr Neil Cherry told the Committee that his work in preparing for a tribunal hearing for the first mobile phone base station in NZ in 1995 had led him to examine epidemiological and biological research from around the world:

> I was very surprised there is so much published evidence in reputable, peer review journals that has not been sighted, summarised or integrated. The more I received the more solid the evidence seemed to be and the more consistent it seemed to be. And so when I heard people saying that the evidence was weak and inconsistent, I decided I should debate this with people and go to conferences and talk to them about it. … This culminated, I believe, in a climax last year at the conference at the European Parliament where I was asked to look particularly at low level effects and epidemiological studies with those response relationships of low level effects. … Over 20 studies show that radiofrequency microwave radiation damages the genes, damages the chromosomes, damages the DNA, and therefore indicates genotoxicity. I am also aware that many studies only use small samples – they are epidemiological studies or laboratory samples. They find elevated levels but they are not specifically significant and they are often described as showing no effects. But I have supplied with my evidence a summary of brain tumour studies, and I have characterised them as studies showing elevated effects, studies showing significantly elevated effects and studies showing dose response effects. And that is a classical way, I believe, at looking at the evidence trail and asking: was it elevated, was it significantly elevated and have we found dose response elevation? …
>
> … Following those principles, I come to totally different conclusions than Dr Moulder, Dr Black, Dr Elwood and Dr Repacholi.[49]

2.45 Mrs McLean of Electromagnetic Radiation Alliance of Australia (EMRAA), said that many studies are showing a range of effects, including brain tumours, leukaemia, heart problems, neurological problems, neuro-degenerative diseases, breast cancer and affects on the immune system, as well as affecting melatonin levels, enzymes, hormones, genes and signal transduction in cells[50]. These are discussed later in this chapter.

Anecdotal and non-peer-reviewed evidence

2.46 A number of submissions to this inquiry referred anecdotally to cases of brain tumours,[51] headaches,[52] hyperactivity in children and nausea,[53] skin growths

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48 Stewart Report, p 47.

49 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 329-330 [Cherry].

50 *Official Committee Hansard*, Sydney, 16 November 2000, p 240 [EMRAA].

51 Ms Marie Kougellis, Submission 1, p 1; Mrs PR Richards, Submission 49, p 1.

protruding from the ear against which the mobile phone was held,[54] chronic fatigue,[55] nose bleeds,[56] and other health effects,[57] which they linked to mobile phone use.

2.47 Submissions also noted that expert panels, such as the Independent Expert Group on Mobile Phones (the Stewart Group), had been presented with anecdotal evidence of adverse health effects from mobile phones and their base stations, which were claimed to be related to non-thermal effects of radiofrequency radiation.[58] Reference was also made to reports of 'microwave sickness' from mobile phones, including headaches, fatigue, impotence, blood pressure changes, chest pain and sleep disturbance.[59] One submission raised the possibility of a link between legionnaires disease outbreaks with the presence of mobile phone towers and high voltage power lines in the vicinity of cooling towers.[60]

2.48 The Committee notes the conclusions of the Royal Society of Canada Report:

> Headache and fatigue are nonspecific symptoms. … Headache is not an indicator of 'brain activity' and in general headaches occur in the absence of structural abnormalities of either the brain or the blood-brain barrier. … Although there is need to consider the possibility of [microwave-induced] symptoms such as headache and fatigue, existing data do not support the conclusion that [microwave fields] can induce headaches.[61]
>
> The panel did not find persuasive evidence of the existence of radiofrequency radiation sickness syndrome, however, some individuals may be able to sense when they are exposed to radiofrequency fields.[62]

2.49 The Report recommended further research into this area.

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52 Mr Walter Kosterke, Submission 2, pp 1-2; Mr Donald Adams, Submission 28, p 1; Ms Gillian Summerbell, Submission 62, p 1.

53 Mr Walter Kosterke, Submission 2, pp 1-2.

54 Mr Joe Friend, Submission 17, p 2.

55 Ms Gillian Summerbell, Submission 62, p 1; Ms Ruth Parnell, Submission 94, p 2; Mr Don Maisch, Submission 20, p 24.

56 Ms Maria Selva, Submission 131, p 1.

57 Ms Dalana MCaren, Submission 22, p 3; Mrs PR Richards, Submission 49, p 1; EMRAA, Submission 80, p 15; Ms Diane Beaumont, Submission 138, p 8; Electromagnetic Awareness Network, Submission 142, p 2; Mr Don Maisch, Submission 20, pp 26-30.

58 Holroyd City Council, Submission 44, p 2.

59 Community and Public Sector Union (CPSU), Submission 110, p 2. See also Mr Don Maisch, Submission 20, p 67; ACTU, Submission 89, p 8.

60 Mr Roger M Lilley, Submission 85, pp 3-4. See also Ms Diane Beaumont, Submission 138, pp 24-25 re links between wireless telecommunication and increases in legionnaires disease and other conditions.

61 Royal Society of Canada Report, p 101.

62 Royal Society of Canada Report, pp 104-105.

2.50 While the EMR Safety Network International argued that anecdotal evidence should be heeded,[63] Dr Repacholi argued that this type of evidence is more valuable in establishing a hypothesis, rather than as proof of causal effect:

> When reviewing the scientific literature, only independently confirmed effects can be considered when assessing health risk. For establishing research needs, effects which have not been confirmed, but are possible and could have implications for health, should be considered because they may ultimately be established.[64]

2.51 The Committee notes that the Stewart Group included evidence from sources other than peer-reviewed scientific journals as part of its assessment of the potential health risks associated with exposure to radiofrequency fields.[65] The Committee was advised that material that has not been peer-reviewed can suffer from several shortcomings, including deficiencies in methodology, analysis and conclusions.

2.52 Dr Repacholi said that the quality of peer review can vary and that the results of many studies need to be compared and evaluated before a conclusion can be drawn.[66]

2.53 Dr John Moulder mentioned difficulties in selecting suitable independent candidates to undertake peer review, particularly in small and highly specialised fields such as dosimetry:

> What I do is look for people who are involved in the specific field but who have no direct connections, either positive or negative, with the authors of the study. Sometimes that is in fact impossible. I will explain what I would do if I could not find the perfect person by taking the example of radiofrequency radiation and cancer in animals. If everybody who is in that field is conflicted, I might look for someone who is an expert in RF dosimetry, even though they knew nothing about cancer, and then look for someone who was into carcinogenesis in animal models, even if they knew nothing about radiofrequency radiation, and then possibly back that up with a statistician who would not necessarily be familiar with either, but statistics is statistics.[67]

Publication and research bias

2.54 Dr David Black, in his submission, also drew the Committee's attention to what he described as 'publication bias', whereby journals may prefer to publish a paper where the study has produced 'novel' results rather than one 'simply reiterating

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63 The EMR Safety Network International, Submission 111, p 4.

64 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol. 4, p 822.

65 Stewart Report, p 40.

66 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 809. See also AMTA, Submission 19, p 4.

67 *Proof Committee Hansard*, Canberra, 2 March 2001, p 316 [Moulder].

a well accepted status quo'. A similar bias was suggested in relation to difficulties in attracting funding for studies considered 'likely to be simply reiterating well established fact', and that these two biases need to be considered when undertaking a literature survey.[68] The Committee also notes the comments of Dr Stan Barnett, CSIRO:

> One of the biggest difficulties that we have in this particular area of research is that there are all sorts of biases in research generally. That is a given. You have to take adequate controls to make sure that you do not allow those biases – the experimental biases, the observer biases and the biases in the statistical analysis program that you use. All of those things are biases which researchers are familiar with and which we understand … but before you even start the research one of the biggest biases that exists generally is that of selection bias. … Selection bias is simply that the person who has the money … has the resources and therefore has the ability to select, firstly, the type of research that they want to spend their money on; secondly, the facility where they would like to have it done … and, thirdly, they can select whomever they wish to do that research, whether it is somebody who has the necessary experience in the area or somebody who has a high profile. There may be issues other than the essential science that determine the selection of the research that is undertaken.[69]

2.55 Concerns raised about the difficulties in obtaining funding for replication studies are referred to in Chapter 3.

Biological effects

2.56 A number of studies have linked exposure to electromagnetic radiation with a range of biological and health conditions including: high blood pressure in humans; severe depression of the immunological and endocrinological responses of young chickens; increases in the permeability of the blood-brain barrier; calcium efflux from brain tissue; effects on the dopamine-opiate system considered to be involved in headaches; influences on epileptic activity; and increases in the mortality of chick embryos. Studies have also found evidence of chromosome aberrations and increases in double and single strand DNA breakages, and increases in the promotion of certain cancers in genetically predisposed mice.[70]

2.57 Biological effects that have been specifically linked to radiofrequencies include changes to calcium ion mobility in the brains of cats and rabbits as well as

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68 Dr David Black, Submission 93, p 20.

69 *Official Committee Hansard*, Sydney, 16 November 2000, pp 229-230 [CSIRO].

70 The EMR Safety Network International, Submission 111, Attachment 3. See also, for example, Mr Robert C Green, Submission 134; Committee on Electromagnetic Energy Public Health Issues (CEMEPHI), Submission 127, p 9.

isolated cells and tissues, changes to the proliferation rate of cells, alterations to enzyme activity, and affects on genes.[71]

The search for a mechanism

2.58 Various mechanisms have been proposed for the way in which radiofrequency fields interact with biological systems, generally involving the induction of movement of molecules.

2.59 Professor Philip Jennings, referred to ferrimagnetic material in human tissue with possible implications for the interaction between electromagnetic radiation, particularly extremely low frequencies, and biological systems.[72]

2.60 Professor Litovitz said:

> There are those who believe that only heat can cause an effect and there are those who believe otherwise, whose experiments suggest that it takes only a signal to a cell to cause the cell to do something. The cell has its own energy; you supply the trigger and the cell proceeds to produce enzymes and proteins, et cetera. … Let us look at the example of garage door openers … You are in your car and you press this and your garage door opens. The question is: can you believe that this supplied the energy for the garage door to open? Was it this that supplied the energy for that motor to pick up the garage door? We are saying no. We are saying that this is a signal that turned on the energy to the motor. That is the similarity, that is what athermal effects are all about: cells receive a signal and turn on the engine inside the cell which produces proteins, which produces enzymes necessary for survival.
>
> We have studied in detail the target of the EMF and we now know the number of milliseconds that it takes the cell to be able to say there is a field there. … It is well known in biology that this information goes to a process called signal transduction on the surface of the cell or receptors. They say something and send a signal to the nucleus, which proceeds to undergo various biochemical processes. This takes seconds.[73]
>
> … We are now working on a possible mechanism which relates EM field exposure to health effects. We find that EM fields alter the levels of protective proteins. It turns out that the major effort in my lab today is to use these non-thermal effects to protect against damage due to heart attacks, to treat cancer and to treat inflammation. These non-thermal effects are remarkably useful, and will be useful in the next few years, in therapy. The question is: when are they therapeutic and when might they be harmful?

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71 WHO Fact Sheet No 193, *Electromagnetic Fields and Public Health: Mobile Telephones and their Base Stations*, May 1998, p 1, included in The World Health Organization, Submission 56, Volume 4, p 790.

72 Professor Philip Jennings, Submission 122, Submission Vol 9, p 1872.

73 *Official Committee Hansard*, Melbourne, 22 September 2000, p 147 [Litovitz].

> … You have a protein that works, you come in with a electromagnetic field stressor, the protein is damaged and unfolded, nature produces protective proteins, goes in and refolds the protein and repairs the damage. This is one of the most exciting discoveries in the past 30 years in medicine. These protective proteins, these stress proteins, are being studied by almost every pharmaceutical company in the country because of their potential, because they are the basic repair mechanisms … and we have found that EM fields can modify the amount of protective proteins that you have. I say 'we' – there is a minimum of four, and I think it is five, labs that have replicated the concept that EM fields can affect protective proteins. …[74]
>
> There is a theory now that these protective proteins are related to Alzheimer's and that a reduction in protective proteins means a greater probability of Alzheimer's. This is a theory which we have not tested, but there is data out there that appears to relate the incidence of Alzheimer's to exposure to electromagnetic fields. … We cannot necessarily say that there is a health effect, but we can say that mechanisms exist for potential health effects.[75]

2.61 Dr Peter French drew a link between evidence of the role of heat shock proteins in cancer and mobile phones:

> In plain English, the point is that it has been demonstrated by several researchers that increasing the amount of heat shock proteins in cells results in the increased potential for developing tumours, increased stimulation of metastasis or spread of cancers, the direct development of cancer, de novo, and the decreased effectiveness of anti-cancer drugs. Any one of these outcomes is obviously undesirable, but there is, within the heat shock protein and medical research literature, evidence for each of these statements.
>
> … where are we with the mobile phone cancer link? This is a summary of this part of my presentation. A mobile phone user will experience energy from the radiation of the phone going into the brain. That can induce some physiological effects, as has been published by Krause et al, but, importantly, it can potentially induce the heat shock response in the brain which can lead to the turning on of heat shock proteins. For a single event that is fine, because that is the body responding defensively. Normally it takes four to eight hours for the protein machinery to work after the protein machinery has been activated. It takes from four to eight hours for the proteins to be secreted, to be made and then ultimately they disappear if they are not needed. If you continually use a mobile phone, you can imagine that the heat shock proteins would be chronically induced, similar to the over-expression studies which have been described. Continued regular mobile phone use can result in chronic expression of heat shock proteins, which can lead to – from those findings which are referenced there – increased

74 *Official Committee Hansard*, Melbourne, 22 September 2000, p 150 [Litovitz].

75 *Official Committee Hansard*, Melbourne, 22 September 2000, p 154 [Litovitz].

> metastasis, initiation and promotion of cancer and resistance to anti-cancer drugs.
>
> I am not saying mobile phones cause cancer. I am saying that this is a pathway – which is founded on solid, peer reviewed international science – which provides a mechanism whereby mobile phone radiation could lead to cancer. Given that that is the case, then I would contend that some action is needed. If this is a possibility, then clearly research is needed to determine whether in fact heat shock proteins are being induced in the brains of mobile phone users; furthermore, we do not need to wait 30 years until that bottom line is confirmed. …
>
> … The link has been made by me. Having said that, the mechanism by which microwaves may cause protein unfolding, leading to the heat shock response, has not yet been determined, and there are a couple of possibilities. De Pomerai's group says that there may be a resonance of the microwave field with the protein or with the water. We have published, and it is in the written submission, a hypothesis paper in the *Journal of Theoretical Biology* which advances those two possibilities as well, for attributing low power as another stressor to activate the heat shock response.[76]

2.62 Associate Professor Olle Johansson from the Karolinska Institutet in Sweden, in discussing the health effects of visual display units, referred to the role of mast cells as a possible mechanism:

> Here in Sweden, the problems around different types of electromagnetic devices arose with the introduction of radio in the twenties and thirties but it was much more evident in the late seventies. When the PC explosion came, all the offices were turned into computer based systems and people were sitting all day long in front of visual display terminals of different types. At the end of the seventies and at the beginning of the eighties, a growing number of people complained of different symptoms, especially from their face, on their neck, arms and hands after they had been sitting in front of these visual display terminals. From the very beginning, it was not understood what was going on, but people were searching around in the working environment for different explanations. Very soon, the ideas focused upon the radiation from the visual display terminals. With respect to the symptoms, one could mention, for instance, skin problems, facial burning, redness, dry skin, facial heat, swelling, tingling sensations and even blisters. Also, it was connected with feelings of fatigue and headaches, and memory losses were claimed et cetera. Of course, as scientists we tried to understand the symptoms.
>
> … In the last years, the focus has been much more on different high frequency devices, which of course include modern computer screens but also include light tubes of high frequency, different kinds of

76 *Official Committee Hansard*, Sydney, 16 November 2000, pp 263-264 [French].

> telecommunications systems, such as wireless DEC telephones, different radio alarm based systems and, of course, mobile telephones. Parallel to this, a number of investigators – some among them having some very interesting data from Australia – have documented the results of experiments at the cellular and tissue level of different animals and humans which show the effects of, for instance, exposure to high frequency signals from mobile telephones. …
>
> … there are now more and more studies coming out pointing to possible mechanisms, from the cellular and molecular level, all the way up to more macroscopic events. Our working hypothesis is very simple actually. For instance, looking at human skin, both from patients claiming these kind of health problems and from normal healthy volunteers who have sat in front of visual display terminals, we see alterations in different cell types. For instance, the histamine contained in mast cells is identical to what you would see – and it is reported also in the literature – from other irradiation damage sources: for instance, from sunrays, X-rays and radioactivity. Our very simple and maybe naive working hypothesis that this irradiation damage is of a more long-term type compared to other more energetic irradiation damage.
>
> Of course, the molecular cell biochemistry machinery has to be worked out in detail and this work is, of course, going on. As I said before, in Australia, you have the research team around Peter French and his collaborators that has been studying these mast cells that have been irradiated using high frequency mobile telephone signals. From their studies, it is evident that these cells are affected. You then have to imagine what would happen if you have the same situation in a human being.[77]

2.63 Dr Cherry proposed another mechanism:

> … The early studies show that oscillating signals interfere with the brain very significantly and can change the EEG and can change the calcium ions, and these change reaction times. This is a classical physics approach of resonant absorption. If a system can oscillate and an oscillating signal comes in, it can resonantly be absorbed. It is what an aerial does, it is what a cell phone does, it is what is used in telecommunications, … It has been demonstrated in many laboratories that it actually does occur.[78]

2.64 But according to Dr John Moulder, in order to induce a biological change, 'radio-frequency radiation must deposit enough energy to significantly alter some biological structure'.[79]

2.65 In noting some of the current hypotheses about possible biological interactions, Dr Repacholi stated:

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77 *Official Committee Hansard*, Canberra, 7 November 2000, pp 187-188 [Johansson].

78 *Proof Committee Hansard*, Canberra, 2 March 2001, p 332 [Cherry].

79 Dr John Moulder, Submission 60, p 16.

> These RF field-induced alterations, if they occur, could be anticipated to cause a wide variety of physiological changes in living cells that are only poorly understood at the present time.[80]

2.66 While observing that thermal effects may account for positive results, the Stewart Report considered that reports of epigenetic effects should be taken seriously and further research undertaken.[81]

2.67 The Committee notes that a number of studies cited in submissions as providing evidence of biological or adverse health effects relate to extremely low frequency (ELF) exposure. Areas of similarity between the effects of radiofrequency radiation and extremely low frequencies include effects on calcium efflux, ODC[82] activity and behaviour associated with the opioid system. The Royal Society of Canada Expert Panel suggested that 'many of the efforts now underway to understand the mechanism associated with ELF effects could be used to investigate the mechanisms by which ELF-modulated RF fields elicit non-thermal effects'.[83]

2.68 The importance of determining the biological mechanism(s) responsible for any observed effects, particularly in relation to the setting of safety standards, was highlighted by the CSIRO:

> … it is generally agreed by various expert panels that research on mechanisms of interaction is essential. Without an understanding of how low energy RF fields cause these biological effects, it is difficult to establish safety limits particularly for non-thermal levels.[84]

How important is it to distinguish between frequencies?

2.69 Dr Moulder argued for the need to clearly distinguish between the evidence for adverse health effects from exposure to radiofrequency radiation as opposed to extremely low frequencies (ELF). The applicability of ELF research to radiofrequency exposure was referred to by EMF South World Pty Ltd:

> … observed bioeffects induced by mobile phone microwave radiation[85] are remarkably similar to bioeffects induced by power-line frequency EMF.[86] This means that two decades of epidemiological data on power-line frequency EMF can be used in the debate on potential health effects of

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80 Repacholi, 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 814.

81 Stewart Report, p 76. A similar comment was made in relation to ELF. See Royal Society of Canada Report, p 42, which states: 'The potential additive or synergistic responses between various environmental hazards need to be considered in assessing the risks of ELF exposure'.

82 An enzyme, ornithine decarboxylase. See para 2.82.

83 Royal Society of Canada Report, pp 47, 98.

84 CSIRO, Submission 95, p 11.

85 That is, radiofrequency radiation, as used in this report – see Chapter 1.

86 Electromagnetic field.

> mobile phone radiation, on which there is virtually no epidemiological data.[87]

2.70 Dr Moulder advised that it was not appropriate to extrapolate the results of exposure to frequencies from different areas of the electromagnetic spectrum:

> … the biophysics of the interaction is completely different. I do not want to be absolutist … But, in general, if you want to understand the biological effects of radiofrequency radiation, you use radiofrequency radiation.[88]

2.71 Dr Moulder later added:

> In general … most of the effects of radiofrequency radiation that we know of are not strongly dependent on frequency … But the bigger the jump you make, the less certain you can be … if we finally concluded that radiofrequency radiation was safe enough for all practical purposes, that does not tell us whether powerline frequency is safe. … But, if you demonstrated that the frequencies used for FM and television were hazardous, then you would certainly worry about cell phone frequency. It would not prove it, but the closer together in frequency your information is, the more likely it is to be relevant.[89]

2.72 The Committee notes, however, the views expressed by Professor Philip Jennings, who stated:

> Our society's experience with ionising radiation should persuade us to take great care … The original standard set for ionising radiation protection … has proven to be quite inappropriate and as further research has been performed and evaluated the public limit has been reduced by nearly a factor of a thousand. This could also happen with EMR. We are still in the infancy of EMR research and we should learn from the mistakes we made with ionising radiation and introduce a principle of prudent avoidance or ALARA'.[90]

2.73 Professor Litovitz argued that:

> The cell's characteristic response to a mobile phone is the same as that to a power line. This was beautiful for us, because it meant that all the data out there on powerline problems could be translated to the data on cell phone or mobile phone problems. That is to say, you could put them together to try to understand what is going on.[91]

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87 EMF South World Pty Ltd, Submission 129, p 2.

88 *Proof Committee Hansard*, Canberra, 2 March 2001, p 318 [Moulder].

89 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 323-324 [Moulder].

90 Professor Philip Jennings, Submission 122, p 1.

91 *Official Committee Hansard*, Melbourne, 22 September 2000, p.148 [Litovitz].

2.74 Many of the studies cited during this inquiry relate to extremely low frequency (primarily 50/60Hz) exposure, which report observed effects on the reproductive system, blood changes, ECG[92], heart rate, blood pressure and body temperature, melatonin and cancer.[93] Studies have also been conducted into the health implications of exposure to radars, which operate at radiofrequencies ranging from 300 MHz to 15 GHz.

2.75 Submissions and evidence to this inquiry have referred to biological and health effects associated with powerlines, radio and television towers and video display units (see below); however, this inquiry is concerned with electromagnetic radiation associated with telecommunications technologies.

2.76 Dr Neil Cherry reported in his submission that:

> Ten epidemiological studies have found significant miscarriage from EMR exposure across the spectrum from ELF, SW, to RF/MW. The Scandinavian physiotherapist studies, Kallén et al. (1982) and Larsen et al. (1991) also found significant prematurity, congenital malformation, still birth and cot death. Ouellet-Hellstrom and Stewart (1993) confirm the causal relationship with a highly significant dose-response relationship.[94]

2.77 Dr Cherry said it was also important to note that if an effect is seen with low frequency signals, such as an ELF 50 Hz or 60 Hz signal, or the Schumann Resonance ELF signals, then it is more likely and likely to be worse for modulated or pulsed RF/MW:

> This is because an ELF signal has a very long wavelength and generally passes easily right through the body. Unless there is a resonant oscillator, such as for the Schumann Resonances, it induces quite small fields in the body. On the other hand the RF/MW signals have wavelengths closer to the dimensions of bodies and body parts, they are more strongly absorbed in human bodies through the aerial effect.[95]

2.78 The Committee notes that the World Health Organization draws a distinction between radio and TV broadcasting and telecommunications facilities. While for the most part the Committee has confined its comments to telecommunications technologies, in acknowledgment of concerns raised in relation to electromagnetic radiation generally, the Committee has digressed into other frequency ranges and technological applications in its review.

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92 Electrocardiogram.

93 WHO Fact Sheet No 201, *Electromagnetic Fields and Public Health: Extremely Low Frequency (ELF) Electromagnetic Fields*, August 1998, pp 3-4, included in The World Health Organization, Submission 56, Volume 4, p 777-778.

94 Dr Neil Cherry, Submission 146, p 13.

95 Dr Neil Cherry, Submission 146, p 14.

Observed biological and health effects of radiofrequency radiation

Movement of substances across cell membranes

2.79 Studies have examined the effect of radiofrequency radiation on the movement of substances across cell membranes. The role of calcium in the functioning of brain and other cells has prompted research into calcium movement in brain tissue. While some studies have shown that low levels of RF exposure cause an increase in calcium efflux from brain tissue, according to the Stewart Report results are contradictory, and evidence of an amplitude modulated response at extremely low frequencies does not appear to be relevant to mobile phone technology, 'where the amplitude modulation within the critical frequency band is very small'.[96] The Stewart Report further concluded that '[i]f such effects occur as a result of exposure to mobile phones, their implications for cell function are unclear and no obvious health risk has been suggested. Nevertheless, as a precautionary measure, amplitude modulation around 16 Hz should be avoided, if possible, in future developments in signal coding'.[97]

Exciting neurons

2.80 The Stewart Report found evidence that exposure to high intensity radiofrequency fields, sufficient to result in a temperature rise in tissue, can reduce the excitability of neurons. However, exposure at non-thermal levels does not appear to have an effect.[98]

2.81 It also reported that various studies have examined the potential of radiofrequency radiation to affect gene expression and produced inconsistent results. While the well publicised study showing an increase in the lifecycle of nematodes may be suggestive of a non-thermal effect, the report said that there was little evidence to support the proposition that mobile phone radiation causes a stress response in mammalian cells.

ODC activation

2.82 The enzyme ornithine decarboxylase (ODC) plays a role in the synthesis of polyamines which can trigger DNA synthesis, cell growth and cell differentiation. Activation of ODC has been related to the late, 'promotional' phase of cancer production, which is usually (but not always) correlated with an increase in the rate of cell division in the affected tissue. Again, the results of studies examining the effects of radiofrequency radiation on ODC activity have been mixed. Positive findings do not indicate an obvious pattern of dose-response or reveal a mechanism to explain the changes. The Stewart Report noted that although all carcinogenic factors stimulate

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96 Stewart Report, pp 50-51.

97 Stewart Report, pp 50-51. The Royal Society of Canada Report states: 'ELF-modulated RF radiation may effect [calcium] efflux from brain tissue' (p 36).

98 Stewart Report, p 52.

ODC, not all stimuli that increase ODC activity promote cancer, and said it was unlikely that the small increases observed from exposure to pulse-modulated radiofrequency fields could, on their own, have a tumour-promoting effect.[99]

2.83 The Royal Society of Canada Report states that:

> … the lack of major [cell] proliferative response in the tissue of cell line following ELF exposure does not necessarily mean that ELF is incapable of serving as a tumour promoter, particularly if alterations in ODC activity are involved …. It is possible that this small change in ODC activity brought about by ELF is unrelated to human cancer risk.[100]

2.84 The Report suggests that further research is warranted.

Heat-shock protein response

2.85 Dr Peter French indicated that the heat-shock protein response which is activated by external stressors such as chemicals, heavy metals, drugs and radiofrequency radiation has been shown in a separate study to be causally linked to cancer formation. Other research submitted by Dr French suggested a link between RF exposure, cell changes and gene transduction.

Melatonin production

2.86 Submissions referred to studies that had shown that extremely low frequency (ELF) electromagnetic fields reduce melatonin production by the pineal gland, and the magnetic fields prevent melatonin from inhibiting the development of breast cancer.[101] Circulating levels of this hormone have a strong circadian rhythm with melatonin levels peaking in humans at night. Melatonin affects the mammalian reproductive system as well as other physiological and biochemical functions.[102] While it may be hypothesised that similar effects may result from exposure to radiofrequency radiation, the Royal Society of Canada Report said that additional research is required to test the effects of RF radiation on pineal function, circulating melatonin levels, and the utilization of melatonin by target cells and tissues.[103]

2.87 Dr Cherry cited a study from Switzerland on the Schwarzenberg tower:

> … They were sampling melatonin before and after the tower was permanently turned off and they found a significant rise in melatonin after the tower was turned off. They found a dose response increase in sleep

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99 Stewart Report, p 64.

100 Royal Society of Canada Report, pp 41-42. The Royal Society of Canada Report provides a detailed summary of ODC-related research at pp 36-42.

101 Mr Stan Stanfield, Submission 36, p 1. See also The EMR Safety Network International, Submission 111, Attachment 3.

102 Royal Society of Canada Report, p 42.

103 Royal Society of Canada Report, pp 42-43.

> disturbance. When the tower was turned off experimentally, the sleep quality improved and melatonin rose in animals.[104]

2.88 The Stewart Report commented that part of the brain and the gland involved in melatonin production are further from the surface of the head in humans than in animals and concluded that:

> … even if there were an effect on melatonin production in animals resulting from a direct interaction of fields within the brain, it would be much less likely to occur in people.[105]

2.89 In his submission, however, Dr Cherry claims that EMR reduces melatonin and enhances free radical activity in humans and that this is genotoxic, damaging the DNA and chromosomes, enhancing oncogene expression and transforming cells to neoplastic cells and causing cancer in exposed populations.

> We have natural EMR-based communication systems in our brains, hearts, cell and bodies. External natural and artificial EMR resonantly interacts with these communication systems altering hormone balances and damaging organs and cells. The brain and the heart are especially sensitive because they mediate and regulate primary biological functions that are vital to life, thinking and heart beat, using EMR signals, the EEG and ECG. When EMR interferes with the EEG this is communicated to the body by neurotransmitters and neurohormones, including the serotonin/melatonin system. EMR reduces melatonin. Melatonin is vital for the health of the Immune System, the Brain, The Heart and every cell, because it is the most potent naturally produced antioxidant. It is a potent free radical scavenger that plays a vital protective role to protect the DNA in every cell. Reduced melatonin causes cancer, miscarriage, heart disease, neurological diseases, viral and bacterial diseases, etc….[106]

2.90 In his submission, Dr Cherry says:

> Cancer is a chronic disease problem from accumulated genetic cell damage. Latencies for children and soft tissue cancers are as short as a few years, for most cancers they take 10 to 40 years to develop. Cancer rates rise rapidly with age over 65 years because of the life-time of accumulated cell damage and the drastic reduction in melatonin that occurs after puberty.[107]

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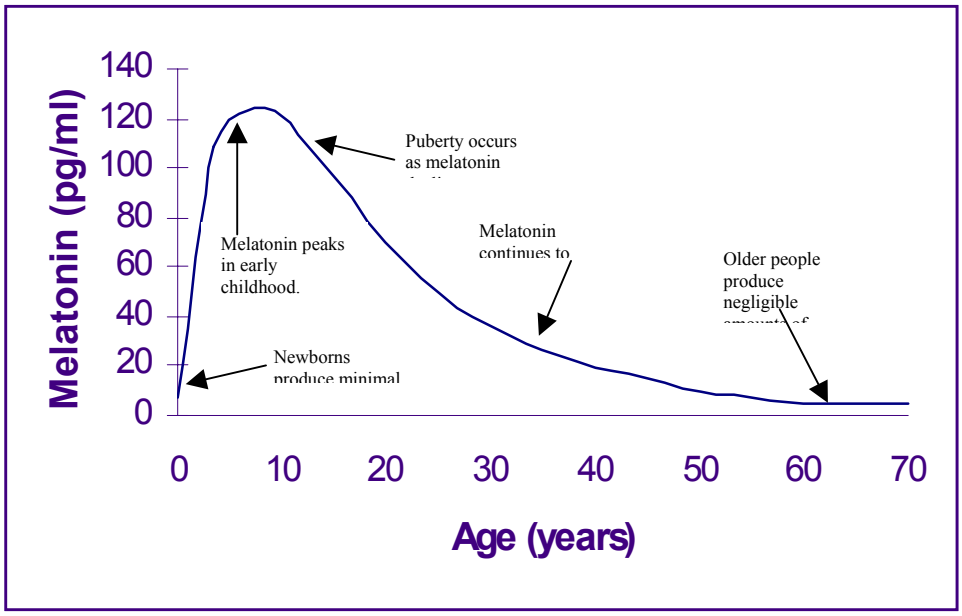
104 *Proof Committee Hansard*, Canberra, 2 March 2001, p 330 [Cherry].

105 Stewart Report, p 61.

106 Dr Neil Cherry, Submission 146, p 1.

107 Dr Neil Cherry, Submission 146, p 2.

Figure 1: Melatonin Production varies with age, Reiter & Robinson (1995)[108]



> This shows how vulnerable very young children are because they have very low melatonin levels and undeveloped immune systems. It also shows how reduced melatonin makes older people more vulnerable and much more prone to disease and cancer.[109]

2.91 Dr Cherry cited a large epidemiological study of female breast cancer over 24 states in the US which identified several organic solvents, including organochlorines, that significantly increased the incidence of breast cancer and which showed that radiofrequency fields were as dangerous as toxic chemicals and ionising radiation.[110]

108 Reproduced from Dr Neil Cherry, Submission 146, p 2.

109 Dr Neil Cherry, Submission 146, p 2.

110 Cantor *et al*, 1995.

Table 1: Breast cancer from occupational exposures, Cantor et al. (1995) [111]

Substance	Odds Ratio	95%Confidence Interval
Carbon Tetrachloride	1.13	1.1-1.2
Methylene chloride	1.15	1.1-1.2
Styrene	1.18	1.1-1.3
Metals and Oxides	1.13	1.0-1.3
Ionizing Radiation	1.14	0.9-1.4
Radiofrequency fields	1.15	1.1-1.2

2.92 Dr Cherry says this evidence is backed by more than 10 other studies showing that EMR across the spectrum increases breast cancer incidence and 15 studies showing reduced melatonin, including four with dose-response relationships:

> … These are sufficient to classify a causal relationship between EMR and breast cancer, with melatonin reduction [a]s the biological mechanism.[112]

2.93 Dr Cherry also cited studies which found that melatonin reduction can be a cause of miscarriage and that microwaves significantly increased the incidence of miscarriage in a dose-response manner in the first trimester and that very young babies are sensitive to variations in the natural EMR at extremely low levels:

> One of the most important single studies involved cot death (Sudden Infant Death Syndrome) in Ontario, Canada. O'Connor and Persinger (1997) were investigating the GMA melatonin hypothesis by seeing if a melatonin-related syndrome (SIDS) varied with GMA. They found that SIDS incidence significantly increased when GMA >30 nT and GMA <20 nT, - a homeostatic result. This confirms that GMA causes illness and death in vulnerable people, babies, and involves melatonin homeostasis.[113]

Blood brain barrier

2.94 A number of studies have examined the potential of radiofrequency radiation to affect the permeability of the blood-brain barrier.[114] While most studies have had negative results, one study did find an increased blood-brain permeability to albumin in RF irradiated rats. While it has been suggested that blood-brain barrier breakdown

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111 Reproduced from Dr Neil Cherry, Submission 146, p 3.

112 Dr Neil Cherry, Submission 146, p 3.

113 Dr Neil Cherry, Submission 146, p 13.

114 Barrier made up of small blood vessel and nerve tissue which limits the passage of certain substances between the blood and the brain.

following microwave radiation exposure may be due to thermal effects, some researchers have suggested that the disturbance may occur under 'power window' conditions where there may be a range of power intensities at which the barrier remains intact.[115]

2.95 The Stewart Report concluded that '[t]he available evidence for an effect of RF exposure on the blood-brain barrier is inconsistent and contradictory. Recent, well-conducted studies have not reported any effects'.[116] In contrast, the Royal Society of Canada Report stated that effects on the blood-brain barrier permeability, calcium efflux and ODC activity 'occur at exposures not thought to elicit thermal effects, [and] it is likely that these effects, even if they also occur at higher exposure levels, are non-thermal biological effects'.[117]

DNA

2.96 A number of studies also have examined the potential of radiofrequency fields to cause damage to DNA, and some have found no effects at non-thermal levels of exposure. While radiofrequency fields do not have sufficient energy to break chemical bonds or directly cause DNA strand breaks, several studies have shown an increase in breakages at non-thermal levels of exposure and chromosomal aberrations. Whilst these studies have not been replicated, they are 'confirmed' by the fact that they were similar and carried out in laboratories independent of each other.

2.97 According to Dr Cherry:

> The first identified study that showed that pulsed RF radiation cause significant chromosome aberrations was Heller and Teixeira-Pinto (1959). Garlic roots were exposed to 27 MHz pulsed at 80 to 180 Hz. for 5 mins. They were examined 24 hrs later. They concluded that this RF signal mimicked the chromosomal aberration produced by ionizing radiation and c-mitotic substances. No increased temperature was observed. …[118]
>
> Garaj-Vrhovac et al. (1990) noted the differences and similarities between the mutagenicity of microwaves and VCM (vinyl chloride monomer). They studied a group of workers who were exposed to 10 to 50 $\mu W/cm^2$ of radar produced microwaves. Some were also exposed to about 5 ppm of VCM, a known carcinogen. Exposure to each of these substances (microwaves and VCM) produced highly significant ($p<0.01$ to $p<0.001$) increases in Chromatid breaks, Chromosome breaks, acentric and dicentric breaks in human lymphocytes from blood taken from exposed workers. The results were consistent across two assays, a micronucleus test and chromosome aberration assay. Chromosome aberrations and micronuclei are

115 EC Report, p 54.

116 Stewart Report, p 60.

117 Royal Society of Canada Report, p 47.

118 Dr Neil Cherry, Submission 146, p 18.

> significantly higher than the controls, ($p<0.05$, $p<0.001$, $p<0.0001$), for each of the exposure intensity.[119]

2.98 Dr Cherry also drew the Committee's attention to studies done of staff in the US Embassy in Moscow that was chronically exposed to radar over a decade and found increased chromosome damage:

> … I have found more than 30 studies showing chromosome damage in people exposed to radiofrequency microwave radiation. This is far more than we have for benzine, which is a carcinogen.[120]

2.99 The results of genotoxic[121] studies were said by the Stewart Report to have been generally negative. Dr Cherry says the studies he cited in his submission show very strong evidence of genotoxic effects from RF/MW exposures and notes that when chromosomes are damaged, one of the primary protective measures is for the immune system natural killer cells to eliminate the damaged cells.

2.100 The Committee notes that the general public ICNIRP guideline for microwaves above 2 GHz is 1 mW/cm^2, and for workers is 5 mW/cm^2. Dr Cherry pointed out that the Garaj-Vrhovac *et al* (1991) study of Chinese hamster cells in an isothermal exposure system showed that even at exposures 100 times below the public exposure guideline a 60 minute exposure kills 28 per cent of the cells and 30 minutes kills 8 per cent of the cells.

2.101 Garaj-Vrhovac (1999) also found that 12 workers occupationally exposed to microwaves had significantly increased chromosome damage as well as disturbances in the distribution of cells over the first, second and third mitotic divisions.

2.102 Dr Stan Barnett in commenting on the CSIRO's unsuccessful proposals for NHMRC funding which was to look at cell response to radiation at specific periods in the cell division cycle, said:

> … One of the biggest failings of all cellular studies is that, largely, they either use highly transformed cell lines which are very sensitive to almost anything, or they use cell lines which are general laboratory, fairly robust cells like lymphocytes. Nobody bothers to try to synchronise the cells. It is well known in radiation biology that cells respond to radiation at specific periods in the cell division cycle. Our proposal was to use a fairly complex system which would allow us to use what we know as a radiation sensitive cell line and to synchronise it so that we only exposed it in G1, where we know – because of 30 years of background work – this particular cell is highly sensitive to radiation. It is deficient in DNA repair enzymes, and we know that, if you are going to produce any kind of impairment of DNA repair which would be manifest as single strand breaks as per the Henry Lai

119 Dr Neil Cherry, Submission 146, pp 18-19.

120 *Proof Committee Hansard*, Canberra, 2 March 2001, p 331 [Cherry].

121 Substances toxic to DNA.

> study, this would be an opportunity to use the most sensitive available end point that we know of to test that scenario.[122]

2.103 It is also the case that studies have shown an increase in the number of cells with micronuclei, the formation of which are considered to reflect DNA damage, after exposure to RF radiation. In spite of this, the Stewart Report concluded that implications for human health are unclear as normal tissue can also exhibit a high and variable incidence of micronuclei, making results difficult to interpret.[123]

2.104 Overall, while there have been numerous studies showing a range of biological effects, and while further research is required to satisfy the need to replicate positive results and to establish their implications for human health, the Committee Chair is persuaded that there is cause for concern.

Health effects discussed

2.105 Sleep disturbance, chronic fatigue, immune system impairment and learning difficulties have also been observed in radiofrequency exposed residential populations, and it has been argued that these effects are consistent with observed biological effects including calcium ion alteration and melatonin reduction. Various symptoms such as headaches, dizziness, feelings of discomfort, burning skin, which appear to be highly correlated with 'warm sensations' on and behind the ear against which the mobile phone is held, are described by Hocking (1998) and later observed in a survey of over 10,000 mobile phone users in Norway and Sweden.[124] There have also been newspaper reports of more epileptic seizures in a school since mobile phone use has increased.[125]

Cancer

2.106 Although the development and promotion of cancer ranks in the general public's mind as a real health risk associated with mobile phone and other telecommunications technologies, and indeed with other artificial sources of electromagnetic emissions, the scientific evidence for this association is said by many to be less definitive.

2.107 One area of contention is whether radiofrequency radiation initiates cancer or whether it may be implicated in the promotion of cancer.[126] While there is general

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122 *Official Committee Hansard*, Sydney, 16 November 2000, pp 225-226 [Barnett].

123 Stewart Report, p 73. See also the Royal Society of Canada Report, which concludes: 'The great majority of [laboratory] studies have failed to demonstrate genotoxic effects due to exposure to radiofrequency fields. … Overall, a number of different assays [technique for analysing something] for studying genotoxicity have failed to produce consistent positive findings regarding RF fields' (p 76).

124 The EMR Safety Network International, Submission No 111, Attachment 2.

125 The EMR Safety Network, Submission 111, Submission Vol 8, p 1718.

126 See Stewart Report, p 77, that concluded that RF exposure is unlikely to be a tumour initiator and that evidence of its effect on tumour progression is equivocal.

agreement that the energy in non-ionising radiation emitted by mobile telephones is unlikely to break chemical bonds, thereby inducing alterations in the genome,[127] Dr Cherry informed the Committee that in his view there is now sufficient evidence to show that EMR interacts and interferes with communication systems in our brains, hearts, cell and bodies through neurotransmitters and neurohormones, including the serotonin/melatonin system.

2.108 According to Dr Cherry, both through reducing melatonin and through enhancing free radical activity, EMR is genotoxic, damaging the DNA and chromosomes, enhancing oncogene expression and transforming cells to neoplastic cells and causing cancer in exposed populations.

2.109 The 1994 CSIRO report says:

> For any biological effect to become significant the body's homeostatic mechanism has to be overcome. Homeostatis uses cellular communications via molecules and ions to control the three basic functions of cells: proliferation, differentiation, and activation. Cancer promotion involves the disruption of cell-to-cell communication.[128]

2.110 There is more agreement and significant evidence to support non-ionising radiation as a cancer promoter.

2.111 Dr John Holt stated that cancer cells were three times as conductive of RF as non-cancer cells, and that non-ionising radiation rendered tumours more sensitive to ionising radiation.[129]

2.112 In its report of 1994, CSIRO said:

> However, because a promoting agent requires high doses, must continue for long periods of time, and is reversible, it has been argued that the risks from a promoting agent are less than the risks from an initiating agent.[130]

2.113 Most epidemiological studies[131] that have been published focussed on RF exposure not directly related to cellular phones, and provide primarily indirect evidence from occupational or amateur radio operator radiofrequency exposure, with exposures being 'more varied in dose, type of signal, and anatomical localisation than exposures from cellular telephones'. These studies had variable findings.[132]

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127 DNA.

128 CSIRO Report, p 85.

129 *Official Committee Hansard*, Canberra, 8 September 2000, pp 81-83 [Holt].

130 CSIRO Report, pp 85-86.

131 Human populations health studies.

132 Kenneth J Rothman, 'Epidemiological evidence on health risks of cellular telephones', *Lancet*, 2000, 356, pp 1837-1840 (Rothman, 2000).

2.114 Professor Mark Elwood, epidemiologist, concluded:

> … overall … I do not see any consistency in relationships between cancer and radiofrequencies. There are quite a lot of studies, so there are some positive results which require further assessment. The studies are limited by lack of information on exposure, lack of control for other factors and, in some studies, biases in the data. … Very often it is the weaker studies, with much smaller numbers and much weaker study designs, that tend to show unusual results, which therefore need testing. So, overall, my conclusion is that there is no consistent evidence relating radiofrequency exposures and cancer in humans, in terms of current research.[133]

2.115 The information provided by these studies is considered, by most reviews, to be of limited value because of inherent selection biases and because they incorporate exposure conditions dissimilar to those experienced from cellular phone use.

2.116 The Stewart Report notes that studies of brain cancer have provided 'inconsistent results'.[134] The Report also refers to studies of other types of cancer, concluding 'data on other types of cancer are more sparse and although some have suggested increased risks from RF exposure, their limitations are such that these findings should not be a cause for concern'.[135] Several studies published since the Stewart Report support this conclusion.[136]

2.117 The recent occupational study of Motorola employees is considered to have dealt with some of the shortcomings of earlier studies.[137] This extensive study of 195,775 Motorola employees between 1976 and 1996 found that for the nine per cent of employees that had experienced moderate to high levels of RF exposure, there was no increase in brain or lymphatic/haematopoietic[138] cancer mortality than either the general population or employees that had been exposed to lower levels of RF radiation.[139]

2.118 Professor Elwood, in his submission to the Committee, commented that the comparisons of employee mortality with general population mortality in this study were of limited value, but that the analyses of mortality between employees with different levels of exposure were more powerful.[140] His analyses revealed no

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133 *Official Committee Hansard*, Melbourne, 22 September 2000, p 143 [Elwood].

134 Stewart Report, p 96.

135 Stewart Report, p 96.

136 See Dr John Moulder, Submission 60A.

137 Although limitations to this study were noted by the authors.

138 Blood-related.

139 RW Morgan, MA Kelsh, K Zhao, KA Exuzides, S Herunger, W Negrete, 'Radiofrequency exposure and mortality from cancer of the brain and lymphatic/hematopoietic systems', *Epidemiology*, 11, pp 118-127, 2000 cited in Rothman, 2000.

140 Professor Mark Elwood, Submission 11, Submission Vol 1, p 47.

increased risk for cancers of the brain, all lymphatic and haemopoetic cancers, leukaemia, non-Hodgkin's lymphoma and Hodgkin's disease (although given the small numbers involved, a slight increase or decrease could not be discounted), nor for any general increased mortality risk.

2.119 Professor Elwood noted that an important finding of this study was the lack of association between degree of exposure and the incidence of the cancers studied, and that it also indicated no difference in overall specific risks between the men and women studied.[141] However, he advised:

> … even a study of this size cannot confidently exclude a modest increased risk of specific cancers which occur in relatively small numbers, although it can confidently exclude increases in total mortality or from major causes such as all cancers.[142]

2.120 In evidence to this Committee, Dr Peter French, Principal Scientific Officer, Centre for Immunology, St Vincent's Hospital, Sydney, advised that there was no 'definitive evidence' for a link between mobile phone radiation and cancer. However, he added that while there apparently was insufficient evidence on the surface, buried within the unsubstantiated assertions, fears, anecdotes and myriad of facts there were clues that point to a link between cancer and mobile phone emissions.[143]

2.121 Professor Elwood, on the other hand, concluded that based on an overall assessment of the research to date, there was 'no consistent evidence relating radiofrequency exposures and cancer in humans'.

> … the better studies … are the ones that show no association. Very often it is the weaker studies, with much smaller numbers and much weaker study designs, that tend to show unusual results which therefore need testing. So, overall, my conclusion is that there is no consistent evidence relating radiofrequency exposures and cancer in humans, in terms of current research.[144]

2.122 Radiation oncologist, Dr John Moulder, in his submission to the Committee, concluded that:

> … the epidemiological evidence for a causal association between cancer and exposure to radio-frequency radiation is weak to non-existent.[145]

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141 Professor Mark Elwood, Submission 11, Submission Vol 1, pp 47-48.

142 Professor Mark Elwood, Submission 11, Submission Vol 1, p 49.

143 *Official Committee Hansard*, Sydney, 16 November 2000, p 262 [French].

144 *Official Committee Hansard*, Melbourne, 22 September 2000, p 143 [Elwood].

145 Dr John Moulder, Submission 60, p 23.

> … animal carcinogenesis studies conducted to date provide no replicated evidence that exposure of animals to radio-frequency radiation at non-thermal intensities causes or promotes cancer.[146]
>
> …[o]verall, exposure of cells to radio-frequency radiation with an intensity that does not significantly raise cell temperature does not produce any consistent evidence for genotoxic or epigenetic activity.[147]

2.123 The interpretation of the scientific literature by some expert bodies, including the ICNIRP in the preparation of its exposure safety guidelines, has been criticised.[148] Dr Cherry stated:

> They decide that there is no evidence of genotoxicity but they do not cite any studies that have been published that do show that RF microwave damages chromosomes – and that is the classic test of genotoxicity… Secondly, when I looked at two of their studies on cancer, they said that two recent studies do not show any significant effects. I have those studies and they do show significant effects.[149]

2.124 Dr Barnett advised that the CSIRO had submitted two projects to the NHMRC, both of which were shortlisted but unsuccessful, related to the potential effects of radiofrequency radiation on DNA and cancer production:

> One was an animal system, where we were looking at repeating, I believe, a very important research finding which has been largely ignored, which was finally published in 1992 by Chou and others. That work was actually undertaken at the Brooks Air Force Base in San Antonio. That study looked at simply exposing rats to 2450 megahertz of radiation throughout their lives.
>
> When the data was analysed for tumour development in the exposed versus controlled animals, it turned out that, depending on how you chose to analyse the data, you got either a negative or a positive result. The study had been largely referred to as providing a negative result. It was only negative if you separated out each type of cancer and then looked at the difference in numbers for each type of cancer. Clearly, because they only used a couple of hundred animals, when it was broken down into all the different types of cancer, the numbers that were being compared were extremely small, so the statistical power would be pretty poor. When they compared the incidence of primary malignancies between the two groups there was a fourfold increase in the exposed group.[150]

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146 Dr John Moulder, Submission 60, p 28.

147 Dr John Moulder, Submission 60, p 32.

148 The EMR Safety Network International, Submission 111, Attachment 2. See also, Mr Don Maisch, Submission 20, Executive Summary.

149 *Proof Committee Hansard*, Canberra, 2 March 2001, p 339 [Cherry].

150 *Official Committee Hansard*, Sydney, 16 November 2000, p 225 [Barnett].

2.125 Some witnesses to this inquiry referred to anecdotal evidence of people claiming, 'with hindsight and when prompted', to suffer from a range of cancer types resulting from chronic exposure to electromagnetic radiation.[151] While it has been claimed that the involvement of electromagnetic emissions in the proliferation of cancer cells and possibly even as the cause of cancer is 'beyond doubt',[152] this view has not been supported by recent reviews on recently published papers.

2.126 The results of a case-control study conducted at five United States academic medical centres between 1994 and 1998 using a structured questionnaire, were published by Muscat *et al* in 2000.[153] There were 469 men and women aged between 18 and 80 years with primary brain cancer, with 422 controls. Details obtained from interviews included the number of years of use, minutes/hours of use per month, year of first use, phone manufacturer, reported average monthly bill, demographics, smoking history, alcohol consumption, exposure to power frequency fields, occupation and medical history. No assessment was made of participants' diet.

2.127 The researchers concluded that the study 'shows no effect with short-term exposure to cellular telephones that operate on (primarily) analog signals' and recommended that further research is undertaken to account for longer induction periods, particularly for slow-growing tumours, and the differences between analog and digital mobile phones.[154]

2.128 There was no association observed between the duration of cellular phone use and incidence of brain tumours. In the cases examined, cerebral tumours occurred more frequently on the side of the head to which the phone had been held, however, for patients with temporal lobe cancer, the tumours occurred more frequently on the side opposite to that against which the phone was customarily held. This contrasts with a Swedish study that found an association between the side of the head a brain tumour occurred and the side of phone use, although this study also did not find an overall association between cell phone use and the risk of brain cancer.[155]

2.129 The Committee received a confidential submission from a person suffering from a growth inside their skull. The growth was adjacent to the mobile telephone antenna position. This person was a heavy user of both analogue and digital mobile phones and believes that the excessive microwave radiation resulting from extremely heavy mobile phone use, most probably caused the malformation.[156]

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151 The EMR Safety Network International, Submission 111, Submission Vol 8, p 1719.

152 The EMR Safety Network International, Submission 111, p 3.

153 Joshua E. Muscat, 'Handheld cellular telephone use and risk of brain cancer', *JAMA*, 20 December 2000, pp 3001-3007 (Muscat *et al,* 2000).

154 Muscat *et al,* 2000.

155 Hardell *et al*, 1999, cited in National Cancer Institute Press Release, 'No association found between cellular phone use and risk of brain tumours', 21 December 2000.

156 Confidential submission.

2.130 Dr Bruce Hocking undertook a survey of 40 people to categorize the types of symptoms exhibited by users of mobile phones. The symptoms mainly affected the head and, for a few, the waist. These symptoms included dull pain, an unpleasant warmth or heating, as well as ache, throb, sharp pain and pressure. All respondents could distinguish the sensations from ordinary headache. Most respondents felt the sensation less than five minutes after commencing the mobile phone call, but for others the sensation built up as the day progressed. For some, the sensation lasted less than an hour after ceasing calls, for others it lasted till bed-time, and five respondents felt it the next day.[157] In addition, Dr Hocking co-authored a paper[158] on a detailed study of a person who had enduring effects on the side of his head where he used his GSM mobile phone. He experienced persistent unpleasant feelings lasting for more than a year and underwent extensive investigations by neurologists to find out if he had brain tumours or some other odd sort of neurological condition that could have been causing these problems, and nothing had been found. Dr Hocking informed the Committee:

> This is the first time that I am aware of that there has been a clear demonstration of a health effect in humans attributable to a mobile phone. I agree it is only one case, and before you get too excited you would like to see more. Nonetheless, I think it is a significant warning when you see it in context with the previous 40 cases that I was reporting that were getting similar sorts of symptoms that there is considerable likelihood that mobile phones, at the low levels of radiofrequency which they are operate on, are causing disturbances of neural function.
>
> It is also considerable evidence of an athermal effect. Given that mobile phones operate at low intensity – we are told by government, WHO and industry that mobile phones operate well within safety standards – that to produce this sort of effect we are having effects outside at low levels. [159]

2.131 Since 1994, researchers at the National Cancer Institute (NCI) in the United States have been conducting an adult brain tumour study which includes investigating a range of possible risk factors including: workplace exposures to chemical agents and electromagnetic fields; dietary factors; family history of tumours; genetic factors; home use of selected appliances; reproductive history and hormonal exposures; viruses; and medical and dental exposure to ionising radiation. Cell phones, as another potential risk factor, were included in the research program in response to public concern about possible links between cellular phones and brain cancer.

2.132 Results from NCI research into cell phones and brain cancer were published early in 2001. The case-control study of the relationship between cellular/mobile

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157 Hocking B, *Preliminary report: Symptoms associated with mobile phone use*, Occupational Medicine, Volume 48, No. 6, 1998, pp 357-360.

158 Hocking B, and Westerman R, *Neurological abnormalities associated with mobile phone use*, Occupational Medicine, Volume 50, No. 5, 2000, pp 366-368.

159 *Official Committee Hansard*, Melbourne, 22 September 2000, p 113 [Hocking].

phone use and brain tumours was conducted in three hospitals in the United States between 1994 and 1998. The study identified 782 patients in these hospitals who had glioma, meningioma or acoustic neuroma; from the same hospitals, 799 patients with non-malignant conditions, were used as the control group.

2.133 The study found no evidence that the risks of glioma, meningioma, acoustic neuroma, or all types of tumours together, was higher among people who used mobile phones for an hour or more a day or regularly for five or more years. The researchers concluded that the results did not support the hypothesis that the use of mobile phones causes brain tumours, but stated that the results were 'not sufficient to evaluate the risks among long term, heavy users and for potentially long induction periods'.[160]

2.134 The Committee acknowledges the difficulty of testing long term exposure and notes that the results of this study should be interpreted cautiously for the following reasons:

- widespread use of mobile phones is only a recent phenomenon, with few people in the United States having used mobile phones prior to the 1990s. Only a small number of study participants had used a mobile phone for over five years. Consequently, the study would not have been able to detect the risk of brain tumours after a long latency period;
- there was a reliance on interviews and the ability of participants to accurately recall mobile phone use rather than by objective measurements of exposure;
- the study was designed to assess the risk of all types of glioma, and the sample was too small to detect increased risk for glioma subtypes; and
- factors other than duration of use influenced the level of exposure of brain and nervous system tissue in the head to radiofrequency radiation, including distance from the base station, local topography and vegetation, whether the phone is used indoors or outdoors, the design of the phone, and the position of the phone and the antenna in relation to the head.[161]

2.135 In recognition of these limitations, the NCI advised that 'it would be premature to conclude that use of hand-held cellular telephones does not cause tumors of the brain and nervous system'.[162] Noting that analog phones were predominantly in use during the study period, contrary to recent years when phones have been increasingly based on digital technology, the NCI nevertheless offers the view that

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160 Peter D Inskip *et al*, 'Cellular-telephone use and brain tumours', *The New England Journal of Medicine*, 344 (2), 11 January 2001, pp 79-86.

161 National Cancer Institute, *Questions and Answers for the National Cancer Institute Study of Brain Tumors and Use of Cellular Telephones*, Press Release, 31 December 2000. See also, Dimitrios Trichopoulos and Hans-Olov Adami, 'Cellular telephones and brain tumours (Editorial)', *The New England Journal of Medicine*, 344(2), 11 January 2001, pp 133-134.

162 National Cancer Institute, *Questions and Answers for the National Cancer Institute Study of Brain Tumors and Use of Cellular Telephones*, Press Release, 31 December 2000.

'there is no evidence at this time that cancer risk would differ for the two types of phones'.[163]

2.136 The results of a unique Danish study into the relationship between mobile phones and cancer were also published at the beginning of February 2001 in the *Journal of the National Cancer Institute*.[164]

2.137 A research team, headed by Dr Christoffer Johansen, conducted a retrospective cohort study[165] of cancer incidence in 420,095 Danish users of mobile phones between 1982 and 1995, using telephone subscription lists from two Danish mobile phone operating companies and the Danish Cancer Registry. The team observed no significant difference between expected and observed incidence of cancers of the brain, nervous system or salivary gland, or of leukaemia. Risks for these cancers did not vary by duration of cellular telephone use, time since first subscription, age at first subscription, or type of cellular phone used (analog or digital). The study concluded that the results did not support the hypothesis that there is an association between the use of mobile phones and tumours of the brain, salivary gland, leukaemia or other cancers.[166]

2.138 Dr Johansen is reported as stating that '[i]f it is assumed that tumour promotion occurs close to the site of exposure, this finding provides additional evidence against a link between cellphone use and brain cancer'. However, Dr Johansen indicated that the study results did not rule out a relationship between mobile phones and other health risks such as ringing noises in the head, migraine, headaches, other symptoms of the conditions associated with the central nervous system, Parkinson's and Alzheimer's diseases, various types of dementia, and skin diseases.[167]

2.139 Responding to the report, Australia's Dr Bruce Armstrong, who is undertaking an epidemiological case-control study on the relationship between exposure to radiofrequency radiation and brain and other tumours in adults (see

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163 National Cancer Institute, *No Association Found Between Cellular Phone Use and Risk of Brain Tumors*, Press Release, 31 December 2000. Not in relation to this study, but in evidence to the Committee, Professor Mackenzie said: '… pulsed radiation should not be considered to be equivalent to continuous radiation of the same frequency and power level. It is important to distinguish between radiation which is made up of short, high-intensity pulses and radiation which is made up of a lower level of continuous radiation. That is the important thing that we need to flag at this time, that there is an actual difference between response to continuous radiation and that to a train of pulses of the same average power …. Analog, of course, is a heavily modulated continuous signal, but it is not very similar to the digital. The digital is much more intense over short time periods. The pulses are more intense and more widely spaced than in the analog system. So there could be a difference in the biological response to the two signals' (*Official Committee Hansard*, Sydney, 16 November 2000, p 272 [Mackenzie]).

164 Johansen *et al*, 2001, Cellular Telephones and Cancer – a Nationwide Cohort Study in Denmark', *Journal of the National Cancer Institute*, 93 (3), February 7, 2001, pp 203-207.

165 A cohort study refers to a study which follows what happens to a group of people over a period of time.

166 Johansen *et al*, 2001, pp 203-207.

167 *Danish cellphone study shows no cancer link*, Reuters news report, Story No. 5178, 7 February 2001.

Australian research below), stated that while it was a 'reassuring study', it did not 'give an ultimate assurance of a lack of a hazard'. A shortcoming of the study was that only a small percentage of the mobile phone service subscribers had used their phones for more than seven years and this 'raised questions on what links there were between cancer and long term mobile phone users'.[168]

2.140 The Committee Chair considers that there is sufficient doubt as to the association between radiofrequency and cancer to warrant further research before the public can be confident that any risks are adequately safeguarded against through current exposure standards. A discussion of the efficacy of current standards is discussed in Chapter 4.

Other effects

2.141 Although a dominant concern, cancer is only one of the health effects that has been attributed to radiofrequency exposure. Electromagnetic emissions have also been implicated in many debilitating and/or serious health conditions, often immune system related, including allergies, repeated flu-like episodes and auto-immune diseases.[169] There is also some evidence of genetic predisposition and age-related factors that may influence sensitivity to potential effects of RF radiation.[170]

2.142 While there have been reports of effects on the cardiovascular system from exposure to electromagnetic radiation, the Stewart Report concluded that 'on the basis of published evidence, [there is] no basis for concern about effects of mobile phone use on the heart and circulation'. People subject to chronic electromagnetic energy exposure have also reported suffering heart attacks and high blood pressure.[171] The Stewart Group said, however, that while normal use of a mobile phone against the head is unlikely to have a direct effect on the human heart, influences on cardiovascular centres in the brainstem and on the carotid body, a body of tissue involved in the regulation of the heartbeat, were more conceivable, and further experimental work on human volunteers was warranted. Observed effects were said to be attributable to thermal effects from acute exposures to radiofrequency radiation.[172]

2.143 Despite concerns about the possible effects of mobile phone use on cognitive functions such as memory, attention and concentration, relatively few laboratory studies have addressed this issue in people and, of those that have, all have investigated effects from acute rather than chronic exposure. While exposure to radiofrequency radiation at levels which cause increases in core temperature of 1ºC

168 *New cancer and mobile phone findings cautiously welcomed*, AAP news report, Story No. 6757, 7 February 2001.

169 The EMR Safety Network International, Submission 111, p 2.

170 CSIRO, Submission 95, p 4.

171 The EMR Safety Network International, Submission 111, p 3.

172 Stewart Report, pp 85-86.

lead to changes in performance of primates in well-learned tasks or other simple behaviour, on which the current standards are based, the Stewart Report said that results at non-thermal levels are inconsistent and recommended further research.[173] Most studies which investigated exposure to low levels of RF radiation focussed on physiological measures of brain function, such as the electroencephalogram (EEG), rather than indices of cognitive performance *per se*. The Stewart Report noted that the functional significance of different components of the normal, waking EEG is poorly understood, making it difficult to interpret results showing an influence of radiofrequency signals on the EEG.

2.144 This was said to be less of a concern with respect to EEG patterns associated with sleep as these are 'well characterised and routinely used as indices of the different sleep stages that a typically healthy individual will move between during the night'. There have been observations of a range of sleep-related disorders, including altered sleep patterns, circadian rhythm and reaction times, from naturally occurring electromagnetic radiation and short-wave radio exposure.[174] However, these effects have been observed at lower frequencies than what are used for mobile phone transmissions. In addition, the Stewart Report said that results of work on the neurotransmitter system, which is involved in regulation of emotion, memory and sleep, appear to show temperature-related effects. To determine the extent to which the results of those studies can be extrapolated across the electromagnetic spectrum requires that these studies should be repeated using radiofrequencies. The Stewart Report concluded that further research should be conducted in both areas.[175]

Alzheimer's Disease

2.145 Reference was made to a study that linked exposure to electromagnetic fields with an increase in incidence in Alzheimer's Disease (AD), which, it is hypothesised, is due to a chain reaction of cellular effects starting with interference to cellular calcium ion homeostasis.[176] In its report, the Royal Society of Canada acknowledged this and another related hypothesis, but noted that studies aimed at testing these claims had used exposure to extremely low frequency fields (powerlines) rather than radiofrequency radiation. In addition, methodological shortcomings limited the interpretation of the results. The report concluded that 'there are no convincing, reproducible data to suggest a relationship between AD and [microwave] exposure'.[177]

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173 Stewart Report, p 60.

174 The EMR Safety Network International, Submission 111, Attachment 2. Cf. Dr David Black, referring to one study that investigated sleep disturbances, stated: '… the investigators for the … study were prepared to commit themselves no further than to say that there seemed to be an association between the presence of the transmitter and sleep disturbances but emphasised that no urgent intervention was indicated' (Submission 93, p 28).

175 Stewart Report, pp 53, 55.

176 The EMR Safety Network International, Submission 111, Attachment 2.

177 Royal Society of Canada Report, p 98.

The Immune System

2.146 While it has been suggested that the evidence indicates that an increase in diseases connected with the immune system may be the long term effect of radiofrequency radiation from mobile phone use,[178] other reviews have been more cautious and point to the ambiguous nature of outcomes in this area of research. The European Commission Report noted that there is a level of adaptability and redundancy built in to the immune system via self-regulation.[179] Thermal effects that have elicited responses in the immune system have been found to be transitory, with levels returning to normal with the cessation of radiofrequency exposure. The Stewart Report concluded that, given the inconsistent results from studies using low level radiofrequency radiation exposure, it was difficult to attribute any effects to exposure.[180]

The eyes

2.147 The Stewart Report also referred to various studies that had investigated the effects of high intensity pulsed RF fields on the eye. Noting that these exposure levels were well above the specific absorption that could occur from the use of current mobile phones, it warned that possible adverse health effects in the eye may be associated with high peak-power pulsed radiofrequency fields.[181]

Reproductive problems

2.148 Some drugs and environmental hazards are known to have damaging effects on a developing embryo at exposure levels which are of little or no risk to the adult animal. According to the Stewart Report, despite extensive research into the potential effects of radiofrequency fields on fertility and development, studies have failed to show any convincing evidence of effects.[182] The Stewart Report referred to a 1993 study that showed an increased risk of miscarriage in physiotherapists who reported exposure during the first six months before or three months after pregnancy and a higher risk in those with more frequent exposure and concluded that there was a 'relatively low response rate to the questionnaire that was used to collect information' and that '[n]o corresponding association was found with use of short-wave diathermy'.[183]

2.149 The Royal Society of Canada Report also referred to the low overall response rate and 'lack of validity in interview-based exposure assessment', limiting the

178 *Official Committee Hansard*, Sydney, 16 November 2000, p 193 [Fist].

179 EC Report, p 36.

180 Stewart Report, p 77.

181 Stewart Report, p 63. The Royal Society of Canada Report concluded: 'At the present time, no definitive conclusions can be reached regarding RF field exposure and effects in the eye. … The unique properties of the eye make this an area which should be treated with caution and concern (p 102)'.

182 Stewart Report, p 80.

183 Stewart Report, p 97.

interpretation of the results.[184] It stated that the Kallén study, while a good design and having a high participation rate, 'the numbers exposed to microwave equipment were too small to provide reliable risk estimates'.[185] The Report also referred to the Larsen *et al* 1991 study cited by Dr Cherry, and noted that '[t]here was no significant association of spontaneous abortion with exposure to short-wave radiation … nor was there any association with the other outcomes studied, except for gender ratio … in the high-exposed group'. The Stewart Report said that other studies of pregnancy in physiotherapists did not support the relationship between miscarriage or other adverse outcomes.[186]

2.150 Dr Cherry disagrees, citing ten epidemiological studies that have found significant miscarriage from EMR exposure across the spectrum from ELF, SW to RF/MW:

> The Scandinavian physiotherapist studies, Kallén et al (1982) and Larsen et al. (1991) also found significant prematurity, congenital malformation, still birth and cot death. Ouellet-Hellstrom and Stewart (1993) confirm the causal relationship with a highly significant dose-response relationship.[187]

2.151 Dr Cherry also argued that research linking cot death to reduction in melatonin related to ELF signals:

> One of the most important single studies involved cot death (Sudden Infant Death Syndrome) in Ontario, Canada. O'Connor and Persinger (1997) were investigating the GMA melatonin hypothesis by seeing if a melatonin-related syndrome (SIDS) varied with GMA. They found that SIDS incidence significantly increased when GMA >30 nT and GMA, <20 nT, – a homeostatic result. This confirms that GMA causes illness and death in vulnerable people, babies, and involves melatonin homeostasis.
>
> This shows that very young babies are sensitive to variations in the natural EMR and extremely low exposure levels. Thus we would expect the fetus to also be vulnerable.[188]

2.152 A study by Magras and Xenos (1997) responded to health concerns among residents living in the vicinity of an RF transmission tower in Greece. They placed groups of mice at various locations in relation to the tower and monitored the fertility

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184 Royal Society of Canada Report, p 89.

185 Royal Society of Canada Report, p 88.

186 The Stewart Report, p 97. The Royal Society of Canada Report also noted that a follow-up study (Guberan 1994) 'did not observe a difference in gender ratio between exposed and non-exposed pregnancies, nor was the result affected by intensity or duration of exposure (p 89)'. See also Dr David Black, Submission 93, p 26, who stated: '[t]aken as a whole, this body of research does not identify any clear association between antenatal EMF exposure and either congenital malformations or spontaneous abortions'.

187 Dr Neil Cherry, Submission 146, p 13.

188 Dr Neil Cherry, Submission 146, p 13.

of the mice over several generations. The 'low' exposure group (0.168μW/cm^2) became infertile after 5 generations and the 'high' exposure group (1.053μW/cm^2) became infertile after only 3 generations. According to the Stewart Report however, this study is not conclusive because it did not include a matched control group nor take into account other environmental factors to which the mice were exposed.[189]

2.153 Dr Cherry disagrees with this interpretation too saying the study confirmed the evidence that chronic low level exposure to RF radiation leads to reproductive problems.

Electro-sensitivity

2.154 Several submissions also referred to the issue of hypersensitivity of some people to prolonged exposure to electricity and electromagnetic fields.[190] The EMR Safety Network International advised, in its submission, that an increasing number of people, through a process of elimination, are attributing health effects to EME exposure and 'find they can no longer tolerate such exposure in the home or workplace'.[191] It was claimed that symptoms including fatigue and concentration difficulties suffered by electro-sensitive people have been dismissed as 'extreme intolerance to stress or imaginary illness', despite evidence that electromagnetic fields can affect body cells and cause disease:[192]

> Electro hypersensitive individuals must also be acknowledged and respected. These people are not merely a few electrophobic individuals seeking attention and special protection. They are visible examples of the injury that any individual may ultimately sustain due to EMR exposure at levels well below the now accepted standards based on the ICNIRP recommendations. At present, electro hypersensitivity is believed to be affecting only a minority group. In my view, this is a gross underestimation of the real situation. It can take time for the individual to develop intolerance to EMR. The unique physiological and genetic make-up of any individual determines the degree of EMR tolerance that they will have and which body system may become affected.[193]

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189 The Stewart Report, p 80. The Committee notes that Dr Cherry was critical of the approach taken by ICNIRP in its health assessment upon which its exposure guidelines are based, which he claimed 'wrongly dismiss[es] the strong association between RF/MW exposure and miscarriage and congenital adverse effects' presented in epidemiological studies. See The EMR Safety Network International, Submission No 111, Attachment 2.

190 National Council of Women of Australia, Submission 32, p 2. See also Mr Don Maisch, Submission 20, p 31; Dr Graeme Stringer, Submission 64, p 3; EMRAA, Submission 80, Submission Vol 7, p 1441. See also *Official Committee Hansard*, Canberra, 7 November 2000, pp 191-192 [Johansson].

191 The EMR Safety Network, Submission 111, p 1.

192 The EMR Safety Network, Submission 111, p 1; EMRAA, Submission 80, Submission Vol 7, p 1441.

193 *Official Committee Hansard*, Sydney, 16 November 1999, p 257 [EMR Safety Network International].

Children

2.155 The greater sensitivity of children to the effects of electromagnetic radiation was raised in several submissions.[194] It has been argued that children are likely to be more susceptible to any adverse health effects because of high cell turnover/division,[195] children have thinner skulls,[196] their immune system and brain wave activity is less robust than adults,[197] and because they will have experienced a longer period of exposure over their lifetime. Parent concerns about this issue are leading some to remove their children from schools that are located near mobile phone towers or base stations.[198]

2.156 The Consumers' Telecommunications Network expressed its concern at the vulnerability of children to potential adverse health effects of mobile phone technologies:

> Our understanding of the publicly available research suggests that we still do not know exactly what the health effects might be. We believe that such effects are likely to be cumulative over time and with usage, that children are likely to be more vulnerable than adults, and that we may not understand the effects fully for some years.[199]

2.157 The incidence of childhood cancer was alluded to in the Stewart Report when it referred to two studies that had been conducted in Australia, which looked at the incidence of leukaemia in children residing in three municipalities surrounding television masts. While the earlier study by Hocking *et al* had found a 60 per cent increase in leukaemia in children living close to the TV towers, the later study by McKenzie *et al* found that this excess occurred in only one of the three municipalities close to the mast.[200] The Royal Society of Canada Report was critical of the ecological design of the 1996 Hocking *et al* study, which it considered weakened the

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194 Mr Joe Friend, Submission 17, p 1; Mr Greg Eggert, Submission 14, p 1; Mr Leigh Tanner, Submission 18, p 1; Mr Noah Yamore, Submission 24, p 1; Ms Sandy Carr, Submission 26, p 2; National Council of Women of Australia, Submission 32, p 1; Professor Barry Boetcher AM, Submission 41, p 2; Mr Gary Schroder, Submission 50, p 1; Sunshine Coast Environment Council Inc, Submission 55, p 2; EMRAA, Submission 80, p 15, Gwenda and Tom Spencer, Submission 82, p 1; Betty and Trevor Shelley, Submission 87, p 1; The EMR Safety Network International, Submission 111, p 2; One-Tel Tower Committee, Submission 132, pp 1-2; Ms Nikki Carabetta, Submission 135, p 1; Mrs Ms Allen, Submission 136; Ms Diane Beaumont, Submission 138, p 7; Mr Alan K Tunnah, Submission 139, p 2; Sunshine Heights Kindergarten, Submission 140, pp 1-2; Mrs Leanne Noakes, Submission 144, p 1.

195 See for example, EMRAA, Submission 80, Submission Vol 7, p 1440.

196 *Official Committee Hansard*, Sydney, 16 November 2000, p 217 [Consumers' Telecommunications Network]; *Official Committee Hansard*, Melbourne, 22 September 2000, p 173 [Dalton].

197 Hyland, GJ, *Potential Adverse Health Impacts of Mobile Telephony*. Memorandum, February 2000 (attached to Submission 111, The EMR Safety Network International, p 1768).

198 Mrs PR Richards, Submission 49, p 2; One-Tel Tower Committee, Submission No 132, p 2.

199 Consumers' Telecommunications Network, Submission 101, Submission Vol 8, p 1635.

200 Stewart Report, p 98.

strength of the results. It also noted that the McKenzie study did not support Hocking's conclusion.[201] In response to criticisms of his study, Dr Hocking stated:

> We have subsequently responded to McKenzie and Morrell, and that is the letter that I have tabled in front of Senator Allison for you, and we point out several things which are incorrect about McKenzie and Morrell's criticisms. I am now standing in front of the poster and pointing out that in the three municipalities surrounding the tower – North Sydney, Lane Cove and Willoughby – there are more cases of leukemia in Lane Cove than in the other two areas. The substance of their criticism is that if the radiofrequency was distributed evenly across all those areas you would have expected proportionately the same number of cases in each one of those municipalities.
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> …
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> … We obviously adjust our data to allow for per thousand population of something like that. Nonetheless, there is this increased rate or numbers of cases in Lane Cove whichever way you look at it. …
>
> There are two things to say. First of all, the original hypothesis was that the group of municipalities surrounding the towers could have a different rate of leukemia compared to the group of municipalities out there. To then take the data and to subdivide it after we had done a test of homogeneity to show there was evenness within statistical bounds between these areas and then to say, 'We are going to treat these areas differently, one from the other, and because there is a bigger number here, therefore this does not hold up,' is incorrect. We have the problem that it is basically moving the goalposts after the kick is taken. The original hypothesis was to treat all of these areas as one unit compared with all those areas out there as one unit. They are then wanting to subdivide the data and say, 'A pocket here is different from a pocket there and yet we would have expected them to be the same. Therefore, there is something wrong with the study.' You cannot do that with such a fragile study. It is a very crudely designed study for reasons I will explain to you.
>
> We were basically constrained by the geographic boundaries of local government areas in Sydney. Therefore, we had to go along the boundaries of Willoughby and Lane Cove and so forth simply to gather in the data. It does not necessarily mean that there is an effect occurring where those borderlines are. If there is an effect it could be that the effect only goes out for two kilometres from the towers and not to the four kilometres where these boundaries roughly lie. In such a case you are then diluting your data. In other words, by having to incorporate cases with the data close to the towers, along with population where there is no effect occurring, you basically wash out or dilute your effect.

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201 Royal Society of Canada Report, p 87.

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> Morrell and McKenzie were factually incorrect. There was additional high power broadcasting in the sense that the transmission times of these television stations increased from 18 hours a day to 24 hours a day in 1975 or 1976 – I have forgotten what it was. Our study commenced in 1972 and went through until 1990. Effectively, you have three or four years where there were only 18 hours a day going up to 24 hours a day. That is a negligible difference in the exposure. …[202]

2.158 The Royal Society of Canada Report concluded that 'none of the few investigations of risk of childhood cancer conducted so far can be regarded as providing useful information concerning the effect of radio-frequency fields on risk of childhood cancer'.[203]

2.159 While the Stewart Report concluded that exposures below ICNIRP guidelines do not cause adverse health effects to the general public, in line with its recommended precautionary approach to the use of mobile phone technologies, it recommended that children be discouraged from using mobile phones for non-essential calls. The Stewart Report recommended that the mobile phone industry should refrain from promoting the use of mobile phones by children.[204] The Independent Expert Group on Mobile Phones (IEGMP)[205] referred to evidence that specific energy absorption rate (SAR) is larger in children than in adults because children's tissue contains more ions and therefore has a higher conductivity.[206] ARPANSA, however, disputed this conclusion in its response to the IEGMP recommendation about mobile phones and children, stating:

> There is no scientific evidence to support the idea that any adverse health effects would occur to any individual exposed to levels below the Australian limit. It is true that children are likely to be exposed for a much longer time than adults but in the absence of any knowledge of an injury mechanism, there is no reason to believe that children will be inherently more vulnerable than any other age groups. However, just as concerned persons may choose to restrict personal use of mobile phones, concerned parents may also choose to limit the use of mobile phones by their children.[207]

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202 *Official Committee Hansard*, Melbourne, 22 September 2000, pp 118-120 [Hocking].

203 Royal Society of Canada Report, p 88.

204 Stewart Report, p 8.

205 Authors of the Stewart Report.

206 Stewart Report, p 38.

207 ARPANSA, Submission 128, Submission Vol 9, p 2046.

2.160 The Committee also notes the views of Dr David Black, medical practitioner, in commenting on the Stewart Report's recommendations vis a vis children:

> The importance given to the perceived differences in RF absorption between children and adults seems to me to be a generically derived concern searching for a mechanism. The debates about skull thickness have been had and dismissed in the literature several years ago. The ideas about different absorption based on conductivity seems to be based on only unquantified unpublished data. In simply considering … the underlying biophysics of this idea … any difference would be small and not important compared to other factors …[208]

2.161 Dr Black further stated:

> … it may be that children do have slightly more ionic fluid in their brain and, therefore, have slightly more conductive tissues. But if that is so, then there would be an increase in screening as well as the conductivity. Therefore, that might even out – it might not. But the difference is only a factor of maybe 20 or 30 per cent, and the actual safety margin and the standard is much higher than that. Furthermore, the testing systems that are currently used for cell phone handsets actually use fluid of much higher conductivity than is in the adult brain, which would be in fact higher than you would find in a child's brain. So I do not think any of those points raised in the Stewart report are actually valid, so I cannot agree with them.[209]

2.162 The Committee notes, however, Dr Cherry's evidence when referring to his early involvement on the siting of a base station in a school that at that time he '[did] not know of any studies showing adverse effects from radiofrequency/microwave radiation or cell phone radiation, but I do know about resonant absorption and I do know about the way the brain works, because we have studied that. So I would be concerned about the sensitivity of children's brains …'.[210]

2.163 The National Cancer Institute has noted that few children used cell phones prior to 1994. While certain agents, for example ionising radiation and particular chemicals, which are known to cause brain and nervous system cancer in rats, have greatest effect when administered early in life when the nervous system is developing, this has not yet been established with respect to mobile phones.

2.164 Of concern to some witnesses were marketing campaigns designed to sell mobile phones to children.[211] It was suggested that mobile phones should be labelled with additional warnings to advise that children and young adults have a greater risk

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208 Dr David Black, Submission 93, p 30.

209 *Official Committee Hansard*, Canberra, 8 September 2000, pp 60-61 [Black].

210 *Proof Committee Hansard*, Canberra, 2 March 2001, p 334 [Cherry].

211 *Official Committee Hansard*, Sydney, 16 November 2000, p 216 [Consumers' Telecommunications Network]. See also, EMRAA, Submission 80, Submission Vol 7, pp 1456, 1462-1463.

of EME absorption, and protective devices or hands-free kits should be included with any mobile phones sold to, or intended for use by, children under the age of 18 years.[212]

2.165 There was support from a number of submitters and witnesses for the Stewart Report's recommendation with respect to children and mobile phones.[213] The Committee considers that a precautionary approach is desirable, and supports the Stewart Report's recommendation that the effects of RF radiation on children should be treated as a priority research area given the increasing use of mobile phones by young children and teenagers.

2.166 Others considered more susceptible or at greater risk to any adverse effects from electromagnetic radiation are pregnant women, the immuno-depressed, workers occupationally exposed to EMR and the elderly. One submission suggested that a national register should be established to record the health status of workers occupationally exposed to electromagnetic radiation.[214]

Mobile phone towers and base stations

2.167 A considerable number of submissions expressed concern about the proliferation of mobile phone towers, particularly in sensitive locations, and their impact on health.[215] One of the concerns about exposure to radiation from towers, in contrast to mobile phones, is the continuous exposure from towers compared with the

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212 Consumers' Telecommunications Network (CTN), Submission 101, p 2.

213 *Official Committee Hansard*, Melbourne, 22 September 2000, pp 114, 128 [Hocking]; *Official Committee Hansard*, Melbourne, 22 September 2000, p 173 [Dalton]. Cf *Proof Committee Hansard*, Canberra, 2 March 2001, p 327 [Moulder] who expressed confusion about the basis for the Stewart Report's recommendation on mobile phone usage by children.

214 Dapto Residents Against Tower Health Risks, Submission 92, p 3.

215 Mr John C Bedford, Submission 3, p 1; Warrimoo Citizens Association, Submission 4, pp 1-3; Chris & Marie Kougellis, Submission 16, pp 2-3; Ms Sarah Wallace, Submission 31, pp 1-2; National Council of Women of Australia (NCWA), Submission 32, p 1; Ms Lyn Ward and Mr Mark Lamb, Submission 33, pp 1-2; Ms Helen Joyce, Submission 35, p 1; Ms Sylvia Douglas, Submission 38, p 1; Ms Stephanie Evans, Submission 39, p 1; Professor Barry Boettcher AM, Submission 41, p 2; City of Melville, Submission 42, p 1; Mr JW Purchase, Submission 46, p 1; Mr E and Mrs A Vassallo, Submission 48, p 1; Mrs PR Richards, Submission 49, p 2; Mr Gary Schroder, Submission 50, p 1; Town of Kwinana, Submission 53, p 1; Sunshine Coast Environment Council Inc, Submission 55, pp 1-2; Mr Nick McKillop, Submission 63, Attachment 5; Ms Helen McKillop, Submission 67, p 1; Mr CS Newton, Submission 70, pp 2-3; Castlemaine Optus Antennas Relocation Group (COARG), Submission 72, pp 1-2; Mr Harold Hird MLA, Submission 74, p 1; Ms Sonia Venditti, Submission 76, pp 1-2; Gwenda and Tom Spencer, Submission 82, p 1; Mr Paul Hunt, Submission 84, p 1; Mr Roger M Lilley, Submission 85, p 2; Maleny Residents' Action Group, Submission 86, p 1; Betty and Trevor Shelley, Submission 87, p 1; The Maple Street Cooperative Society Ltd, Submission 90, p 1; Ms Ruth Parnell, Submission 94, p 1; Mr & Mrs Davies, Submission 97, p 1; Ms Sandra Jordan, Submission 104, p 1; Mr Richard Giles, Submission 112, p 3; Centre for International Research on Communication and Information Technologies (CIRCIT), Submission 114, pp 1-3; Ms Heather Anne Meyer, Submission 123, p 1; Dr J Phua, Submission 126, p 1; Sutherland Shire Council, Submission 130, p 1; Ms Diane Beaumont, Submission 138, p 7; Sunshine Height Kindergarten, Submission 140, p 1; Sunshine Action Group, Submission 141, p 1; Mrs B Humphries, Submission 145, p 2.

more spasmodic nature of mobile phone calls,[216] and the involuntary nature of the exposure.[217]

2.168 There have also been differing claims about the relative risks associated with exposure to mobile phone emissions and radiation from mobile phone base stations or television towers. For example, Mr Neil Boucher, consulting engineer, said in his submission that:

> … it is worth noting that the exposure from a base station placed 100 meters away is minuscule compared to the exposure one would get from making a few calls a day with a handheld mobile phone.[218]

2.169 One submission stated:

> Real or perceived, people are afraid of these installations and don't want to live near something that pumps out electromagnetic radiation 24 hours a day. Just what the world needs: more pollution, both visual and environmental in the case of this technology. And all to operate mobile phones which now appear to be hazardous to our health![219]

2.170 Concern was also expressed about the community being used as 'guinea pigs to prove or disprove the effects of long term exposure to EMR'.[220] The radiation from mobile phone towers was seen to be 'an invisible time bomb', where 'if the radiation was visible such as smoke … the issue would have been clearly addressed sooner'.[221]

2.171 Although some evidence to the Committee and conclusions from recent expert reviews indicate that radiation from mobile phone towers is considered to be potentially less harmful than mobile phone emissions, it was suggested by physicist Dr GJ Hyland, that this may not be the case. In referring to studies which examined the effects of electromagnetic radiation exposure on DNA, Dr Hyland stated:

> Although the power density of the radiation used in these experiments is typically that associated with mobile phone handsets, and thus much higher than that found in the publicly accessible areas [in] the vicinity of a Base-station, the *information content* of the radiation emitted by the latter is the **same**; accordingly, these results are *not* irrelevant to the consideration of potential adverse health effects associated with chronic exposure to Base-

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216 The Vaucluse Progress Association, Submission 5, p 2. See also, Ms Sarah Wallace, Submission 31, pp 1-2; Telecommunications Officers Association Branch of the CEPU, Submission 66, p 3; Betty and Trevor Shelley, Submission 87, p 1; The Maple Street Cooperative Society Ltd, Submission 90, p 1.

217 Ms Sonia Venditti, Submission 76, p 2; Maleny Residents' Action Group, Submission 86, p 1; Mr Roger M Lilley, Submission 85, p 2; Mr Stewart Fist, Submission 30, pp 2-3.

218 Mr Neil J Boucher, Submission 118a, Submission Vol 11, p 2377.

219 Chris & Marie Kougellis, Submission 16, p 3.

220 Betty and Trevor Shelley, Submission 87, p 1. See also Sunshine Action Group, Submission 141, p 2; EMF South World Pty Ltd, Submission 129, p 2.

221 Sunshine Action Group, Submission 141, p 4.

> station radiation. Indeed, there are instances where the response of the living system is either sharper … or actually *increases* … as the irradiating power density **decreases** – possibly due to a corresponding decrease in thermal influences, which at higher intensities tend to mask (and eventually obliterate) any (contra-thermal) non-thermal effects. [222]

2.172 Nevertheless, ARPANSA noted that:

> … ARPANSA has conducted extensive survey measurements of environmental radiofrequency levels produced by mobile telephone base stations and also by other broadcast sources of radiofrequency radiation. The ARPANSA data clearly show that mobile phone base stations contribute only a small fraction of total environmental RF levels arising chiefly from other sources such as AM radio masts and television towers. In addition, total environmental exposure levels are low in comparison to public exposure limits specified [in] relevant Standards.[223]

2.173 Mr Wayne Cornelius, ARPANSA, stated:

> … For the most part, people in the general environment are not exposed to the levels that are being debated about as low level; but there is the issue of the mobile phone, where the device is quite close to the head and the levels are very much higher than from, say, a base station transmitter or a radio tower, unless you are very close to a radio tower.[224]

2.174 The Stewart Report concluded that there is no general health risk to people living near mobile phone base stations, but said anxiety about the uncertainty felt by those people could affect their well-being. ARPANSA suggested that appropriate research should be undertaken to examine the health implications of the public's anxiety about potential health risks associated with mobile phone base stations.[225]

Benefits of mobile phones

2.175 It was suggested to the Committee that although there are concerns about the potentially higher risk to children from excessive mobile phone use, it may also promote safety by enabling children to keep in contact with their parents. However, the Committee notes that there have also been cases of people being mugged for their mobile phone.[226]

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222 GJ Hyland, *Potential Adverse Health Impacts of Mobile Telephony Memorandum*, February 2000, (included in The EMR Safety Network International, Submission 111, Attachment 3).

223 Australian Radiation Protection & Nuclear Safety Agency (ARPANSA), Submission 128, Attachment K, p 3.

224 *Proof Committee Hansard*, Canberra, 2 March 2001, p 347 [Cornelius].

225 ARPANSA, Submission 128, Submission Vol 9, p 2046.

226 *Official Committee Hansard*, Sydney, 16 November 2000, p 216 [Consumers' Telecommunications Network].

2.176 The extent to which the benefits of mobile phone technology should take precedence over the health of the community was also raised. The Dapto Residents Against Tower Health Risks stated:

> The authorities seem to have adopted the view point that the advantages of telecommunications equipment and facilities are far greater than the disadvantages like possible adverse health effects from the emitted electromagnetic radiation (EMR).[227]

2.177 The Consumers' Telecommunications Network (CTN), noted that its members value the benefits of mobile phone technology and 'would not support restrictions in their availability'.[228] People with hearing aids have also expressed a desire for greater access to mobile telecommunications.[229] The CTN did not support EMRAA's call for the prohibition of mobile phone use in certain public places.[230]

Electromagnetic Interference (EMI)

2.178 Evidence was put to the Committee that electromagnetic interference (EMI) from digital, but not analog, mobile phones can affect the operation of implantable cardiac pacemakers and defibrillators. The effect is not present when the mobile phone is turned off.[231] Electromagnetic interference with cochlear implants was also referred to in one submission,[232] and with hearing aids.[233]

2.179 The Stewart Report acknowledged the potential hazards that may arise from indiscriminate use of mobile phones in areas, including hospitals, where RF radiation may interfere with sensitive electronic equipment.[234] The Independent Expert Group on Mobile Phones (Stewart Group) supported steps to warn people about the dangers of using mobile phones at these sites and recommended that hospitals place visible warning signs at entrances to buildings advising that mobile phones should be turned off.[235]

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227 Dapto Residents Against Tower Health Risks, Submission 92, p 2.

228 Consumers' Telecommunications Network (CTN), Submission 101, p 1. See also AMTA, Submission 19, pp 17-18.

229 CTN, Submission 101, p 1.

230 CTN, Submission 101, p 1.

231 US Food and Drug Administration – Centre for Devices and Radiological Health. *Cellular Phone Interference*, 1 November 1995. Attachment C, Answers to questions on notice, AMTA, 31 January 2001. See also Rothman (2000), which refers to two studies that examined interference to pacemakers from mobile phones, one of which determined that the frequency of interference was dependent on the type of pacemaker and type and position of the phone (Hayes *et al*, 1997), while the other found no pacemaker interference from mobile phones used in Europe (Occhetta *et a*l, 1999).

232 Ms Gillian Summerbell, Submission 62, p 1.

233 Deafness Council of NSW Inc, Submission 149, p 1.

234 Stewart Report, p 121.

235 Stewart Report, p 121.

2.180 To minimise the potential for EMI, the Australian Therapeutic Goods Administration has advised that mobile phones should not be kept in pockets above the site of implants, and that users use the ear furthest away from the implant when operating the phone, and avoid direct contact between the antenna and the user's skin.[236]

2.181 The Committee Chair is of the view that greater efforts should be taken by industry to solve these interference problems.

2.182 Given the problems of interference associated with electromagnetic radiation for planes, cardiac pacemakers, hearing aids and other medical devices, it has been suggested that a human being may not be immune from similar interference.[237] The Committee notes that an analogy has been drawn between electromagnetic interference with mechanical devices and biological effects. However, Dr John Moulder, oncologist, argued:

> Some of our modern electronic equipment, particularly in the hospital environment … is incredibly sensitive to picking up electromagnetic interference, in part because that is how it was designed. You can certainly interfere with delicate radio equipment at RF levels that are hundreds to thousands of times below where anyone has seen any biological effects. The other advantage is that, although we cannot always prevent electromagnetic compatibility problems, they are fairly well understood from the electrical engineering side, and the sorts of things which cause compatibility problems would not be expected to have much relevance to biology … On the other hand, I would accept that as a totally human reaction. If it interferes with my radio, maybe it can interfere with me. But in terms of the biology and physics it is not an obvious connection at all.[238]

2.183 Scientific uncertainty and continuing fears about the possible adverse health effects from exposure to radiofrequency radiation are important in the policy making process, particularly in relation to the inclusion of a precautionary approach for current standards. These issues are discussed in Chapter 4.

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236 Cellular Mobile Phones and Cardiac Pacemakers. Attachment B, Answers to questions on notice, AMTA, 31 January 2001. See also CEMEPHI, Submission 127, Submission Vol 9, pp 1950-1951.

237 The EMR Safety Network, Submission No 111, Attachment 3. See also, for example, *Official Committee Hansard*, Sydney, 7 November 2000, p 194, where Professor Olle Johansson from the Karolinska Institutet, Sweden, stated in relation to 'human electromagnetic compatibility': 'Your mobile telephone should not alter the figures at the bank, change the equipment at the hospital or whatever, and it should not affect electronics in an aircraft. Therefore, they are in different ways shielded from each other. … If you have a computer screen, a light tube or a mobile telephone, to what extent should we allow it to affect molecular and cellular events in our body?'

238 *Proof Committee Hansard*, Canberra, 2 March 2001, p 318 [Moulder]. The Committee notes that the view that electromagnetic interference cannot be compared to adverse health effects from radiofrequency, was not supported by Dr Cherry, who stated: 'My judgment is that that is completely wrong. The early studies show that oscillating signals interfere with the brain very significantly and can change EEG and can change calcium ions, and these change reaction times. That is a classical physics approach of resonant absorption. If a system can oscillate and an oscillating signal comes in, it can resonantly be absorbed (*Proof Committee Hansard*, Canberra, 2 March 2001, p 332 [Cherry]).

Electromagnetic radiation from non-telecommunication technologies

2.184 In addition to concerns about mobile phone technology, submissions and witnesses also referred to evidence about possible health effects from other artificial sources of electromagnetic radiation, including visual display units, TV towers and powerlines. Some of these concerns are outlined below.

2.185 Associate Professor Olle Johansson, Experimental Dermatology Unit, Karolinska Institutet, Sweden, in his submission to the Committee, referred to evidence of similarities between the cutaneous alterations and damage from UV, X-rays and radioactivity and the symptoms of people claiming to suffer from electrosensitivity or screen dermatitis.[239]

2.186 The issue of the placement of high voltage/tension electricity lines away from populated areas was also addressed in submissions.[240] Dr Repacholi from the WHO, also expressed concern about the potential health effects from extremely low frequency power lines. He stated:

> Some studies suggest increases in leukemia and brain tumours by working with power frequency fields. But the most worrying to me is the residential studies where children living near powerlines seem to have a higher incidence of leukemia. That is what we are concentrating our research on now.[241]

2.187 A recent report from the chairman of the UK's National Radiological Protection Board's Advisory Group on Non-ionising Radiation, epidemiologist Sir Richard Doll, concluded:

> Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general. There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukaemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify a firm conclusion that such fields cause leukaemia in children. Unless, however, further research indicates that the finding is due to chance or some currently unrecognised artefact, the

239 Professor Olle Johansson, Submission 103, p 1.

240 See for example, Power to the People Action Group, Submission 109, p 1; National Council of Women of Australia (NCWA), Submission 32, p 2; Mr John Allen, Submission 65, p 1; Mr Tony & Mrs Lorraine Reeves, Submission 105, p 1; Power to the People Action Group, Submission 109, p 1; Mr Darryl Davies, Submission 116, p 1; Coomera Valley Progress Association, Submission 117, p 1.

241 *Official Committee Hansard*, Canberra, 31 August 2000, p 18 [Repacholi].

> possibility remains that intense and prolonged exposures to magnetic fields can increase the risk of leukaemia in children.[242]

2.188 Comparatively little evidence was received by the Committee in relation to possible health effects from TV towers. It was claimed that the emissions from television towers far exceed the emissions from mobile phone towers, and concerns were raised at the placement of TV towers close to schools and residential areas.[243]

2.189 The Committee Chair considers that further research is required to study the incidence of cancer around TV towers and notes the recent publicity given to the incidence of tumours and leukaemia around the Vatican's radio towers. On these installations, Dr Cherry said in evidence to the Committee:

> The radio towers are much more powerful than the base stations so, as the Hocking study shows, the effects occur much further out. I believe that the community concern that the base stations are closer to their homes because there are many more of them is a valid concern.[244]

2.190 The Committee notes that, while this inquiry has focussed on the standards for exposure to telecommunications technologies, there is considerable community concern about other artificial sources of electromagnetic radiation.

Recommendation 2.1

The Committee Chair recommends that, particularly in the light of recent reports on the links between powerlines, radio towers and leukaemia, additional research into extremely low frequencies and TV/radio tower exposure should be encouraged.

Recommendation 2.2

The Committee Chair recommends that precautionary measures for the placement of powerlines be up-graded to include wide buffer zones, and undergrounding and shielding cables where practicable.

Measures to minimise potential health risks

2.191 There are a number of ways in which potential health effects may be minimised, particularly given community concerns about the placement of mobile

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242 National Radiological Protection Board, *ELF Electromagnetic Fields and the Risk of Cancer. Report of an Advisory Group on Non-ionising Radiation*, Vol 12, No 1, March 2001.

243 Mrs Leanne Noakes, Submission 144, p 2.

244 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 337-338 [Cherry].

phone towers and base stations near schools, hospitals, shopping centres, churches and people's homes:[245]

- adopting a precautionary approach in the setting of emission/exposure safety standards;
- ensuring that the mobile phone tower/base station emission beams of greatest intensity are sited away from sensitive areas like schools and hospitals;
- encouraging limits to the use of mobile phones, particularly by children;
- using devices which shield or otherwise minimise the level of emissions from mobile phones; and
- labelling mobile phones to inform consumers about emission levels, with the additional objective of allowing market forces to encourage companies to develop phones that can be efficiently used with the lowest levels of emissions possible.

2.192 The Committee also received evidence which suggested that the superimposition of random frequencies eliminated observed biological effects associated with pulsed radiofrequency radiation from digital mobile phone transmissions.[246] However, while the Committee was advised that several laboratories had successfully tested this hypothesis,[247] the Stewart Report stated that the experimental evidence had yet to be independently replicated.[248] According to Dr Swicord, the Food and Drug Administration in the United States also was unable to replicate this result.[249]

2.193 The incorporation of a precautionary approach for acceptable emission levels could be adopted as part of the new standard. This is probably of most importance with respect to occupational use of mobile phones or other telecommunications technologies, where a personal approach to limiting use may not be practical. The requirement to attach meaningful labels to phones, in manuals and at point of sale, could also be incorporated into industry codes of practice. These issues are discussed in Chapter 4.

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245 See for example, Mr Greg Hutchison, Submission 108, pp 2-3. See also *Official Committee Hansard*, Canberra, 31 August 2000, p 6 [Repacholi]: 'Individuals can be encouraged to take their own precautions if they have concerns about children. There was a lot of press following the Stewart inquiry about children being more sensitive. If people feel that this is the case – and there is no evidence for that, but it is a possibility – then hands-free kits or limiting times of calls are good ways to reduce exposures'.

246 See for example, *Official Committee Hansard*, Melbourne, 22 September 2000, pp 148-151 [Litovitz].

247 See for example, Simon Fielding, OBE, Submission 119, p 2; EMF South World Pty Ltd, Submission 129, Submission Vol 10, p 2077; EMF Southworld Pty Ltd, Submission 129a, pp 1-2; *Official Committee Hansard*, Melbourne, 22 September 2000, p 153 [Litovitz].

248 Stewart Report, p 44.

249 The Committee notes that Dr Litovitz was involved in this replication attempt. *Proof Committee Hansard*, Canberra, 2 March 2001, p 367. The Committee also notes EMF Southworld's explanation for this failure (Submission 129a, p 2).

Limiting phone use

2.194 Individual phone users could limit the time spent on a mobile phone, an approach particularly recommended for children. The Committee supports the Stewart Report's statement that:

> If there are currently unrecognised adverse health effects from the use of mobile phones, children may be more vulnerable because of their developing nervous system, the greater absorption of energy in the tissues of the head …, and a longer lifetime of exposure… we believe that the widespread use of mobile phones by children for non-essential calls should be discouraged. We also recommend that the mobile phone industry should refrain from promoting the use of mobile phones by children.[250]

2.195 The Committee recognises that many people are blase about their health, particularly the young, as evidenced by the continued rate of smoking uptake in teenagers despite labelled warnings and strong evidence of a causal link between cancer and smoking. However, the Committee considers that government has a responsibility to the community to provide clear, objective and detailed information about the potential risks, to enable individuals to make an informed choice about the extent to which they are prepared to expose themselves to electromagnetic radiation.

Recommendation 2.3

The Committee recommends that based on a growing body of research that provides evidence of biological effects, the Commonwealth Government considers developing material to advise parents and children of the potential risks associated with mobile phone use.

Shielding devices and hands-free kits

2.196 Other options for preventing or minimising the level of mobile phone emissions to which the body is exposed are shielding devices and hands-free kits.[251]

2.197 While a consumer association's magazine in the UK claimed that hands-free kits were found to act like an aerial and delivered three times as much radiation towards the brain,[252] tests conducted for *Choice* magazine in Australia found that

250 Stewart Report, p 121. See also Mr Stewart Fist, Submission 30, p 2.

251 The Committee was advised of EMF bioprotection technology, which is not a shielding device, but claimed to eliminate non-thermal biological effects, based on work carried out by Professor Litovitz at the Catholic University of America. *Official Committee Hansard*, 8 September, p 67 [EMF South World Pty Ltd].

252 Referred to in Ms Ruth Parnell, Submission 94, p 2; EMRAA, Submission 80, pp 29-30.

'radiation was greatly reduced'.[253] The Electrical Compliance Testing Association (ECTA), which undertook the tests criticised the inadequate instructions on how to use the hand held set. They recommended holding the phone along the bottom of the device and away from the body.[254]

2.198 Concerns about potential health risks from mobile phones has led to the development of various shielding devices. These devices claim to shield users from RF radiation. The Committee was advised, given the manner in which mobile phones operate, that it is possible that the level of exposure may actually be greater when a shielding device is used. Under normal circumstances, a mobile phone 'powers down' the closer it is to a tower. Shielding devices may make it difficult for the phone to 'contact' the base station or tower and result in the mobile phone 'powering up' and raising emission levels,[255] or directing emissions to other parts of the body.[256] ECTA expressed concern that many of the shielding devices currently on the market were unregulated.[257]

2.199 Another device that has been mentioned recently is the attachment of a so-called 'ferrite choke' to a hands-free set, to further reduce radiation without affecting sound quality or battery power. However, it has been claimed that the choke would only bounce the radiation off onto another part of the body.[258]

2.200 The Committee Chair was disturbed at the lack of industry and government attention to developing or promoting lower-emission mobile phone technology or consumer advice about minimising exposure. The Committee found that the effectiveness of shielding devices and hands-free kits was at best unclear, that no standards or other regulations existed for these devices and that whatever guarantees there were of mobile phone compliance with current standards, these became null and void with the use of such devices.

Recommendation 2.4

The Committee recommends that shielding and hands-free devices are tested, labelled for their effectiveness and regulated by standards.

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253 *Official Committee Hansard*, Melbourne, 22 September 2000, p 159 [ECTA]. See also, AMTA, Submission 19, p 23, which add that regardless of whether a hand-held or hands-free kit is used, all mobile phones are required to meet safety standards.

254 *Official Committee Hansard*, Melbourne, 22 September 2000, p160 [ECTA].

255 *Official Committee Hansard*, Melbourne, 22 September 2000, p 159 [ECTA].

256 ECTA, Submission 98, p 2.

257 ECTA, Submission 98, p 2. See also Mr Don Maisch, Submission 20(c), p 1; EMRAA, Submission 80, p 2; *Proof Committee Hansard*, Canberra, 2 March 2001, p 408 [Doull].

258 'Scientists Believe A Ferrite Choke Clipped to the Wire of A Hands-Free Set Could Dramatically Lower Radiation', *Financial Times*, 12 February 2001.

2.201 The Committee notes that no advice was available from AMTA or ARPANSA on the implications of moving to the new generation (3G) spectrum mobile phones.

Siting of mobile phone towers

2.202 While recent reviews have agreed that the potential health risks associated with mobile phone towers are considerably lower than those that may be related to mobile phones, there are steps that should be taken to minimise any risks. A number of submissions received during this inquiry highlighted community concerns about the placement of base stations and mobile phone towers, particularly those near schools, hospitals, shopping centres, churches and people's homes. Community groups and individuals were also concerned about the inadequate consultative process when decisions were being made to install new towers.

2.203 An approach that could be adopted in relation to the siting of mobile phone towers and base stations is to prohibit the placement of these structures at particular distances from sensitive sites such as schools, a practice that has been adopted in some countries.[259] The manner in which the emissions are beamed results in a concentration of the RF intensity at around 100 metres from the tower or base station so a buffer zone of 150 metres may be appropriate. The Stewart Report in discussing the moves in some communities to oppose the siting of transmission towers on school grounds, for instance, recommended:

> … a better approach would be to require that the beam of greatest RF intensity … from a macrocell base station sited within the grounds of a school should not be permitted to fall on any part of the school grounds or buildings without agreement from the school and parents … when consent is sought from a school and parents about this question, they should be provided with adequate information to make an informed decision, including an explanation of the way in which the intensity of radiation falls off with distance from the antenna. This may be particularly relevant for schools with large grounds. If, for an existing base station, agreement could not be obtained, its antennas might need to be readjusted.[260]

2.204 The network operator should provide similar advice where a base station is located near school grounds, nursing homes, child care facilities, hospitals and so on, and if necessary, placement should ensure that vulnerable groups are not chronically exposed where the beam is of greatest intensity.

2.205 An Australian Communications Industry Forum (ACIF) code of practice is expected to address these issues (see Chapter 4).

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259 Stewart Report, p 117.

260 Stewart Report, p 118.

Recommendation 2.5

The Committee Chair recommends that the Government review the Telecommunications (Low-impact Facilities) Determination 1997, and as a precautionary measure, amend it to enable community groups to have greater input into the siting of antenna towers and require their installation to go through normal local government planning processes.

Complaints mechanism

2.206 The Committee notes that currently there is no mechanism by which health effects attributed by users to their mobile phones are collected.[261] In 1995, Dr Bruce Hocking, occupational health consultant, after reviewing the recommendations of the 1994 CSIRO *Report on the Status of Research on Biological Effects and the Safety of Electromagnetic Radiation: Telecommunications Frequencies*, additionally recommended, *inter alia*, the establishment of a 'register of health effects to systematically investigate and record reports of adverse health effects from mobile phone use'.[262]

2.207 The Committee also notes that Dr Hocking has periodically published reports of symptoms claimed to be associated with mobile phone use. The value of a database of anecdotal reports was criticised by Dr Black, a New Zealand medical practitioner:

> I think you can only have a formal reporting system when you have a clear sort of threshold point or diagnosis. It would be very difficult to get data from, for example, GPs. It would be a bit meaningless because you would have the number of cases but you would not know the population that was over. There will be too many variables for consistency of reporting. … I do not think it would be possible to have any system of mandatory reporting because I do not know what the data would mean. But it is certainly an area which is deserving of continued monitoring and scrutiny.[263]

2.208 The Mobile Manufacturers Forum indicated that a database of symptoms claimed to be associated with emissions from mobile phones or other telecommunications structures would serve only to prompt scientific research into possible health effects:

> All the anecdotal reports do in those reporting mechanisms is tell you one of two things: either you should do human studies or you should do epidemiological studies. What we are doing now is going to the next step. We are supporting human studies and epidemiological studies to address the

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261 See for example, EMRAA, Submission 80, p 38; *Official Committee Hansard*, Sydney, 16 November 2000, p 215 [Consumers' Telecommunications Network].

262 ACA, Submission 100, p. 11.

263 *Official Committee Hansard*, Canberra, 8 September 2000, p 62 [Black].

> issues in a scientific way. There is no added value in looking at the issue of anecdotal reports.[264]

2.209 Dr Swicord, appearing on behalf of the Mobile Manufacturers Forum advised that studies into electro-hypersensitive people were already under-way, and one study had already been completed and had been unable to demonstrate an association between symptoms including headaches and exposure to radiofrequency radiation emitted by mobile phones.[265]

2.210 The Committee Chair notes, however, that there is a difference between electro-hypersensitivy (EHS) and health effects. EHS covers a broader range of problems, including neurological and the Committee did not receive sufficient evidence on EHS to form a view about collecting data in this field.

2.211 The Australian Communications Authority (ACA) was questioned about its efforts in recording complaints about health effects resulting from mobile phone use. Mr Ian McAlister, Manager, Radiocommunications Standards Team, ACA, stated:

> … I should admit it [the complaints system] is rather embryonic at the moment. We have had some 20 to 25 legit complaints that we have recorded, more or less. What we have started to do now is to ask the same questions of people ringing up with complaints. We started this at the request of Dr Hocking when he was starting to do some work into headaches and mobile phone use. He said, 'If you get any calls, please take them down'. We started doing that, but now it is a much more methodical arrangement. But it is not anything like a database or something like that…
>
> … I do know, for example, that people complain they will go to the carriers; they will go to suppliers where they bought the phones; they will go to the TIO; they will come to the ACA; they will go to the department and the Department of Health as well. I think if you pulled them all together, you might get a basis for some research.[266]

2.212 He later continued:

> The ACA gets complaints on a whole range of things. With headaches, we have not worked out a set policy on this; but if someone rings me directly I tell them they should talk to their medical practitioner first.
>
> … As I mentioned, it is at a very early stage, where we decided to collect information and to start to record information coming from people ringing us directly. We were not setting up a database or setting up some sort of basis for epidemiological study or anything.

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264 *Proof Committee Hansard*, Canberra, 2 March 2001, p 373 [Swicord].

265 *Proof Committee Hansard*, Canberra, 2 March 2001, p 372 [Swicord].

266 *Official Committee Hansard*, Sydney, 16 November 2000, p 309 [McAlister].

> … All I did was at Dr Hocking's suggestion, that he would like to know of people who had complaints about headaches and if we asked them if they would be willing for us to pass their contact details on to someone doing research in this area we would be happy to do so. That is the basis of our complaint handling on adverse health effects.[267]

2.213 Dr Robert Horton, Deputy Chairman, ACA, added:

> What we will be doing is a sort of community education campaign, if you like, over the coming six months. We will be putting together fact sheets and so on which explain whatever the circumstance is, the process you should follow, and what is in place – who is responsible for what – whether it is about towers or whether it is about purchasing equipment in the marketplace. There are plenty of questions and answers, which we will set out and go public with. We have also found that there is an education campaign with even local councils who do not understand the new act and their position in this area.
>
> … I cannot tell you what they [the fact sheets] will say at the moment or if they will say anything about headaches, but we may provide information of where people should go if they do have problems.[268]

2.214 The Committee recognises that research is being undertaken to investigate a range of symptoms attributed to mobile phone use but industry codes of practice should be developed which ensure that mobile phone users who complain are provided with advice with regard to minimising exposure and referred to a Government agency such as ARPANSA or the Health Department and records of consumer complaints reported annually.

2.215 The Committee is of the view that the development of a database of reports of adverse health effects from mobile phones and other sources of radiofrequency radiation would assist consumers and provide researchers and Government agencies with valuable data in formulating future research hypotheses.

Recommendation 2.6

The Committee recommends the development of an industry code of practice for handling consumer health complaints.

Recommendation 2.7

The Committee recommends the establishment of a centralised complaints mechanism in ARPANSA or the Department of Health for people to report adverse health effects associated with mobile phone use and other

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267 *Official Committee Hansard*, Sydney, 16 November 2000, pp 310-311 [McAlister].

268 *Official Committee Hansard*, Sydney, 16 November 2000, pp 309-310 [Horton].

radiofrequency technology, and for the data from this register to be considered by the NHMRC in determining research funding priorities.

The difficulties of drawing conclusions

2.216 There were essentially three positions put in relation to the scientific evidence on the health effects of radiofrequency radiation. There were those who argued that there is insufficient evidence on adverse health effects associated with RF radiation, those who said the evidence is insufficient to rule out any health risks, and those who argue that evidence shows a causal relationship between health effects and exposure to low-power microwave emissions.

2.217 It is important to acknowledge the complexity of the subject matter and to also recognise that parties offering interpretation of the scientific literature are not always completely at arms-length from industry.

2.218 The Committee Chair notes that Dr Michael Repacholi has in the past been employed by the power and telecommunications industry both as a consultant and as their scientific expert in court. He now holds influential positions as Coordinator, Occupational and Environmental Health at the World Health Organization and Chairman of the International Radiation Protection Association's International Non-ionizing Radiation Committee which later became ICNIRP. This committee interacts with the WHO, the International Labour Office, the International Commission on Radiological Units, the International Electrotechnical Commission and the Commission of European Communities. Dr Repacholi was instrumental in developing the TE/7 Committee standard setting procedures in Australia, advocates the adoption of the ICNIRP based standard and was seconded from the Royal Adelaide Hospital to the Australian Radiation Laboratory – now ARPANSA – for two years to complete EMF research projects. Dr Repacholi was also a member of the Independent Expert Group on Mobile Phones (The Stewart Report). The involvement of Dr Ken Joyner, employee of Motorola, and member of the Australian RF EME Expert Committee which provides advice to NHMRC on research grants is also discussed in Chapter 3.

2.219 It is difficult for people, especially those without a working knowledge in this field, to confidently understand all the implications of the research methodologies and interpretation of results, particularly when abstracts of studies are extensively relied upon.[269]

2.220 While it has been argued that 'the jury is still out' with respect to the effects of exposure to electromagnetic radiation, in particular, mobile phones, and that current research provides no evidence of long term adverse health effects from relatively short exposures to radiofrequency/microwave radiation, it is also the case that few studies

269 CSIRO, Submission 95, p 7.

have examined directly the effects of mobile phone emissions and that, necessarily, no long term studies have been done on humans to show that cancer, with its long latency period, is neither promoted or initiated by radiofrequency radiation.

2.221 Given the evidence put before it, the Committee considers that it would be unwise to be complacent about the potential adverse health effects of mobile phone use, particularly effects that may manifest themselves after long term exposure.

2.222 The failure to provide sufficient evidence to allow the technology to be considered safe, is in contrast to the continued appearance of studies that have found biological effects if not health effects.

2.223 The Stewart Report concluded that whilst a number of scientific studies suffered from methodological or analytical shortcomings, the public cannot be reassured that there is no risk. The Committee Chair found, however, that there was by no means agreement about these criticisms and notes that it is possible for vested interests to undermine the integrity of studies in this way, leaving the general public uncertain about the findings.

2.224 Nevertheless, the Committee agrees with the need for rigorous and well-designed studies in this as in all fields of science.

2.225 There are many historical examples of scientific results that are found to conflict with other results and with established understanding but which eventually replace earlier theories. In fact there were a variety of reasons for discounting research that found links between mobile phone emissions and biological or health effects.[270]

2.226 The Committee Chair considers that the effects of electromagnetic radiation deserve attention and that a concerted and targeted approach to research in this area is needed,[271] and, in the light of the inconsistency of many of the results of these studies, a cautious approach should be adopted to policy-making in this area (see Chapter 4 for a discussion of precautionary approaches as they relate to the setting of standards for mobile phone emissions).

2.227 The Committee notes that a conference was held in Coogee, Sydney, Australia on 22-23 March 2001, entitled: *The Radio Frequency Spectrum: Managing Community Issues*, which provided a forum for all views in this debate to be represented and discussed. The Committee considers that such forums are valuable opportunities for scientists and other interested parties to attempt to publicly discuss

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270 Ms Yvonne Jayawardena, Submission 81, p 3.

271 The Committee notes the views expressed by the CSIRO: 'Research has been sporadic. The results have been controversial and contradictory. It is not really surprising. Unless you have a properly structured and directed system of research, you will not overcome the initial problem of the undirected sporadic bits of research that are carried on, sometimes not particularly well … If you do not provide adequate or proper resources, you are being extremely optimistic in expecting a decent outcome' (*Official Committee Hansard*, Sydney, 16 November 2000, p 224).

the potential and actual health effects of exposure to radiofrequency radiation. The Committee sees merit in the Commonwealth Government sponsoring similar conferences, under the auspices of a body such as the National Academy of Science, to include respected Australian and international researchers in this field and for such forums to be open to the public. The Committee notes that in March 1999, the National Museum of Australia coordinated Australia's first consensus conference on gene technology in the food chain, which enabled lay people to put questions to an expert panel.[272]

Recommendation 2.8

The Committee recommends that the Commonwealth Government consider sponsoring conferences on the health effects of radiofrequency radiation along similar lines to that conducted on gene technology.

International research

World Health Organization International Electromagnetic Fields Project

2.228 In November 1996, an international seminar was held on the biological effects of low-level radiofrequency electromagnetic fields. The seminar, after surveying the literature and preparing status reports, concluded 'although hazards from exposure to high-level (thermal) RF fields were established, no known health hazards were associated with exposure to RF sources emitting fields too low to cause a significant temperature rise in tissue'. The seminar identified a number of research areas requiring further study or replication.[273] The WHO RF Electromagnetic Fields Research Coordination Committee outlined an agenda for future research into radiofrequency fields.[274] The WHO Committee said 'the only established health effects of RF fields relate to thermal effects (for frequencies between about 1 MHz and 300 GHz) or induced electrical currents and fields (for frequencies up to about 1 MHz), following exposures at relatively high levels' and that although 'some studies suggest biological effects from low-level RF exposure … there is a lack of well replicated findings'.[275] The WHO Committee recommended that:

a) exposure levels, frequencies, modulation and pulse characteristics should be as relevant as possible to human experience; and

b) there should be relevant biological end-points, that is, those that can be related to possible health risks.

272 See www.austmus.gov.au/consensus/

273 Repacholi 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 806.

274 Repacholi 1998, included in The World Health Organization, Submission 56, Submission Vol 4, p 806.

275 NHMRC, Submission 69, p 43.

2.229 In terms of research priorities, the WHO Committee said greater emphasis was placed on the results of *in vivo* and epidemiological studies rather than *in vitro* studies, unless the latter provide mechanisms for extrapolation to humans or additional information that supports the results of *in vivo* studies.[276]

2.230 Research needs included in the WHO's research agenda were said to be identified on the basis of whether the evidence for a health risk was judged to be suggestive but insufficient to meet the criteria for assessing health risk. The overall goal was to promote studies that demonstrate a reproducible effect of EMF exposure that has the likelihood to occur in humans and has potential health consequences. This research agenda formed part of the Australian RF EME Expert Committee's considerations in making its research recommendations (see *Australian research* below).

2.231 The EMF Project provides a forum for a coordinated international response to various electromagnetic field issues. International scientific reviews have provided health status reports and identified gaps in knowledge where further research is required. Australia's EMF research program was largely based on the WHO's research needs identified at an international symposium on the biological effects of exposure to non-thermal radiofrequency fields in Munich in November 1996.

2.232 The EMF Project includes the monitoring of all relevant research results culminating in the publication of a report, anticipated to occur in 2005, that will provide information on health effects of exposure to static and time varying electric and magnetic fields in the frequency range of 0-300 GHz.

2.233 Organisations collaborating with the WHO on the EMF Project are:

- International Commission on Non-Ionizing Radiation Protection (ICNIRP) – develops international guidelines on exposure to non-ionising radiation;
- International Agency for Research on Cancer (IARC) – looks at carcinogenic effects of radiation;
- International Labour Office (ILO) – EMF exposure and occupational health;
- International Telecommunications Union (ITU) – development of telecommunications equipment; information on current and future communications systems;
- International Electrotechnical Commission (IEC) – standards;
- United Nations Environment Programme (UNEP) – environment and human health;
- North Atlantic Treaty Organization (NATO) – NIR effects on personnel; and

276 NHMRC, Submission 69, p 44.

- European Commission (EC)
    - Directorate General on Employment, Industrial Relations and Social Affairs (DG V)[277]
    - Directorate General on Science, Research and Development (DG XII)
    - Directorate General on Telecommunications, Market Information and Research Exploitation (DG XIII).

2.234 The 1997 WHO Research Agenda for the International EMF Project, being conducted under the auspices of the WHO, was re-examined in 1999. Of the seven areas that were deemed to require further research, two were considered to have not been addressed while several others were not fully addressed, according to Dr Swicord who made an assessment on WHO's behalf:

- In relation to bioassays to test for cancer initiation, promotion, co-promotion and progression, six studies were conducted in four laboratories including two EC studies, one in Germany and one in Finland.
- Two studies are being conducted to replicate the Repacholi mouse study, one in Australia (see the Vernon-Roberts study below) and the other, supported by the EC, in Italy.
- In relation to studies to test the reproducibility of reported changes in hormone levels, effects on the eye, inner ear and cochlea, memory loss, neurodegenerative diseases and neurophysiological effects, a French study is examining behavioural elements of this area. In addition, an Australian study (see the Stough study below) is addressing components of the neurophysiological area.
- In response to WHO's call for epidemiological studies to be undertaken which focus on head and neck cancers and any disorders associated with the eye or inner ear, a large scale IARC mobile telephone study is covering nine countries in Europe, Israel and four additional countries, for which funding is not yet in place. One of the additional countries is Australia, which has recently announced funding for the extension to the Armstrong pilot study (see below). A large occupational study in the UK is also in the pilot study phase.
- In relation to studies to provide a better assessment of any health risks from exposure to radar technology, including ultra-wide band radars, Dr Swicord advised that this issue was not currently being addressed. However, the NHMRC noted that the US military had undertaken considerable work in this

277 Supports communications among European scientific researchers through COST 244 *Biomedical effects of electromagnetic fields* initiative, originally proposed by the Faculty of Bioelectrical Engineering, University of Zagreb, Croatia, and adopted in October 1992. COST, European Cooperation in the field of Scientific and Technical Research, was set up in 1971 and is a framework for R&D co-operation in Europe, involving 25 countries and the European Commission. COST Actions exist in over 15 research domains the largest of which is COST Telecommunications. See radio.fer.hr/mainpage.htm.

area which was in the process of being published, and that additional work was being undertaken in Russia, China, and the UK.

- While it was indicated that studies testing people reporting specific symptoms such as headaches, sleep disorders or auditory effects, and who attribute them to RF exposure, were required, the NHMRC advised that some areas on cognitive disorders and behaviour are proposed and that a number of other human studies in this area have been proposed or are under-way in Germany, Italy and the UK.
- In relation to suggested research at the cellular level that may be directly relevant to possible *in vivo* effects, this was considered to have been addressed to a large extent already, with the possible exception of replication studies of DNA aberration results and ODC results. The NHMRC noted that some work on ODC and DNA aberrations is being undertaken in France, Italy and Finland.[278]

2.235 In late 1999, the Research Coordination Committee of the WHO International EMF Project reassessed its research agenda and identified one area that was not being well addressed; there is still a need for well controlled studies to test people with specific symptoms such as headaches, sleep disorders or auditory effects, which they attribute to RF exposure.

European Commission

2.236 Internationally, the European Commission has also responded to WHO's (revised) research agenda, announcing, in early 2000, four projects in addition to the IARC study (see below):

- *Combined effects of EMFs with environmental carcinogens: molecular changes and genetic susceptibility*: This study, to be conducted by Jukka Juudlainen at the University of Kuopio in Finland, is examining the possible effects of RF/MW exposure and known mutagenic agents; whether RF/MW similar to those emitted by mobile phones enhance tumour development in a carefully selected animal model; whether RF/MW exposure is a possible enhancer of DNA damage *in vivo*; and examining *in vitro*, what the effects are of RF/MW fields, alone or in combination with environmental chemicals, on selected cellular processes related to carcinogenesis and non-genotoxic carcinogenesis.
- *Risk evaluation of potential environmental hazards from low-energy EMF exposure using sensitive in vitro methods*: Franz Adlkofer, Foundation for Behaviour and Environment in Munich, Germany, is carrying out *in vitro* investigations of molecular and functional responses of living cells to EMFs covering genotoxic effects, and effects on differentiation and function of embryonic stem cells and tumour cells, gene expression and targeting, the immune system, and cell transformation and apoptosis.

278 NHMRC, Submission 69, pp 22-23.

- *In vivo research on possible health effects related to mobile telephones and base stations: carcinogenicity studies in rodents:* This study, coordinated by Clemens Dasenbrock at the Fraunhofer Institute in Germany, is undertaking two-year bioassays in Wistar rats and B6C3F1 mice with 900 MHz GSM and 1800 MHz PCS radiation, a replication of the DMBA-initiated breast cancer bioassay in female Sprague-Dawley rats with 900 MHz GSM radiation, and a replication of the lymphoma bioassay in *Pim-1* transgenic mice with 900 MHz GSM radiation.
- *Development of advice to the EC on the risk to health of the general public from the use of security and similar devices employing pulsed EMFs*: Coordinated by Jürgen Bernhardt, German Federal Radiation Protection Office, Oberschleissheim, Germany, this study will produce an advisory document for the European Commission and member states addressing the issue of possible adverse public health effects from exposure to pulsed electromagnetic fields associated with electronic security and similar devices.[279]

IARC INTERPHONE study

2.237 Following recommendations from several expert reviews and the completion of a detailed feasibility study in 1998 and 1999, which determined that a multi-national study into a range of cancers would be feasible and informative, the International Agency for Research on Cancer (IARC) established, and will coordinate, a multi-centre study of brain tumours, salivary gland tumours, acoustic neurinomas and other head and neck tumours, and leukaemia and lymphomas in Australia, Canada, Denmark, Finland, France, Germany, Israel, Italy, Japan, New Zealand, Norway, Sweden and the UK. The results are expected in 2003 or 2004. This study is partially funded by the EC Fifth Framework programme.[280]

UK Link Collaborative Research Programme

2.238 On 8 December 2000, in response to the Stewart Report's recommendations, the UK Government announced a £7 million collaborative Mobile Telecommunications and Health Research Programme.[281] Applications have been called for and will close at the end of March 2001, with a further call for research applications later in the year. Research contracts would be awarded on the basis of the most creative approach, those likely to be effective and predictable, and those demonstrating value for money. The areas of research for which bids are being particularly sought reflect the recommendations from the Stewart Report: effects on brain function; consequences of exposure to pulsed signals; improvements in dosimetry; sub-cellular and cellular changes induced by radiofrequency radiation and their possible impact on health; psychological and sociological studies related to the use of mobile phones; and epidemiological and human volunteer studies including the

279 CEMEPHI, Submission 127, Submission Vol 9, pp 1923-1924.

280 See MMF, Submission 75, p 8. See also europa.eu.int/comm/research/fp5.html and www.iarc.fr/pageroot/UNITS/RCA4.html.

281 See www.doh.gov.uk/newsdesk/archive/december/4-naa-08122000.html.

study of children and individuals who may be more susceptible to radiofrequency radiation.

Cooperative Research and Development Agreement (CRADA) on Health Effects of RF Emissions from Wireless Phones (Mobile Units for Commercial Mobile Radio Services)

2.239 As part of a collaborative research program between the US Food and Drug Administration (FDA) and the Cellular Telecommunications Industry Association (CTIA), the US FDA's Center for Devices and Radiological Health (CDRH) will make recommendations on the studies that are required, and the CTIA will contract directly with third parties to undertake this research, the results of which are to be published in peer-reviewed journals or other appropriate forums. Interim reports and ongoing working data of these researchers will be kept confidential under the terms of the Agreement. The research undertaken by the third parties will be conducted under agreement independent of the CRADA, and CTIA will make the decision on which research proposals should be funded. The Agreement will focus on two topics: mechanistic studies related to genotoxicity (or carcinogenesis) and research on additional epidemiological studies, and is due to conclude in December 2002.

2.240 The Committee understands that the Working Group for the genotoxicity study was formed in August 2000, and that a request for genotoxicity proposals was issued in September to be responded to by December. The Working Group for the epidemiology study appears to be still being organised, and it will be some months before research proposals are sought. The Committee was advised that no genotoxicity research grants appear to have been awarded as yet.[282]

Australian research

Radiofrequency electromagnetic emissions research program (RF EME program)

2.241 The background to and components of Australia's electromagnetic emissions research program will be detailed later in this report. Briefly, the Committee on Electromagnetic Energy Public Health Issues (CEMEPHI), currently convened by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), has responsibility for the overall implementation of the Australian Radiofrequency Electromagnetic Energy Program, and was responsible for developing the research strategy. The National Health and Medical Research Council (NHMRC) is responsible for the management of the research component of the program through its Strategic Research and Development Committee (SRDC), which established a Radiofrequency (RF) Electromagnetic Energy (EME) Expert Committee to oversee the research.[283]

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282 *Committee correspondence,* Dr John Moulder, 17 February 2001.

283 National Health and Medical Research Council (NHMRC), Submission 69, Submission Vol 6, pp 1076.

2.242 The RF EME Expert Committee developed research priorities based on the CEMEPHI research strategy.[284] The research agenda also took into consideration the proposals of the European Commission's 1996 report on 'Possible health effects related to the use of radiotelephones – Proposals for a research program by a European Commission Expert Group'. The WHO's 1996 and subsequent revised RF research agendas are also referred to in determining research priorities.[285]

2.243 The main priorities of the research strategy identified by the CEMEPHI were:

- dosimetry and exposure systems;
- field measurements of RFR sources and personal exposure;
- numerical modelling and verification of SAR[286] distributions in the body;
- *in vivo* and *in vitro* studies of biological effects;
- mechanisms for interaction between radiofrequency radiation and cellular processes;
- animal and human laboratory studies on non-cancer disorders of the brain and neck, including neurobehavioural and immune system effects, affect on blood brain permeability, sleep disorders etc;
- epidemiological studies on acute and chronic exposure to radiofrequency radiation, particularly of groups with higher exposure than the general population;
- brain cancer; and
- further testing of hypothesised association between residence near TV towers and childhood leukaemia.[287]

2.244 The NHMRC advised the Committee that, although the EME program is intended to be Australian-based and to examine RF EME issues of particular relevance to the Australian environment, it is also intended that the program complement overseas research activities.[288] Four research projects were funded from the first round and they are outlined briefly below.

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284 National Health and Medical Research Council (NHMRC), Submission 69, Submission Vol 6, pp 1070-1072.

285 CEMEPHI, Submission 127, p 6.

286 Specific Absorption Rate.

287 CEMEPHI, Submission 127, pp 51-53.

288 NHMRC, Submission 69, Submission Vol 6, p 1073.

The Sykes pilot study on intrachromosomal recombination[289]

2.245 Dr Pamela Sykes, Flinders Medical Centre, Adelaide, was funded to conduct an *in vivo*[290] pilot study to test whether radiofrequency induced mutations in transgenic mice[291] with a view to identifying a biological mechanism that links RF and cancer. The study provided for exposure to radiofrequency radiation at a certain dose for three different time periods. If an increase in mutations were observed in the spleen cells of animals, then a lower dose would be investigated.

2.246 The study was conducted at Flinders University in South Australia. The results of the pilot study undertaken at specific absorption rates at which thermal effects might be expected, did not show more DNA breakage than was observed in mice not exposed to RF electromagnetic emissions (EME), although it did show changes which Dr Sykes said were worthy of further study. The results were evaluated by the NHMRC's RF EME Expert Committee, which decided not to recommend further funding for a full proposal by Dr Sykes, based on testing the same hypothesis with the same methodology.[292]

The Vernon-Roberts study on tumour incidence in transgenic mice

2.247 Professor Barrie Vernon-Roberts, Head of the Department of Pathology, Adelaide University and Director of the Institute of Medical and Veterinary Science, is undertaking a replication study of the 1997 Adelaide mouse study, to test whether exposure to GSM[293]-like radiofrequency fields affects lymphoma rates in *Eμ-pim-1* transgenic mice.[294] In addition to the methods followed in the earlier study, the Vernon-Roberts study will test a range of doses and use enhanced dosimetric techniques.

2.248 Large numbers of *Eμ-pim-1* transgenic mice, which are predisposed to lymphoma development, will be exposed to electromagnetic fields similar to those emitted by mobile telephones. There will be four dose exposure levels in addition to control groups. The incidence of cancer in exposed and non-exposed mice will be compared.

2.249 The Committee notes that the exposure of the mice is expected to be completed in June 2001, followed by analysis of pathology results and the report write-up, expected to be completed by June 2002.[295]

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289 Mutations

290 In a living body as opposed to *in vitro* – in glass.

291 Mice genetically engineered usually to be susceptible to a particular type of disease.

292 NHMRC, Submission 69, pp 7, 11. See also *Proof Committee Hansard*, 2 March 2001, pp 400-401 [NHMRC].

293 Global System for Mobile Communications – a standard for mobile telephony which uses pulsed signals.

294 A strain of genetically modified mice engineered to be susceptible to a particular type of cancer.

295 *Proof Committee Hansard*, Canberra, 2 March 2001, p 367 [Swicord].

2.250 The application originally included a proposal to undertake a similar study with another genetically-modified mouse variant (*p53* mice). However, the RF EME Committee considered that as definitive results from the *pim-1* study were two years away, and should the study show no increase in lymphoma risk, that this would substantially reduce the justification for funding the *p53* mouse study.[296] The funds have been used for the second round of NHMRC funding for EMR research (see below).

2.251 The World Health Organization, in its submission to this inquiry, recommended that the Vernon-Roberts team should be funded to complete a study using the *p53* mouse model, as results could 'add significantly to our understanding of the way RF fields interact with biological tissues' and 'allow a better understanding of the results of the *pim-1* mouse study'.[297] Dr Peter French, Principal Scientific Officer at the Centre for Immunology, St Vincent's Hospital, Sydney, in his submission to the Committee, noted:

> It is true that [the 1997 Adelaide mouse study] does not imply that there is an increased risk to humans of lymphoma induced by mobile phone exposure. It may indicate however that in individuals genetically predisposed to certain forms of cancer, the long term intermittent exposure to RF such as that used in mobile phone technology may be an important environmental stimulus in the induction of malignancy, by an as yet unknown mechanism.[298]

2.252 The authors of the original mouse study, in their conclusion, observed that while no humans were known to carry an activated *pim1* gene, there were cases of individuals expressing the *p53* gene, and that these individuals may 'comprise a subpopulation at special risk from agents that would pose an otherwise insignificant risk of cancer'.[299]

2.253 The Committee Chair recognises that funding decisions are made by the NHMRC, notes the reasons for the decision to re-allocate the funding originally set-aside for the *p53* study, but is persuaded that this study should be undertaken.

Recommendation 2.9

The Committee Chair recommends that a study into *p53* mice be listed as an area of research for which future research applications should be encouraged.

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296 *Official Committee Hansard*, Canberra, 8 September 2000, p 52 [NHMRC].

297 The World Health Organization, Submission 56, Submission Volume 4, p 773.

298 Dr Peter French, Submission 37, pp 2-3.

299 Michael H. Repacholi, Antony Basten, Val Gebski, Denise Noonan, John Finnie and Alan W. Harris, 'Lymphomas in Eμ-*Pim1* Transgenic Mice Exposed to Pulsed 900 Mhz Electromagnetic Fields', *Radiation Research*, 147, 1997, pp 631-640 at p 639.

The Stough study on neuropsychological impairment

2.254 Dr Con Stough, from Swinburne University, Victoria, was funded to conduct an 18 month human study to test whether exposure to EME emissions from mobile phones causes impairments in neuropsychological functioning (in contrast to previous studies of the use of mobile phones affecting driving performance that could just indicate divided attention). The study, using 120 participants taken from the general community, first established a baseline with respect to memory, attention and problem solving and then gave either an RF EME or 'sham' (placebo) for 60 minutes. The participants were reassessed on the same day after the 60 minutes of either EME or sham. After 7 days, a second baseline assessment was measured and was followed by a further assessment. At each assessment subjects completed various neuropsychological tests. These tests were designed to measure a wide range of psychological processes, including: visual-motor coordination and speed; visual scanning; incidental learning; sustained attention; language comprehension; rapid decision-making; psychomotor speed; short-term memory and attention; verbal encoding and recall; sequencing; capacity to learn; and short-term recall.

2.255 This study has been completed and the results are to be submitted for publication.

The Armstrong study on brain and other tumours

2.256 Professor Bruce Armstrong, Director of the Cancer Control Information Centre, NSW Cancer Council, has been funded to conduct a 16 month epidemiological case-control pilot study of brain and other tumours in adults and exposure to radiofrequency electromagnetic energy in the use of mobile phones. Professor Armstrong's research forms part of an International Agency for Research on Cancer (IARC) study that includes participation from the UK, France, Italy, Sweden, Denmark, Israel and Canada. The pilot study was accepted, and Dr Armstrong has received funding for the full study.[300]

2.257 The full study will examine adults aged 20-69 years, diagnosed for the first time with primary glioma[301] or meningioma[302] of the brain, acoustic neuroma[303], or cancer of the parotid gland[304] between 1999-2001. An equal sample size of age and sex matched controls has been randomly selected using electoral rolls. A 45 minute questionnaire based interview will be conducted that includes questions on mobile

300 *Proof Committee Hansard*, 2 March 2001, p 403 [NHMRC].

301 Gliomas are brain tumours of the glial cells, which make up the tissue that support nerve cells in the brain. Primary gliomas are those that arise in the brain rather than those that begin elsewhere in the body and spread to the brain.

302 Brain tumours that develop in the protective membrane, called the meninges, that surrounds the brain directly underneath the skull.

303 Tumours that develop in the cells that produce the substance that protects the acoustic nerve.

304 Largest salivary gland situated near each ear.

phone usage and pattern, type of phone (analog or digital), and use of antenna. Demographic and other variables will also be collected.

Latest research projects

2.258 A second round of funding was agreed to in February 2000 to address areas of research identified by the RF EME Expert Committee as being under-researched. In line with the revised research agenda developed by the World Health Organization (see above), the RF EME Expert Committee emphasised the areas of neuropsychological and neurophysiological abnormalities in its call for a second round of research expressions for interest, including:

- effects on the eye and vision;
- effects on the inner ear, cochlea and hearing;
- memory loss;
- headaches;
- sleep disorders;
- other neurological effects;
- neuroendocrine effects;
- immunological effects; and
- areas of possible biological effects.[305]

2.259 Two projects, out of five full research proposals submitted, were announced as part of the second round of funding.[306] The funding details of these projects are discussed in Chapter 3. The projects are briefly described below.

The Wood study on human physiological responses

2.260 Dr Andrew Wood, from the Swinburne University of Technology in Victoria, will conduct a three-year study which will expose human volunteers to radiation similar to that which would be experienced during a mobile phone call, to identify the immediate effects of mobile phone use on the ability of participants to respond to

305 NHMRC, Submission 69, Submission Vol 6, pp 1075-1076. The NHMRC also advised that research priorities identified in the report by the Royal Society of Canada may also be addressed in the latest round of EME funding proposals, including: laboratory-based studies of ocular effects and neurodegenerative changes, studies to identify the biophysical detection mechanism that detects RF radiation; as well as clinical studies to identify whether some people potentially are more sensitive to RF fields, and/or whether people vary in their response patterns to RF exposure of the brain activity (Submission 69, p 25).

306 Dr Michael Wooldridge, Minister for Health and Aged Care, 'NHMRC research to throw light on the human effects of mobile phone use', *Media Release*, 1 March 2001.

visual and auditory stimuli. The quality of participant sleep during the night following exposure will also be measured.[307]

The Mitchell study into effects on vision and hearing

2.261 Associate Professor Paul Mitchell, Westmead Hospital, University of Sydney, will conduct a two-year study based on the large scale Blue Mountain Eye Study[308] to examine the consequences of long-term mobile phone use on standard measures of vision, eye disease and hearing. The project will also test for subtle changes in sensory function.[309]

Future research

2.262 A number of areas of possible future research were highlighted in evidence to the Committee.[310] The Committee notes calls by submitters to this inquiry for more human and epidemiological research to be conducted on health risks associated with exposure to low levels of radiofrequency radiation,[311] and occupational exposure.[312]

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307 See also *Proof Committee Hansard*, Canberra, 2 March 2001, pp 397-398 [Clarkson].

308 This study examined a sight disorder called age-related macular degeneration (the macula is a part of the retina).

309 See also *Proof Committee Hansard*, Canberra, 2 March 2001, p 398 [Clarkson].

310 See for example, ACTU, Submission 89, pp 5-6; CSIRO, Submission 95, p 5; Mr Pranay Bhattacharya, Submission 107, pp 3-6; Ms Diane Beaumont, Submission 138, p 49, 53-54. The Committee also acknowledges the view expressed by Dr Cherry in evidence to the Committee when he stated: 'When I started in this area, I found that there was so much available that it did not need to have new studies to show effects because they were already published, but many of them were misinterpreting the radiation patterns because they did not know the engineering (*Proof Committee Hansard*, Canberra, 2 March 2001, p 333 [Cherry]). See also, *Proof Committee Hansard*, Canberra, 2 March 2001, p 343, where Dr Loy, ARPANSA, also indicated that further research in this field was required; *Proof Committee Hansard*, Canberra, 2 March 2001, p 407 [Doull].

311 See for example, Dr Bruce Hocking, Submission 21, p 1; *Official Committee Hansard*, Canberra, 8 September 2000, p 83 [Holt] and Melbourne, 22 September 2000, p 115 [Hocking]. See also Mr Simon Fielding, OBE, who stated that '[i]t is important to note, however, that to demonstrate any conclusive link between these biological effects and any long term health implications will take many years of epidemiological research' (Submission 119, Submission Vol 9, p 1832). The Committee notes the views expressed by Mr Neil Boucher who stated: 'Most of the "research" that has been carried out on the health effects of electromagnetism are top down studies. That is people are assembled, with largely medical and statistical qualifications (and usually with little or no knowledge of electromagnetism itself), to look for epidemiological evidence of some health effect. The fact that nothing conclusive has been found to date testifies both to the relative insignificance of any effect (if it exists) and to the futility of the methods employed …. A bottom up approach done by suitably qualified people that looked at the effect of low energy (radio frequency) electromagnetism on simple atoms, then simple molecules and then moving on to more complex organic molecules would reveal any mechanisms for interaction and suggest what (if any) types of damage could be caused by the exposure, accounting in particular for the levels that are necessary to be relevant compared to external background radiation and radiation developed with the organisms themselves as they go about their daily business.' (Submission 118, Submission Vol 11, pp 1826-1827. See also Mr Boucher's evidence where he advocates initially research at the physics level rather than the 'needle in a haystack approach of biology studies' (*Official Committee Hansard*, Canberra, 8 September 2000, p.79). See also *Official Committee Hansard*, Sydney, 16 November 2000, p 267, where Dr Peter French, cell biologist, stated: 'The issue is that it is very difficult to go looking for epidemiology for disease when you do not know exactly what the disease is … [What the] cell studies and the gene studies can tell us is what genes are affected. Those genes which are known have well-

The Committee Chair supports the view that human studies should be undertaken as quickly as possible to ensure that there are sufficient people to act as suitable controls.[313]

2.263 While the technology is relatively new and evidence of some health effects may have a long latency period, for example the incidence of cancer that may or may not be related to mobile phone and base station emissions, given the increasing number of people worldwide, particularly young people, using mobile phones, there is an urgent need to replicate studies, commence long-term epidemiological studies and establish a scientifically substantiated body of evidence to provide guidance to the public about the possible adverse health effects of electromagnetic radiation.

2.264 The Committee notes that while research into extremely low-level RF radiation is not as plentiful as research into other portions of the spectrum, there is sufficient evidence to justify conferences to discuss the current state of the science. The Committee has made recommendations relating to the funding of research in this area in the next chapter.

2.265 The Committee Chair also calls on the telecommunications industry to give priority in its technology development to research on reducing exposure to RF radiation.

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known connections to diseases and therefore that can provide the basis for an intelligent epidemiology study rather than a fishing trip…' and Professor David McKenzie who added: 'It is important to emphasise that a scientific approach is necessary. The mechanism has got to be identified before any substantial science can be done in this field. A viable mechanism has to be established by doing meticulous science, establishing that mechanism, working out what it could lead to and then looking for those effects in the population at large. A cell biology experiment is crucial here to identify and to prove the mechanism, identify possible links and then work on those links by looking at epidemiological evidence'. Cf Dr Holt who states in his submission: 'For any advance to be made in the problems facing your committee recourse must be had to the knowledge directly derived from living people and not artificial conditions from experimental work' (Submission 143, Submission Vol 11, p 2418). The Committee also notes the conclusion of the Royal Society of Canada Report (p 93): '…the epidemiological evidence [for non-thermal health effects] to date is inadequate for a comprehensive evaluation of risk, and does not support a hypothesis of an association between exposure to radiofrequency fields and risk of cancer, reproductive problems, or congenital anomalies. However, there is a need for additional, larger well-designed studies, to provide further information on these relationships'.

312 ACTU, Submission 89, p 4. See also *Proof Committee Hansard*, Canberra, 2 March 2001, p 407 [Doull].

313 See CEMEPHI, Submission 127, Submission Vol 9, p 1962.

CHAPTER 3

ALLOCATION OF AUSTRALIAN RADIOFREQUENCY ELECTROMAGNETIC ENERGY PROGRAM FUNDS

Introduction

3.1 This chapter focuses on the $4.5 million Radiofrequency Electromagnetic Energy Program the stated aim of which is to address community concerns about exposure to electromagnetic radiation occurring in the radiofrequency range of the spectrum. This Program is managed by two government agencies: the Committee on Electromagnetic Energy Public Health Issues (CEMEPHI) and the National Health and Medical Research Council (NHMRC). Both of these agencies come under the Department of Health and Aged Care. The Committee examined the funding allocation as well as criticisms of the program raised during its inquiry.

Committee on Electromagnetic Energy Public Health Issues (CEMEPHI)

3.2 On 23 October 1995, the Government established an interdepartmental Committee on Electromagnetic Energy Public Health Issues (CEMEPHI). This Committee is responsible for advising the Government on public health issues related to the use of the radiofrequency spectrum for communications including:

- the current status and suitability of technical standards relating to electromagnetic energy in the radiofrequency spectrum and public health (but not to cut across the standards development process);
- how standards are being implemented by the industry;
- whether compliance programs are adequate, and, if they are found to be lacking, developing appropriate reporting processes to ensure compliance is being maintained (relying as much as possible on self regulation strategies but utilising legislative means if necessary);
- the extent of human services programs put in place to assist those experiencing interference problems with health equipment from electromagnetic energy;
- the status of overseas and Australian research into the health/electromagnetic energy issue and the scope for further research to be undertaken in Australia; and
- the implementation of a community information program to ensure all relevant information on the health/electromagnetic energy issue is freely available.[1]

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1 Committee on Electromagnetic Energy Public Health Issues (CEMEPHI), Submission 127, p 4.

Radiofrequency Electromagnetic Energy Program

3.3 On 15 October 1996, the Australian Government announced the program which would fund electromagnetic radiation research into health issues associated with mobile phones, mobile phone towers and other communications devices and equipment; contribute to a World Health Organization (WHO) project that coordinates the international research effort, and reviews the scientific literature; and provide public information. A total of $4.5 million was drawn from a one per cent levy on radiocommunications licences in 1996-97, set aside for use over a five year period.

3.4 Of the $4.5 million, $3.15 million was initially allocated for research, with the remainder identified for public information and the WHO collaboration. The research component was later increased to $3.4 million.

3.5 With the establishment of the Radiofrequency Electromagnetic Energy (RF EME) Program, the CEMEPHI became responsible for the overall implementation of that Program. In addition, it became specifically responsible for the public information component and Australia's involvement in the WHO collaboration.

3.6 On 1 July 1998, the support function for the CEMEPHI was transferred from the then Department of Communications and the Arts, and its administrative costs drawn from the $4.5 million. The CEMEPHI is currently convened by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) which falls under the aegis of the Department of Health and Aged Care. Current membership of the CEMEPHI is:

Table 3.1

CEMEPHI Membership[2]

Dr John Loy (Chair)	ARPANSA
Dr Kevin Buckett	Department of Health and Aged Care (Public Health Division)
Professor Don Cameron	NHMRC
Mr David Clarkson	NHMRC
Mr Wayne Cornelius	ARPANSA
Ms Liz Cotton	NHMRC
Mr Tad Jarzynski	DCITA
Mr Ken Karipidis	ARPANSA Secretariat

2 ARPANSA, Committee on Electromagnetic Energy Public Health Issues (CEMEPHI), response to written questions on notice.

Mr Ian McAlister	Australian Communications Authority
Ms Leonie Tarnawski	Australian Communications Authority

National Health and Medical Research Council (NHMRC)

3.7 The research component of the Radiofrequency Electromagnetic Energy (RF EME) Program is managed by the National Health and Medical Research Council (NHMRC). The NHMRC is a national body which makes authoritative recommendations to Commonwealth, state and territory governments. It is regularly referred to for advice on prevailing public health, medical research and ethical issues, as well as providing practical advice to the community.

3.8 The NHMRC's role in the RF EME Program is to develop a research framework, determine priorities, call for funding proposals, make recommendations and ensure that the research is of a high quality and in the public interest. It requires that the research findings are submitted for publication in peer-reviewed scientific literature. The NHMRC does not manage the research it funds. This is the responsibility of the grant recipients and their institution.[3]

3.9 The NHMRC established a Radiofrequency Electromagnetic Energy Expert Committee (the Expert Committee) for the purpose of administering the research funding for the RF EME Program. The Expert Committee was formed pursuant to a Memorandum of Understanding (MOU) between the CEMEPHI and the NHMRC. This MOU specified the roles and responsibilities of the NHMRC and the CEMEPHI in relation to the research, and provided a framework for the EME research.

Where the Funds Have Been Allocated

3.10 Funding for the whole program has been made available at the rate of $1 million per year starting on 1 January 1997. Of the $1 million, $700,000 goes to the NHMRC for the research program and the remaining $300,000 covers the involvement in the WHO International EMF Project ($US50,000 per year) and also the public information program ($131,000 spent by June 2000).

3.11 The MOU between the CEMEPHI and the NHMRC provides that funds, which are not required for other parts of the Program, may be transferred to the research component. This occurred when the support function for the CEMEPHI was transferred from the Department of Communications and the Arts to ARPANSA and an additional $250,000, not required in the other parts of the Program, was allocated to the research component.

3 National Health and Medical Research Council (NHMRC), Submission 69, p 10.

Australian Research Component

First round of funding

3.12 On 25 October 1997, the NHMRC advertised in the national press for expressions of interest for research proposals to be received by 5 December 1997. Twenty-two expressions of interest were received covering a range of fields. The Expert Committee participated in a round table debate on the strengths and weaknesses of each proposal and arrived at an agreed rating for scientific merit. Seven highly rated proposals were short-listed and invited to submit full proposals.

3.13 The NHMRC arranged for peer review, including possible conflict of interest issues, of the full proposals. This involved both Australian and international grant assessors. All full applications each went to four assessors. Mr David Clarkson, Director, Research Development Section, Centre for Research Management, NHMRC described the assessment criteria:

> When examining this proposal versus that proposal, there is a list of criteria that we give to assessors and that the committee use – for example, the quality of the science: is it good science, is it good methodology, has it got ample sample size, are there enough subjects involved, are there enough mice involved? There is also the track record of the scientists: have they done work in this area before or is it something they have never done before, and have they got enough people on their team to do the specialised examination of the issues within the project – for example, have they got an epidemiologist, if that is required; have they got somebody who knows something about the dosimetry, which is fairly complex for a lot of the scientists because it is an area they are unfamiliar with; have they got somebody who is a medical statistician? Those sorts of things depend on the issue that they are looking at.
>
> So those are the issues: relevance, scientific importance, track record and, important in this particular area, is it strategically important, is it answering those questions? In the last call for proposals, we put on the bottom 'other areas that may be relevant'. There is a judgment made by the panel about relevance as we ask the assessors to make a judgment call on that one too.[4]

3.14 Four projects, two of which were pilot studies, were selected for funding in the first round, totalling approximately $1.4 million. Funds were quarantined to convert two of the pilot studies to full studies if results from the pilots indicated that this would be required.

3.15 Three of the research projects were announced in July 1998, following endorsement by the Minister for Health and Aged Care. The pilot studies were:

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4 *Official Committee Hansard*, Canberra, 8 September 2000, p 50.

- a case-control study of brain and other tumours in adults, conducted by Professor Armstrong, administered by the NSW Cancer Council. This 16 month pilot study received $90,000; and
- the effect of radiofrequency exposure on intrachromosomal recombination in mutation and cancer, conducted by Dr Sykes and administered by Flinders University of South Australia. This pilot study received $75,000.

3.16 The third project was an 18 month study on human volunteers testing the effect of 900 MHz radiofrequency radiation on human neuropsychological responses conducted by Dr Stough and administered by the Swinburne Institute of Technology, Victoria. This project received $50,000.

3.17 The fourth project was announced in September 1998. This project was to test the effects of GSM-like fields on tumour incidence in *Eμ-pim-1* mutant mice[5]. It was to be conducted by Professor Vernon-Roberts, administered by the University of Adelaide and received $1.122 million. This was a replication or confirmation study of research, funded by the Federal Government and Telstra and conducted in 1993-95 by the Royal Adelaide Hospital.

3.18 A report on the Professor Armstrong pilot study was reviewed by the Expert Committee and a decision made to fund a full, stand alone, four year study. The grant, totalling $1.2 million, was announced in December 2000.

3.19 Dr Sykes reported at the end of 1999. The findings from the pilot study did not support the hypothesis of the project and the Expert Committee decided there was no justification to provide further funds for a full study to test the same hypothesis with the same methodology.

3.20 The NHMRC informed the Senate Committee that Dr Stough's project is now complete and the final report is awaiting publication.[6]

3.21 Further details of these projects can be found in Chapter 2.

Second round of funding

3.22 In February 2000, the Expert Committee called for a second round of expressions of interest for radiofrequency electromagnetic energy research. It was able to do this when funds set aside for Dr Sykes' full study were not required. In addition, a decision had been made to reallocate funds earlier quarantined for an additional component to Professor Vernon-Roberts' study, which it was thought would be better spent elsewhere.[7] There were also monies transferred from other parts

5 A strain of genetically modified mice engineered to be susceptible to a particular type of cancer.

6 *Proof Committee Hansard*, Canberra, 2 March 2001, p 397.

7 The original application for this project proposed a large additional component, which had been kept under consideration for some time. This was for a similar study to that currently under way, using another mouse variant (*p53* mice). The NHMRC advised that the Expert Committee believed there was

of the Radiofrequency Electromagnetic Energy Program in line with the MOU between the NHMRC and the CEMEPHI (refer to paragraph 3.9 above). The second round of funding came to $530,000.

3.23 The second round endeavoured to address research areas that have been identified by the World Health Organization as still requiring attention. Research in the areas of neuropsychological and neurophysiological abnormalities was particularly encouraged by the NHMRC.

3.24 The NHMRC sought expressions of interest in April 2000. Eleven proposals were submitted (although some proposals incorporated more than one project) with one of the eleven proposals being ineligible for funding through the Radiofrequency Electromagnetic Energy Program because it would have been based and managed overseas.

3.25 The process for deciding which projects to fund was similar to that for the initial funding round. The Expert Committee met on 20 June 2000 to shortlist the expressions of interest, subsequently inviting full applications from six proposals. Five full applications (one applicant chose not to submit a full application) were received, peer reviewed, and considered by the Expert Committee.

3.26 The Expert Committee recommended two grants for funding which were announced by the Minister on 1 March 2001. The projects, totalling $522,575, were:

- human physiological responses to exposure to mobile phone type radiation. This study will be conducted by Dr Andrew Wood at Swinburne University of Technology. Funds allocated are $213,570 over three years; and
- effects of radiofrequency electromagnetic radiation from long term mobile phone use on vision and hearing. Associate Professor Paul Mitchell at Westmead Hospital will conduct this study. Funds allocated are $309,005 over two years.

Criticism of the research program

3.27 The Senate Committee received submissions which were critical of the research program. The criticism focussed on the amount of funds provided for the program; the length of time taken to get research results; the selection of projects for funding; and scientists whose findings have indicated in the past that there may be health and psychological effects from electromagnetic radiation have had their funding discontinued or made unavailable for the necessary experimental replication, or they have not been awarded grants at all.

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no justification for the second variant of mouse until the first study had been completed. So if there was something that came out of the *pim-1* study that indicated that another variant mouse study was required, then the Expert Committee would consider it at that time instead of holding the money virtually in embargo for another two years. NHMRC, Submission 69, p 8 and *Proof Committee Hansard*, Canberra, 2 March 2001, p 396.

Amount of funds

3.28 Witnesses argued that, in the light of the revenues earned by the Government from the telecommunications industry, and the large number of people exposed by the use of mobile phones in particular, a much larger sum should be provided for research into the health effects of electromagnetic radiation. The Electromagnetic Radiation Alliance of Australia (EMRAA) commented:

> This amount of funding for research into the health effects of EMR is paltry, given that the telecommunications industry generates millions of dollars annually for the government and many millions more from the sale of spectrum.[8]

3.29 According to Mr Stewart Fist, a journalist:

> The most generous characterisation that any reasonable person could put on the present government's $4.2 [sic] million funding for EMF research and public information about cellphone dangers, is that it is tokenism at its worst.[9]

3.30 The NHMRC provided to the Committee comparative information on grants which it distributes in other areas. In 2000, it distributed approximately $118 million in grants, of which approximately $42 million were new grants. It argued that the $700,000 per annum research component of the Radiofrequency Electromagnetic Energy Program was consistent with amounts awarded in the following areas:

- aetiology and neurobiology of depressive and bipolar disorders ($621,549);
- vascular biology in thrombosis ($813,386); and
- biological function of genes in the pathophysiology of Downs syndrome ($621,549).

3.31 A media release from the Minister for Communications and the Arts claimed that whilst there are public concerns about possible health effects of electromagnetic radiation, other health issues such as damage to skin through exposure to the sun, the development of breast cancer or death or injury because of road accidents are of greater concern.[10]

3.32 Dr John Moulder, a Professor of Radiation Oncology in Wisconsin, told the Committee that it becomes a political and social decision whether to divert resources from one area of inquiry into another:

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8 Electromagnetic Radiation Alliance of Australia (EMRAA), Submission 80, p 4.

9 Mr Stewart Fist, Submission 30, Appendix C, p 1.

10 National Health and Medical Research Council (NHMRC), Submission 69, Attachment 1, p 27.

> Sometimes, as soon as you start looking, you find something hazardous, but once some work has been done and it does not show any strong evidence of a hazard, then it is a political decision how much more time and money should be spent on this issue as opposed to all the other things out there that are possible or known hazards. I think that is a social or a political decision.[11]

3.33 The NHMRC received a smaller number of applications in response to the second round of funding and said:

> One can look at the number of applications we received for the second round. Eleven is not a lot, given the amount of interest in the area, so maybe we need to stimulate it in different ways …[12]

3.34 The NHMRC acknowledged that, with an increase in money, more research could be funded, but had reservations about the small number of researchers in this particular area in Australia. In addition, the one-off nature of the funding is seen as a problem by the Expert Committee and this aspect of the funding does not encourage researchers to specialise and become expert in the area.[13] According to Mr David Clarkson from the NHMRC:

> … good people are working in other areas and are not being pulled across to this area because of its limited career path …[14]

3.35 The Australian Mobile Telecommunications Association (AMTA) informed the Committee that if there were not enough funds to cover projects identified by the NHMRC as appropriate, it would look at funding them:

> I should draw your attention to the fact that in our submission we said that, were the NHMRC to identify research programs that were appropriate for funding and there was insufficient funding, the industry would be prepared to look at providing funding for those projects. But they would be projects identified by the NHMRC.[15]

3.36 There is consensus among stakeholders in this area, that more research needs to be conducted into the effects of electromagnetic radiation and the Committee recommends that the Government maintain a research program on an ongoing basis. This is necessary not only for the research findings that will be the result of such a program, but also to develop the expertise in this area in Australia and enlarge the pool from which researchers can be drawn.

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11 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 322-323.

12 *Official Committee Hansard*, Canberra, 8 September 2000, p 48.

13 *Proof Committee Hansard*, Canberra, 2 March 2001, p 403.

14 *Proof Committee Hansard*, Canberra, 2 March 2001, p 403.

15 *Official Committee Hansard*, Canberra, 8 September 2000, p 36.

3.37 Professor Philip Jennings, Professor of Physics at Murdoch University (in a personal submission) made the point that:

> … health research related to the effects of EMR is well behind the level needed to ensure that public health is not adversely affected by technological progress. This is partly a result of underfunding and partly due to the emphasis on ionising radiation in the past. We have very little experience of long term exposure of large numbers of people to the sorts of EMR doses we are now experiencing.[16]

3.38 The amount of funding was criticised as inadequate for independent Australian scientists to seriously explore the possibility of health problems caused by electromagnetic radiation, and the Committee Chair therefore considers that the level of funding should be significantly higher and adequate to deliver a structured program of research which is independent and of high quality and relevance.

3.39 Much of the controversy in the area arises from attempts to discredit studies because of their design or methodology or the fact they have not been replicated.

3.40 The CSIRO suggested that a figure of $60 million, based on a $10 levy on each mobile phone user, would be a generous amount of research funding:

> If Australia wants to do this sort of research then it needs to be adequately funded. Therefore, a levy seems one way to do that; there are others, I am sure. I think there are six million subscribers, so $10 is quite a lot. It adds up to $60 million. That is about the budget for my division, which is 400 people.[17]

3.41 Other submissions also advocated a levy on mobile phone users which would be used to fund research. Mr Les Dalton, a retired CSIRO Principal Research Scientist, advocated that there be:

> … a levy on users of mobile phones to provide the research funding. That would channel funds from the industry far better than direct handouts by carriers themselves; it is then at arms-length between the research and the funding source. A very small levy would provide a far greater research fund than anything the government has so far been prepared to offer.[18]

3.42 Mr Don Maisch, an electromagnetic energy activist, also suggested that there be a levy on the phone user:

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16 Professor Philip Jennings, Submission 122, p 1.

17 *Official Committee Hansard*, Sydney, 16 November 2000, p 230.

18 *Official Committee Hansard*, Melbourne, 22 September 2000, p 173.

> Considering the amount of profits that are being made by the industry, I think a small tax on mobile phone users, going back into research, is not really very much of a thing to ask.[19]

3.43 The Electromagnetic Radiation Alliance of Australia suggested that '[i]n order to avoid the difficulties of obtaining genuine results from credible science, there is a great need for independent research and independently administered funding'.[20] It recommended that:

- two funds be established, one to finance studies on the effects of telecommunications technology on health and the other to finance studies on the effects of powerline fields on health;
- funding for these be derived from all telecommunications companies and all power utilities;
- each mobile phone user be required to contribute $10 per annum to research the effects of mobile phone use; and
- money from these funds be allocated to research by independent panels comprising public health professionals and members of the community.[21]

3.44 Mr Fist provided the Committee with a proposal for an independent Commonwealth Institute of Radio/Environmental Health which could be incorporated within the CSIRO. He argued that this was necessary because:

> Currently the research being conducted into cellphone health problems around the world is scattered and the researchers often work in isolation, only meeting at conferences. Australian funding is piece-meal – the money is being scattered to a few institutions and researchers with little long-term strategy. [22]

3.45 Mr Fist suggested that this Institute should be funded on a user-pays basis, by a levy on all cellphones in Australia or on all mobile phone bills:

> People are spending on average $1,200 a year on these things. For God's sake, they should be able to spend another $5 or $10 a year on whether they are safe. You fund by a levy, and therefore it is not on the budget and not subject to budget cuts. You keep it independent within the CSIRO where people will trust it, where the money does not get sloughed off into other CSIRO research.[23]

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19 *Official Committee Hansard*, Melbourne, 22 September 2000, p 96.

20 Electromagnetic Radiation Alliance of Australia, Submission 80, p 8.

21 Electromagnetic Radiation Alliance of Australia, Submission 80, pp 8 and 9.

22 Mr Stewart Fist, Submission 30, Appendix A, p 2.

23 *Official Committee Hansard*, Sydney, 16 November 2000, p 202.

3.46 The Consumers Telecommunications Network suggested that research could be funded from the sale of Telstra but was not opposed to the idea of a consumer levy. Ms Corbin said in relation to a levy:

> I think $10 is probably a bit much. However, I do think consumers would be happy to have some form of levy. … The public wants to know whether mobiles have a detrimental effect. The most common question I get asked when people find out what I do for a living is, 'Do you know if mobile phones actually affect you?' There is a huge hunger out there to have that question answered. I think people would be happy to contribute to research and also to proper labelling.[24]

3.47 The Committee Chair considers that a levy would circumvent the problem alluded to earlier, where, to increase research in the electromagnetic radiation area, resources would need to be diverted away from other areas.

3.48 Submissions suggested that research funds should be raised from a levy on mobile phone users rather than on the carriers, in order that the research so conducted is at arms-length from the industry, to avoid implications of bias.

3.49 The Committee Chair is not persuaded that the means of raising funds is a determinant of independence. Rather the process for deciding which research receives funding must be at arms length and seen to be so.

3.50 Mr Les Dalton provided another reason for restricting the levy to mobile phone research rather than for other radiofrequency emitting equipment. He suggested that mobile phone users are a special case because they are so numerous and are subjected to intense levels of radiation.[25]

3.51 The Committee Chair considers that revenue raised from the mobile phone sector should primarily be used for such research but that it should be a matter for the body which administers the research program to determine whether research into radiofrequency emissions from other sources has relevance.

3.52 The Committee Chair considers that revenue for research from the sector should be linked to the numbers of users of mobile phones but holds the view that industry and Government should develop the fairest and most administratively effective system of collection.

3.53 One way of determining the amount of additional funding required in Australia for this research would be to draw on the total value of the expressions of interest which were lodged with the NHMRC:

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24 *Official Committee Hansard*, Sydney, 16 November 2000, p 219.

25 *Official Committee Hansard*, Melbourne, 22 September 2000, p 179.

Table 3.2

Value of applications for RF EME research

	Expressions of interest received	Full proposals received
First round of funding	$9,357,557	$4,334,443
Second round of funding	$3,103,985	$1,069,626

3.54 However, the Committee Chair considers this approach to be limited because an ongoing program of funding for research would likely produce a more substantial number of proposals.

3.55 The Committee Chair supports the concept of the CSIRO being the premium research body for this work but as the CSIRO pointed out, even though it has a watching brief on telecommunications radiation issues it does not have a budget to conduct research. Dr Haddad explained:

> … the Division of Telecommunications and Industrial Physics … has a lot of dealings with telecommunications carriers, but primarily in a very much more commercial role than the sort of area that Dr Barnett has been talking about. CSIRO has a choice these days. It is required to maintain its external income level at a reasonably high level for a research organisation and, as such, it has to choose the areas in which it works quite carefully. Appropriation funding has been flat; in fact, in real dollar terms, it has decreased significantly over the last few years. That makes it harder and harder to maintain a variety of areas of what I would call more fundamental research, if you like, which underpins all this sort of short-term tactical work that you can do to earn money. So we are forced to make choices. In this particular area, yes, it is of great public interest, but it harks back to the fact that I do not believe that, unless a significant amount of money is available, we will be doing anything more than tinkering around the edges. So my attitude would be: if you want it done, do it properly, or, essentially, keep a watching brief and stay out of it.[26]

Recommendation 3.1

The Committee Chair recommends that the equivalent of $5 for each mobile phone in use be collected annually for this purpose (approximately $40 million) and that the rate be reviewed after a period of five years.

26 *Official Committee Hansard*, Sydney, 16 November 2000, pp 227-228.

Recommendation 3.2

The Committee Chair recommends that funding for maintaining the NHMRC-administered research program be provided at $4 million per annum of the $40 million and that the balance be used by the CSIRO to establish a structured program of research and set up a specialised research unit for this purpose.

Length of time taken to produce research results

3.56 Submissions expressed frustration with the time taken to produce research results:

> The Council is concerned that almost four years have elapsed since the Federal Government provided the $4.5 million fund for EMR research with only preliminary research having been undertaken so far.[27]

3.57 The CSIRO pointed out, however, that the issue of effects of radiofrequency radiation is not going to be solved quickly or easily:

> I think the committee should be aware that this is not the sort of research work that you will get done by next month. This is a long, rigorous and arduous piece of work to establish cause and effect in this particular situation. You need epidemiological studies. You need all sorts of things that will take a significant length of time. You cannot have it finished by Christmas.[28]

3.58 The NHMRC and the CEMEPHI argued that their processes aimed to ensure that electromagnetic energy research, funded through the NHMRC, was of the highest standard, was independent, and addressed the most important scientific questions in relation to any health effects of exposure to radiofrequency electromagnetic energy.

3.59 Dr Barnett of the CSIRO, however, suggested that the NHMRC often takes a long time to distribute research funds:

> Once the Department of Communications obtained those funds from cabinet, they were essentially passed on to NHMRC because it was felt at the time – at least within government circles – that that was the expeditious way to do things. In fact, it did take rather a long time to get around to actually providing any funding for research. That is not atypical of NHMRC – the time frames are usually long.[29]

3.60 The NHMRC outlined for the Committee the steps taken which led to the allocation of funds and the conduct of the research. The draft Australian Research Agenda, developed by the CEMEPHI, was forwarded in August 1997 to the NHMRC

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27 Holroyd City Council, Submission 44, p 1.

28 *Official Committee Hansard*, Sydney, 16 November 2000, p 224.

29 *Official Committee Hansard*, Sydney, 16 November 2000, p 225.

as a basis for developing its research priorities. The Strategic Research Development Committee (one of the four principal NHMRC committees) and the CEMEPHI signed a Memorandum of Understanding (MOU) on 22 September 1997 to set out their respective roles and responsibilities. The MOU between the CEMEPHI and the NHMRC specified that the NHMRC should establish a Radiofrequency Electromagnetic Energy Expert Committee under its Strategic Research Development Committee. The Expert Committee was convened and research questions were refined in October 1997. The call for expressions of interest took place also in October 1997. Expressions of interest were received in December 1997, shortlisted applicants were invited to submit full proposals in February 1998 and full applications were sent for peer review in March 1998. Assessor reports were forwarded to applicants for their comments in May 1998 and the Expert Committee considered the peer reviews and rebuttals. It made its recommendations to the Minister in May 1998 who announced the successful grant recipients in July 1998.[30]

Influence of the telecommunications industry on the research

3.61 Some submissions suggested that the RF EME Research Program wasted funds on projects designed to spread industry-based propaganda:

> Much of the money from the 5-year research/public education program has been wasted on projects designed to spread industry-based propaganda and to cover up the existing research that shows a possible connection between electromagnetic radiation and health problems.[31]

3.62 It was contended that the telecommunications industry will try to influence research into electromagnetic emissions to show that there are no ill effects from its technology:

> If you are a researcher doing research that is being funded by industry, if you are coming up with results that are not what the company wants to hear, you will not get further funding. But if you give results that look good you tend to get further funding. So there is very much a bias to slant your research towards the person who is providing the funding.[32]

3.63 Some submissions have claimed that industry cover-ups and interference in the publication of research results, and selection bias in the choice of studies to be funded, are reasons for the failure to replicate many studies that have shown a relationship between EMR and biological and health effects. Mr Fist pointed out:

> On the question of replication, if a scientist does a study and produces a certain result, then replication needs to be done by someone else. … Independent universities are not going to fund the replication because their

30 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 399-400.

31 Mr Ray Winter, Submission 13.

32 *Official Committee Hansard*, Melbourne, 22 September 2000, p 101 [Maisch].

> interest is in advancing into new areas. The only people who have the money to fund replication when adverse effects are found are the cellphone companies and the government. The government does not fund it around the world and the cellphone companies have no interest in funding replication of adverse effects, at least not in public release, so you get pseudo replications.[33]

3.64 The Committee also notes the following observation:

> Scientists do not want to go out and do an exact replication. This is an enormous waste of time. What science is built on is that, if you do something and you claim a result, what is the implication? If I do it in a cervical cancer cell, does it imply that it will work in a breast cancer cell? So I can confirm a concept not by going and doing it in cervical cancer but I can do it in a breast cancer cell.[34]

3.65 Mr Dalton expressed concern about the lack of independence of scientific studies when research is carried out under a direct contract between the corporation and the research team. Mr Dalton claimed that under these arrangements 'the release to the public of the information about the research findings can, and at times has been, restricted or manipulated'.[35] Other submissions also stressed the need for research to be overseen by an independent committee and conducted independently of industry.

3.66 Mr Dalton referred to the 1997 Adelaide mouse study, the results of which, he claimed, had been delayed by a telecommunications company under a confidentiality clause in the research contract.[36] Mr Dalton advised that this study had indicated that the 'rate of tumour incidence in the mice increased over time, showing that the development of tumours is related to a measurable dose of radiation'.[37]

3.67 Mr Fist drew parallels between the operations of tobacco companies and telecommunications companies whereby, he alleged, both industries manipulate the research, discredit findings and researchers who produce unfavourable results, and employ various public relations techniques for managing the debate and influencing government policy. Mr Fist commented that:

> … especially in the United States but also in parts of Europe, particularly in Germany, there has been the development over the last years of a subset of the public relations industry which has specifically targeted science and scientists, which has systematically corrupted the presentation of evidence, which attempts to control a couple of scientific disciplines – mainly

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33 *Official Committee Hansard*, Sydney, 16 November 2000, p 198.

34 *Official Committee Hansard*, Melbourne, 22 September 2000, p 151 [Litovitz].

35 Mr Les Dalton, Submission 40, p 2.

36 Mr Les Dalton, Submission 40, p 2.

37 Mr Les Dalton, Submission 40, p 4.

> epidemiology and toxicology – and which very much controls what is now being called 'risk assessment'.[38]
>
> … the science in this country [Australia] is particularly good. The countries that stand out around the world are Australia, England and Sweden. The most corrupt science countries are America by far, Germany and some of the Scandinavian countries like Finland, which in the cellphone area depend totally on the cellphone industry for funding all sorts of research. In the States the government withdrew totally from funding research. The EPA and the FDA were both doing a lot of research. In fact, at one stage the EPA classed cellphones as a potential carcinogen. They got stopped from doing that and they got their research rights taken away from them. So since about 1994-95 until now research has been totally in the hands of the cellphone industry.[39]

3.68 Dr Michael Repacholi from the World Health Organization, however, claimed that the telecommunications industry has learnt not to repeat the experience of the tobacco industry when it funded research to support its product:

> … I think industry has got the message that they are the cause of the problem to start off with – it is their technology, their industry – and they are putting substantial amounts of money into this, there is no doubt. …
>
> We know about the tobacco industry but I think industry has learnt from that and they do not want to go through that again. That is my understanding. But we certainly have had industry saying early in the program, 'We have funded lots of projects but the people do not believe the results'. I say, 'What do you expect? If you were there dealing directly with the scientists then people will relate back to the previous experiences of other industry funding'. We recommended that that has to be a firewall. There has to be an independent panel that deals with the funding agency and the scientists …[40]

3.69 The Mobile Manufacturers Forum told the Committee:

> … we are striving to be open and responsive to consumer concerns about questions that have been raised about health issues. There is a very large scientific database in existence which is continually being reviewed, and the conclusions are consistent in confirming no health risk from mobile phone use. However, many of these reviews are calling for further research. We are taking the research call very seriously. … We have established principles within our research sponsorship to assure transparency.[41]

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38 *Official Committee Hansard*, Sydney, 16 November 2000, p 188.

39 *Official Committee Hansard*, Sydney, 16 November 2000, p 192.

40 *Official Committee Hansard,* Canberra, 31 August 2000, p 25.

41 *Proof Committee Hansard*, Canberra, 2 March 2001, p 361.

3.70 Although Dr Repacholi claimed industry was providing substantial amounts for research, the Australian Mobile Telecommunications Association (AMTA) advised the Committee its members are generally not undertaking research.[42] Furthermore, the Committee Chair fails to see how the industry's 'established principles' can 'assure transparency' and prefers Dr Repacholi's recommendations that research should be dealt with through an independent panel.

3.71 In convening the Expert Committee which administered the research funding, the NHMRC informed the Senate Committee, that it was particularly cognisant of the need to maintain very high standards to avoid conflicts of interest. The NHMRC said that measures to protect against conflict of interest were standard practice, but given the particular sensitivity of the electromagnetic radiation issue, the NHMRC refined its procedures for the EME process. These were consequently more stringent than those in place for other areas of the NHMRC at that time.[43]

3.72 Members of the Expert Committee were appointed on the basis of their recognised expertise in areas of science relevant to the EME research program. Committee expertise includes the fields of epidemiology, cancer biology, radiation physics, physical dosimetry and engineering, nuclear medicine, mathematical modelling, and neurology. Two representatives from the Strategic Research Development Committee who had not been involved in the EME area were nominated to independently co-chair the Expert Committee. A member with a background in, and knowledge of, consumer issues was also appointed.

3.73 Membership of the Expert Committee, and members' fields of expertise follow:

Table 3.3

NHMRC Electromagnetic Energy Expert Committee[44]

Prof Don Cameron (co-Chair)	Endocrinology - SRDC nominee
Prof Judith Black (co-Chair)	Respiratory/Thoracic - SRDC nominee
Dr Chris Bain	Epidemiology
Prof Tony Basten	Cancer Biology (resigned February 2000)
Prof Annette Dobson	Epidemiology/Biostatistics

42 *Official Committee Hansard*, Canberra, 8 September 2000, p. 35.

43 National Health and Medical Research Council (NHMRC), Submission 69, p 6.

44 National Health and Medical Research Council (NHMRC), Submission 69, p 5; and overhead presentation at Committee Hearing, Canberra, 2 March 2001.

Prof Kay Ellem	Cancer Cell Biology (resigned June 2000)
Dr Alan Harris	Cancer Biology
Prof Michael Halmagyi	Neurology (commenced June 2000)
Dr Ken Joyner	Radiation physics, physical dosimetry and engineering (expert observer)
Ms Michelle Kosky	Consumer issues - NHMRC nominee (resigned 2000)
Dr Fred Khafagi	Nuclear Medicine
Dr Colin Roy	Radiation Physics, physical dosimetry (observer from CEMEPHI)
Prof Colin Thompson	Mathematical modelling

3.74 The NHMRC believes that it has developed procedures to ensure that bias is not present in the selection of projects for funding:

> The NHMRC was invited to manage the research in recognition of its independence, the rigour of its peer review processes and the overall quality of the research it supports. The EME Expert Committee has no preconceived ideas in relation to possible health effects of mobile phones and related telecommunications equipment, wishing only to know the facts relating to this issue.[45]

3.75 Mr David Clarkson, Director, Research Development Section, NHMRC, was questioned by the Committee about whether any allegations had been raised at either the Expert Committee level or the more senior board level about actual bias or perceptions of bias in the allocation of funds. He informed the Committee that no allegation of bias has been raised formally at either level.[46]

3.76 The CSIRO commented that one member of the Expert Committee was a previous chairman of the New South Wales Cancer Council which received funding for one of the four projects approved by the Minister, and that this could be perceived as a conflict of interest.[47]

3.77 The NHMRC response to this comment was to inform the Committee that Professor Armstrong resigned from the Expert Committee before the call for the first round of funding. The NHMRC emphasised that it is a requirement that all potential appointees declare any personal or financial interest they have in the area of research under consideration. If appointees declare a conflict of interest, the Expert Committee

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45 National Health and Medical Research Council (NHMRC), Submission 69, p 5.

46 *Official Committee Hansard*, Canberra, 8 September 2000, p 51.

47 *Official Committee Hansard*, Sydney, 16 November 2000, p 227.

will consider how it can be most appropriately managed. All members of the Expert Committee are requested to declare any potential conflict on a regular basis.[48]

3.78 Some submissions to the inquiry pointed out that Dr Ken Joyner is a member of the Expert Committee even though he presently works for Motorola and previously worked for Telstra. Dr Joyner and the NHMRC defended this potential conflict of interest on the basis that he does not have voting rights on the Committee but acts as an expert adviser. According to Mr Clarkson from the NHMRC:

> We were obviously, as a secretariat, very concerned about a potential conflict of interest because it is a very emotive issue. We always are very conscious of conflict of interest anyway because we have only a small number of researchers in certain areas and so it is an issue that always occurs. All members have to specify any interest they may have in Telstra shares or whatever. In Dr Ken Joyner's case it was his membership of an organisation associated with industry. That has to be spelt out and if there is a conflict of interest that prohibits them being involved in the discussion, they are excluded from the discussion. If a decision is made that it is not peripheral but is pertinent to the issue being discussed at the time, they may be permitted to be part of the background discussion but excluded from voting. For example, in the case of Dr Joyner, he is not permitted to vote on the actual allocation of grant applications.[49]

3.79 The Committee Chair notes that any member taking part in the research funding process has the capacity to influence the Expert Committee and is of the view that greater efforts should be made by the NHMRC to ensure that the Expert Committee is and is perceived to be, at arms length from industry.

3.80 The Committee did not find evidence of industry bias within the NHMRC but the Committee Chair was nonetheless attracted to Mr Fist's suggestion that the CSIRO should be charged with setting up a 'premier research institute' whereby:

> … you have a way of concentrating on a single problem with all of these various scientists – the dosimetrics people, the molecular biologists, the normal biologists, epidemiologists and all of those people – in one institute where they can cross-fertilise, where they can collect and collate information. You would have a chance of doing something substantial. Until you do that, you really cannot set standards. All you can say is that we need to take precautions.[50]

3.81 Dr Haddad of the CSIRO advised that:

> We at CSIRO, particularly within Telecommunications and Industrial Physics, continue to maintain a watching brief on the scientific literature

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48 *Proof Committee Hansard*, Canberra, 2 March 2001, p 401.

49 *Official Committee Hansard,* Canberra, 8 September 2000, pp 51.

50 *Official Committee Hansard*, Sydney, 16 November 2000, p 202.

> pertaining to radiofrequency bioeffects, but we do not have the resources available at the current time to undertake active scientific research in this area so it is a watching brief only.[51]

3.82 Dr Barnett explained that:

> We have certainly been involved for many years, in fact since 1993 when the Department of Communications approached CSIRO to evaluate the status of research on biological effects of radio frequency radiation. We have been involved in analysing what was available, and I spend a lot of time visiting laboratories, speaking to scientists who were actively involved in research from 1993. That resulted in a report and monograph that was written, a fairly comprehensive monograph, published in 1994. So from that perspective we have certainly done a lot of literature research. As far as hands-on experimental research directly related to RF biological effects is concerned, we have not done any.[52]

3.83 Allegations were raised about the funding of the Vernon-Roberts study which is a replication of a Repacholi *et al*, 1997 transgenic mouse study which found a more than two-fold increase in lymphomas in Eμ-*Pim1* transgenic mice exposed to pulsed 900 MHz electromagnetic fields which simulated the digital mobile phone system.[53] According to Mr Fist:

> Not only has it taken years for this government to issue grants of any kind through the NHMRC, the decision has been made for the major grant to be given to the Adelaide Hospital for a replication study of its own work. Thus the group who did the original work, are being called upon to confirm that work. This is equivalent to having the police force investigating itself.[54]

3.84 According to the NHMRC however, this is not correct. The administering body for the Repacholi *et al*, 1997 Telstra study was the Adelaide Hospital. The administering body for the current study is the University of Adelaide and the project is being undertaken at the Institute of Medical and Veterinary Science, in Adelaide.

3.85 The NHMRC acknowledged that there was some overlap within the research groups at a junior and associated clinician level but said that, given the limited number of people in Australia with relevant expertise, it is to be expected that some overlap would occur.[55]

3.86 When it was put by the Committee to Mr Fist that only two people would be on the team from the previous study he said:

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51 *Official Committee Hansard*, Sydney, 16 November 2000, p 221.

52 *Official Committee Hansard*, Sydney, 16 November 2000, p 223.

53 Mr Stewart Fist, Submission 30, Appendix C.

54 Mr Stewart Fist, Submission 30, Appendix C, p 1.

55 Committee correspondence, letter from Robert Wells, CEO, NHMRC, dated 14 August 2000.

> That still largely defeats it. It is a bit like justice needing to be seen to be done. When studies are replicated, that study will be open to attack whatever happens. If it comes out the same as before, everyone is going to say they were covering their tracks. If it comes out totally different, they are going to be saying they are trying to get Telstra funds again. You really needed to shift that study away. The reason it was done in the same place is that Australia really has only one decent animal house capable of doing this work. You need very expensive exposure systems. … we need to develop a major facility for the study of long-term insidious effects. I do not hold that cellphones are a potential immediate threat to anyone; I think cellphone handsets against the side of the head have the potential to produce very large-scale increases in some specific diseases, mainly connected with immune systems, in the long term. That is what I think the evidence shows.[56]

3.87 Although peer-reviewed, the original study has been largely discounted by industry because it had not been replicated and its methodology criticised. The Vernon-Roberts study is a 'confirmation' rather than a 'replication' because the methodology has been changed and considerably improved, according to the NHMRC.[57] For instance, the mice are confined within metal tubes for the period of exposure instead of being free to move around. There is also an Italian study being done, which, to a large degree, mirrors the Vernon-Roberts study:

> The importance of the second study being done by the Italians is that, if they come out with findings that are similar using the same methodology, you can have a greater degree of confidence in the results than in one study alone. That is just a scientific method.[58]

3.88 Dr Stan Barnett from the CSIRO, commented that there were many parties with an interest in this study being replicated, because of the significance of its findings and that the cost was quite modest for a whole-of-life rodent study:

> I guess it would have come as no surprise to anybody who has been involved in this area that the Repacholi mouse study would be repeated in some form. Clearly that was a very important finding, and there is lots of pressure – scientific, political and others – to ensure that that work is continued in some way. So I do not think it is surprising that that Adelaide study was funded. One of the difficulties with doing that sort of research is that it is certainly expensive. I think the funding of about $1.1 million that went to the Adelaide study was quite modest for a whole-of-life rodent study.[59]

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56 *Official Committee Hansard*, Sydney, 16 November 2000, p 193.

57 *Official Committee Hansard,* Canberra, 8 September 2000, pp 48-49; *Official Committee Hansard, Canberra*, 31 August 2000, pp 10-11; and *Proof Committee Hansard*, Canberra, 2 March 2001, p 317.

58 *Official Committee Hansard*, Canberra, 8 September 2000, p 49 [Clarkson].

59 *Official Committee Hansard*, Sydney, 16 November 2000, p 223.

Scientists who have found effects were not awarded grants

3.89 Reports have appeared in the media suggesting that the NHMRC was failing to support some of the most promising lines of inquiry in its attempts to discover any link between radiofrequency radiation and health effects.[60] Dr Sykes' pilot study, for which funds were not provided for a full study, was cited as one example. The NHMRC explained to the Committee that Dr Sykes' pilot study was not converted to a full study because results had failed to support its hypothesis. Dr Sykes had acknowledged that this was the case but argued that the effects found in the pilot were nonetheless significant and warranted further study.

3.90 Dr Barnett advised the Committee that the CSIRO was one of the organisations which had not been successful in its applications for funds:

> We did apply to the NHMRC and we had two projects short-listed out of the six that were short-listed. Unfortunately, odds seem to be against us. Four of the six that were short-listed were funded and we were not. I do have ongoing research allied to this area in developing specifically radiation sensitive biosensors. That work is carried on outside of Australia. It is undertaken and sponsored through the United States Air Force. They apparently are more interested in our research than Australia is.[61]

3.91 In detailing the study proposals, Dr Barnett said:

> Essentially we had two types of projects that we submitted as expressions of interest, and both of those were short-listed. They involved looking at the potential effects of radiofrequency radiation on DNA and cancer production in two different systems. One was an animal system, where we were looking at repeating, I believe, a very important research finding which has been largely ignored, which was finally published in 1992 by Chou and others. That work was actually undertaken at the Brooks Air Force Base in San Antonio. That study looked at simply exposing rats to 2450 megahertz of radiation throughout their lives.
>
> When the data was analysed for tumour development in the exposed versus controlled animals, it turned out that, depending on how you chose to analyse the data, you got either a negative or a positive result. The study has been largely referred to as providing a negative result. It was only negative if you separated out each type of cancer and then looked at the difference in numbers for each type of cancer. Clearly, because they only used a couple of hundred animals, when it was broken down into all the different types of cancer, the numbers that were being compared were extremely small, so the statistical power would be pretty poor. When they compared the incidence of primary malignancies between the two groups there was a fourfold increase in the exposed group.

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60 *Sydney Morning Herald*, 18 December 2000, p 10.

61 *Official Committee Hansard*, Sydney, 16 November 2000, p 223.

We felt that was a pretty important study. Because that study had been largely ignored, and because my colleagues at Brooks Air Force Base agreed to work with me, we thought that it would be an interesting one to try to duplicate, with some improvements on the exposure conditions but essentially using the same laboratory set-up and looking at other indicators of chromosomal damage such as the micronucleus assay, which has now just this year become an important issue because there have been some publications of positive effects in that area.

The other study was looking at using what we know as a radiation sensitive cell line, which has been specifically developed, again with that organisation. One of the biggest failings of all cellular studies is that, largely, they either use highly transformed cell lines which are very sensitive to almost anything, or they use cell lines which are general laboratory, fairly robust, cells like lymphocytes. Nobody bothers to try to synchronise the cells. It is well known in radiation biology that cells respond to radiation at specific periods in the cell division cycle. Our proposal was to use a fairly complex system which would allow us to use what we know as a radiation sensitive cell line and to synchronise it so that we only exposed it in G1, where we know - because of 30 years of background work – this particular cell is highly sensitive to radiation. It is deficient in DNA repair enzymes, and we know that, if you are going to produce any kind of impairment of DNA repair which would be manifest as single strand breaks as per the Henry Lai study, this would be an opportunity to use the most sensitive available end point that we know of to test that scenario.

The result of the expressions of interest were that the committee in its wisdom thought that the two studies that we were proposing were so similar – we found that hard to believe, but they seemed to think that they were similar – that we should combine them into one study and submit that. We chose to ignore that direction, because they clearly are not similar, and decided against doing the whole-of-life animal study. Also, suspecting – or, in fact, knowing – that someone else had submitted to do a repeat of the Repacholi study, we thought that, because of the amount of money involved, there was no way the NHMRC were going to fund two whole-of-life rodent studies. So we put in our submission on the basis of the radiation sensitive cell line that we have and the outcome was that we were not funded. I have, incidentally, continued to do that work to develop that radiation sensitive line further. Again, under sponsorship of the US Air Force, I spent some time over there last year. But we have not yet obtained funding to use it as an end point for RF radiation. We have used it for ionising radiation.[62]

One of the concerns that was expressed, certainly to me [by NHMRC], was that the committee did not want to see any research done outside of Australia because this was supposed to be an Australian research program. More importantly, they did not want any funding to go outside of Australia.

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62 *Official Committee Hansard*, Sydney, 16 November 2000, pp 225-226.

> My proposal made it absolutely clear that none of the funding was being used outside. I had established a collaborative research program with, again, partners in the US Air Force. They were prepared to do their side of the program at no cost to us or the NHMRC program. That was made pretty clear in my submission, but it was used as one of the reasons given – there were a couple of reasons given – as to why they chose not to fund that particular project.[63]

3.92 The NHMRC informed the Committee that it was asked to coordinate the research component of the EME program in recognition of the rigour of its peer review processes and overall quality of its research effort. Selection of all grants is made through a competitive process and recommendations for funding are made on scientific merit and ability of projects to meet the objectives of the EME program.[64]

3.93 The NHMRC argued that if a researcher is unable to get funds under the Radiofrequency Electromagnetic Energy Program, there are other sources of funds available. An annual grant round in December is open to any researcher to put in a proposal in any field.

3.94 On the other hand, the RF EME Research Program falls into the category of research which is required to meet a specific need:

> … what we call strategic research. These are areas identified as underdone or needing additional support and encouragement, and a small amount of money is allocated to that research. In those areas, the research questions are more specifically defined, with an orientation to getting results as quickly as possible.[65]

3.95 Dr Barnett of the CSIRO, however criticised the lack of a 'sensible structured program of research':

> Research has been sporadic. The results have been controversial and contradictory. It is not really surprising. Unless you have a properly structured and directed system of research, you will not overcome the initial problem of the undirected sporadic bits of research that are carried on, sometimes not particularly well. Clearly if you pay peanuts you get monkeys, as the old saying goes. If you do not provide adequate or proper resources, you are being extremely optimistic in expecting a decent outcome.[66]

3.96 In answer to the Committee's question as to whether CSIRO would be well placed to head up an RF radiation research effort, Dr Haddad said:

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63 *Official Committee Hansard*, Sydney, 16 November 2000, p 225.

64 *Proof Committee Hansard*, Canberra, 2 March 2001, p 400.

65 *Official Committee Hansard*, Canberra, 8 September 2000, p. 48.

66 *Official Committee Hansard*, Sydney, 16 November 2000, pp 223-224.

> We would certainly be interested in looking at coordinating such an effort, provided we could be assured that we could get somewhere within a finite time.[67]

3.97 Dr Peter French raised the issue of difficulty he and Professor David McKenzie have had in accessing funds for their joint research:

> We have been struggling to raise funds. … I believe that the funding difficulties are attributable to a number of problems and that is mainly to do with the fact that it is a cross-disciplinary field: it does not fit neatly into the NHMRC or the [Australian Research Council] – it crosses both. It is an area of investigation which five years ago was certainly quite obscure. It has now become of much greater interest.[68]

3.98 Professor McKenzie added:

> I think this field is one of the most difficult things to get support for that I have experienced in my scientific career. I have had no success in being funded for this work. Although we have tried jointly and separately for many years, we have not succeeded in securing adequate support for our work. …
>
> I think that it is partly the interdisciplinary nature of it, the controversial nature of it. It tends to raise eyebrows when you are working in interdisciplinary areas without supposedly adequate qualifications in all fields. But, together, I would contend that Peter [French] and I have more than adequate qualifications. In fact, we now have a significant track record together, so I think we should be considered expert in the field; nevertheless, it proves and remains difficult.[69]

3.99 Dr French and Professor McKenzie expanded on the usefulness of the disciplines of cell biology and physics coming together in EMR research:

> **Dr French**: It is essential in this area. I know not very much about electromagnetic physics, and I know a lot about cell biology. David is in a reverse position. For this area, which requires a complex understanding of both issues, given the reductionist way science goes, it is very hard to get that expertise in one group or one institution. Certainly, it has been of great help assisting in devising exposure systems that can seek to answer the sorts of questions that David has raised and to characterise the exposure systems that we have used in the past.
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> **Prof. McKenzie**: While I am not expert in cell biology and Peter is not expert in electromagnetic fields, we are fortunate in being able to understand

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67 *Official Committee Hansard*, Sydney, 16 November 2000, p 224.

68 *Proof Committee Hansard*, Sydney, 16 November 2000, p 266.

69 *Proof Committee Hansard*, Sydney, 16 November 2000, p 266.

> each other's language. We interface very well and come up with new science because of this ability to understand each other's language.[70]

3.100 It is not the role of the Senate Committee to advocate which projects should or should not have been awarded grants, however it would appear that a greater pool of available research funding would help overcome many of the criticisms which arise when research proposals do not receive funding.

3.101 The Committee has not found evidence that the NHMRC has been deficient or biased in its allocation of the research funds.

World Health Organization Electromagnetic Field Project

3.102 The World Health Organization (WHO) is coordinating an international response to the various electromagnetic fields issues through its International Electromagnetic Fields (EMF) Project. This project, established in 1996, involves over 45 countries and eight international organisations. It provides a research coordination role with an emphasis on determining research needs. The second part of the Australian Radiofrequency Electromagnetic Energy Program is an annual contribution of $US50,000 to the WHO project.

3.103 The budget of the World Health Organization International EMF Project is $US600,000 per year. Contributions to the project are voluntary. The costs in Australian dollar terms, of Australia's contribution to the project are shown below:

Table 3.4

WHO Contribution[71]

Time Period	**Cost ($A)**
1996/97	$64,000
1997/98	$78,000
1998/99	$76,000
1999/00	$87,000
Total	**$305,000**

3.104 The WHO is currently coordinating approximately $100 million worth of research world wide.[72] It will assess the health and environmental effects of exposure to static and time varying electric and magnetic fields in the frequency range 0 - 300 gigahertz (GHz), with a view to the development of international guidelines on exposure limits.

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70 *Official Committee Hansard*, Sydney, 16 November 2000, pp 265-266.

71 Electromagnetic Energy Public Health Issues Committee (CEMEPHI), Submission 127, p 16.

72 *Official Committee Hansard,* Canberra, 31 August 2000, p 2.

3.105 When Dr Michael Repacholi appeared before the Senate Committee on 31 August 2000, the WHO EMF project had completed its initial literature reviews and was in the research period which he anticipated would last about three years.[73] Dr Repacholi emphasised that it takes time to do the research. The project is due to end in 2005 when the results from all the research projects will be analysed and a final report will be published.

3.106 Three of the initial four studies funded by the NHMRC form part of the international agenda for research: Professor Vernon-Roberts' study is one of two replications of the Repacholi *et al*, 1997 mouse study - another replication study is being done in Italy; Dr Stough's project addresses components of the neurophysiological area, identified by the World Health Organization as requiring research; and Dr Armstrong's study forms part of a large scale International Agency for Research on Cancer (IARC) mobile telephone epidemiological study which is expected to cover nine countries in Europe plus five others.[74]

3.107 The NHMRC call for the second round of research funding was designed to address outstanding issues identified in the WHO Research Agenda.

3.108 The Committee was advised that if Australia is to maintain research into the effects of electromagnetic radiation, any results showing effects from radiofrequency radiation would likely require replication and verification in other independent laboratories. It is therefore important to maintain links with overseas institutions and to continue and extend active participation in the WHO program, which will enable the results of many studies to be pooled and analysed.

Public Information Program

3.109 The third component of the Radiofrequency Electromagnetic Energy Program is the Public Information Program. This component has involved determining the information that is required by the public, obtaining the details and presenting it in a clear and concise manner.

3.110 The funds expended on this component of the RF EME Program appear below:

73 *Official Committee Hansard,* Canberra, 31 August 2000, p 2.

74 National Health and Medical Research Council (NHMRC), Submission 69, p 23.

Table 3.5

Information program costs[75]

Time Period	Cost ($A)
1996/97	$24,000
1997/98	$81,000*[76]
1998/99	$12,000
1999/00	$14,000
Total	**$131,000**

3.111 Criticism of the lack of information available on the potential risks associated with electromagnetic radiation was expressed by witnesses and submissions to the inquiry.

3.112 Some submissions referred to the contradictory information being presented to the public from the government and industry on the one hand claiming that there is no substantiated evidence that mobile phone base stations or using mobile phones will cause adverse health effects, and the print and electronic media on the other, which report studies that show biological effects and epidemiology which suggest the potential for adverse health effects from radiofrequency radiation.

3.113 Mr Stan Stanfield advocated that there be regular reports to the public regarding mobile telephones and telecommunications towers. In addition, he felt that there is insufficient information on research findings being made available to the public:

> Why isn't the public being told more about these connections, and what is being done about this specific research matter? … does using a hands-free kit create a greater risk than not using one?[77]

3.114 Similar concerns were raised in relation to television towers. Mrs Leanne Noakes stated:

> Inconclusive as results may have been so far, the public should be given the opportunity to make an informed decision for themselves and their families' own well being. The government has an obligation to inform the public fully of any possible health risk. People are being told that the television towers are perfectly safe at the distances they have been placed to residents

75 Committee on Electromagnetic Energy Public Health Issues (CEMEPHI), Submission 127, p 16.

76 Includes $73,000 for the Measurement Program (part 1).

77 Mr Stan Stanfield, Submission 36, p. 1.

> and schools etc. This is not a truthful answer and does not give people the opportunity to make their own informed decision. The truth is society does not know if they are safe and current research in fact indicates there may well be adverse effects on people living in close proximity to the various telecommunication facilities … The public have a right to know and a right to make our own informed decision on the safety and welfare of our families. To do this, information must become freely available to the public without any bias or concealment.[78]

3.115 The Committee sees a great need for a public information program to accurately inform the community of radiofrequency issues. It can be a highly technical area with concepts which are difficult to understand for the professional in the area, never mind the layperson. Even here, however, the Government's program has been criticised:

> There is a need for much greater public awareness about the issue of EMR. However, it is important that this information be independent. As the telecommunications industry and the government benefit substantially from the proliferation of telecommunications technology, they are neither independent nor reliable sources of information. They must not be promoted as such.[79]

3.116 Some submissions criticised the Public Information component of the Government's program, particularly since the fact sheets were published ahead of any of the research program being put into effect. Some argued that the Government was misusing the $4.5 million fund by spending $12,483.75 to brief local and state governments in February 1997, as a part of the wider briefing on network rollout activities. According to the Electromagnetic Radiation Alliance of Australia:

> A good proportion of the $4.5m research fund was squandered on an expensive and ill-directed public relations exercise. …
>
> However, public information campaigns must not be funded from the meagre $4.5 [million] research allocation.[80]

3.117 These comments may show that the Public Information Program has not been a success in informing the public. ARPANSA offered the view that it is difficult to address the concerns of people who are particularly worried about possible health effects of EMR, other than by one-on-one direct interaction over a period of time. ARPANSA says that it, and other agencies, are devoting resources to talking directly to people with particular concerns. The Committee was unable to verify the effectiveness of this one-on-one communication.

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78 Mrs Leanne Noakes, Submission 144, p 3.

79 Electromagnetic Radiation Alliance of Australia (EMRAA), Submission 80, p 36.

80 Electromagnetic Radiation Alliance of Australia (EMRAA), Submission 80, p 4.

3.118 The CEMEPHI advised that it consulted with consumer focus groups, public health associations and the general public. It reported that the Australian public's awareness and concern about the possibility of adverse health effects from long-term exposure to radiofrequency emissions from telecommunications had been stimulated and heightened by the increasing visibility of base stations and hand-held mobile phones. The problem was said to be exacerbated by the perceived absence of balanced public information on the question. Mobile phone base station towers provided a frequent visual reminder of a possible health risk and carried an element of environmental pollution with aesthetic, property value and health implications.[81]

3.119 ARPANSA informed the Committee that current information regarding EMR has been disseminated to the public through the following channels:

- fact sheets and other information on the ARPANSA website;
- distribution of hardcopy versions of the fact sheets;
- responding to telephone inquiries;
- consulting in public meetings;
- participating in seminars and conferences; and
- the ACA in collaboration with ARPANSA has recently developed a poster outlining the facts concerning base stations and EMR.

Fact sheets

3.120 In February 1997, in response to public concerns, the CEMEPHI released a set of fact sheets which provided detail on the Government's Radiofrequency Electromagnetic Energy Program, potential health effects of electromagnetic energy emissions and other related issues.

3.121 The fact sheets are:

- 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?;

81 Electromagnetic Energy Public Health Issues Committee (CEMEPHI), Submission 127, p 14.

> The weight of national and international scientific opinion is that there is no substantiated evidence that RF emissions associated with living near a broadcast or mobile phone tower poses a health risk.
>
> To date, the only health effect that has been proven to exist as a result of exposure to RF EME relates to heating of part or all of the body. This is known as the thermal effect, and the Australian exposure standard AS/NZS2772.1(Int):1998, which sets public and occupational limits of exposure to radiofrequency radiation, is designed to avoid adverse heating effects where people are exposed to RF EME.[82]

and

- The standards making process and AS/NZS2772.1(Int):1998 (under revision).

3.122 These fact sheets are available from the CEMEPHI website and are sent out on request. In addition, the fact sheets are distributed at public meetings, seminars and conferences. The website also provides a link to ARPANSA's report on the measurement of levels of radiofrequency radiation from GSM mobile phone base stations.

Base station radiofrequency measurement program

3.123 At the state and territory briefings in 1997, local councils were invited to nominate two mobile telephone base station sites in major population centres in each state and territory that were of concern to local communities. ARPANSA was asked to carry out a survey of the radiofrequency electromagnetic energy emissions (RF EME) in the vicinity of these base stations. The Public Information Program funded this site measurement program.

3.124 Measurements were performed at 14 different locations throughout Australia. Although the primary focus of the ARPANSA study was to measure the radiofrequency emission levels from GSM (Global System for Mobile Communication) base stations, fixed site environmental measurements from other radiofrequency sources were also recorded, including the analogue mobile phone system (AMPS), VHF TV, UHF TV, AM radio, FM radio and paging.

3.125 The results of the survey showed that the radiofrequency emissions from GSM base stations were several orders of magnitude below the maximum permitted limit in the Australian Standard. Measurements showed that exposure levels are generally less than one per cent of the exposure limits recommended by the Standard.[83]

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82 Committee on Electromagnetic Energy Public Health Issues, Fact sheet, *What about telecommunications towers, and are there any health effects?*, May 1998.

83 A worst case radiofrequency electromagnetic energy power flux density* prediction, based on the measurements from GSM base stations, was 0.178 microwatts** per square centimetre (0.178 $\mu W/cm^2$). This

3.126 Dr Michael Repacholi made the point that despite the fact that emissions from mobile phone base stations are 1,000 or 10,000 times below the levels recommended in standards, they get singled out:

> I know there is pressure by people, but the pressure is really because the base stations are ugly-looking things. They are in people's living environments – probably by schools – and people do not want anything happening to their children, which is absolutely right, so they pick on a technology. They do not worry about the paging transmitters, because the paging transmitters are much smaller, but they emit much higher levels than base stations.[84]

The future

3.127 A major on-going activity for the CEMEPHI is to provide the public with information that reflects current scientific opinion and the most recent research. The CEMEPHI has indicated that specific future activities to be engaged in include:

- assessing ongoing research;
- assessing the UK Independent Expert Group on Mobile Phones Report (the Stewart Report);
- drafting new and revising current fact sheets;
- establishing a searchable database of quality research publications;
- improving the webpage to facilitate public access; and
- investigating and/or developing a multimedia information package.[85]

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level is at least 1,000 times below the 200 μW/cm^2 exposure limit in the Standard. Also, the average radiofrequency exposure level from GSM base stations is considerably less at 0.0016 μW/cm^2 which is at least 100,000 times below the 200 μW/cm^2 limit of power flux density permitted by the Standard.

Measurements of the fixed site environmental radiofrequency electromagnetic energy power flux density levels indicate that, relative to the maximum exposure limit permitted in the standard, after adjusting the exposure limit with respect to the frequency of the signal, the highest environmental radiofrequency exposure was FM radio (0.0259 μW/cm^2), which is about 7,000 times below the 200 μW/cm^2 limit of power flux density.

[Line P, Cornelius W, Bangay M, and Grollo M, *Levels of Radiofrequency Radiation from GSM Mobile Telephone Base Stations*, Australian Radiation Protection and Nuclear Safety Agency, Technical Report 129, p 1, January 2000.]

* Radiofrequency (RF) power flux density is the rate of flow of RF energy per unit surface area expressed in watts per square metre (W/m^2).

** A microwatt (μW) is a unit of power equivalent to one millionth of a watt (W). (1 μW = 1/10^6 W)

84 *Official Committee Hansard,* Canberra, 31 August 2000, p 14.

85 Electromagnetic Energy Public Health Issues Committee (CEMEPHI), Submission 127, p 16.

3.128 The Senate Committee supports these activities but considers that there is scope for improvement in the CEMEPHI's website in the information available to the general public. The CEMEPHI's website, which at present only includes the fact sheets listed above, should be regularly updated to reflect ongoing developments in EME research and standard setting and there should be advice to the public as to where people can go if they consider that they suffer from electromagnetic emissions related effects. It would also be useful if the CEMEPHI advice to Government was tabled in the Parliament.

3.129 Many submissions to the inquiry compared the seemingly unrelated Bovine Spongiform Encephalopathy (BSE) crisis in Europe, asbestos and the tobacco industry to the electromagnetic radiation debate. Whatever the health effects from electromagnetic radiation, the Government needs to recognise that public trust in governments and industry to say what is safe and what is not, has been seriously undermined by assurances and fact sheets which do not generally reflect the level of uncertainty about the safety of cellphones identified in so many scientific studies.

3.130 In this respect, the Government has a responsibility to provide independent, honest, competent advice to the general public about radiofrequency issues. The Australian Government could spend millions of dollars on an information program, but if that information is not believed by the general public, the funds are wasted.

3.131 Mr Les Dalton suggested that a key to minimising exposure from radiofrequency emissions to individuals and the community is an informed public. He advocates that there be a national 'prudent user campaign', not unlike the Quit campaign directed towards smokers.[86]

3.132 The funding for the Radiofrequency Electromagnetic Energy Program runs out at the end of the 2000-01 period. Research worldwide into health effects of radiofrequency radiation is ongoing and the major literature reviews of the World Health Organization from the International EMF Project will not be completed until 2005. The Committee considers that there is an ongoing role for the CEMEPHI to monitor developments in this area and to more widely provide information to the public.

86 *Official Committee Hansard*, Melbourne, 22 September 2000, p 173.

CHAPTER 4

AUSTRALIAN STANDARD ON RADIOFREQUENCY FIELDS EXPOSURE LEVELS

Introduction

4.1 Uncertainty about potential of low intensity, long-term exposure to RF from telecommunications technology was found by the Committee to be the basis of the continuing argument for a sensible precautionary approach (principle). With the inadequate research data currently available, it has not been possible to estimate or quantify with any degree of accuracy the extent of a safety margin that needs to be prescribed in standards to be properly protective of the risk to the public.

4.2 Central to the question of the adequacy of our standards was whether or not they dealt with non-thermal emissions which have been shown by a growing body of research to show biological effects. Dr Michael Repacholi of the World Health Organization explained that the scientific studies on which our standards are set were observations of behavioural change in primates exposed to heat emitting devices. The Committee Chair found the progress of standard development to have been somewhat arbitrary and inadequate in dealing with non-thermal effects.

4.3 The Committee stresses in Chapters 3 and 4, the necessity for research to be carried out into the mechanisms of interaction of telecommunications frequency microwaves with biological tissue. This research must operate independently of influence by industry, government or regulatory bodies. Without basic science data the Committee found that it is not possible for anyone to predict what adverse health outcomes might occur.

Development of the standard

4.4 The Australian Standard, first published in 1985, deals with human exposure to radiofrequency fields. It was developed and subsequently revised by a technical committee of Standards Australia. The technical committee did not reach agreement on the last revision of the Standard in 1999, which sought to introduce the more lenient ICNIRP Guidelines, and the responsibility for setting a new standard was transferred by the Government to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) which will formally adopt the Standard as an ARPANSA standard and incorporate it into its regulations once it is accepted by the ARPANSA Radiation Health Committee.

4.5 In the meantime, both ARPANSA and the Australian Communications Authority have legislative instruments in place to limit human exposure to radiofrequency fields. These instruments (Radiocommunications (Electromagnetic Radiation — Human Exposure) Standard 1999 and Australian Radiation Protection

and Nuclear Safety Regulations) are based on the limits previously contained in the interim 1998 standard (AS/NZS 2772.1(Int):1998). These limits represent a weakening of protection for both occupational and public exposure.

Basis of Radiofrequency Standards

4.6 Radiofrequency signals were first used in 1895 and by the early 1920s broadcasting was becoming commonplace. At this time, research was beginning to probe the potential for biological effects of radio waves, effects on the nervous system, and other observations of harm such as localised burns and electric shocks caused by direct contact with a conductor.

4.7 During and after the Second World War, the effects of exposure to radiofrequency radiation became a matter of intense study particularly in the then Soviet Union. Over time, military applications became more powerful and the frequency range used grew. As higher power uses of radiofrequency developed, its ability to cause serious burns became evident. The US Military devised criteria based on tolerable thermal loadings

4.8 According to Dr David Black, a medical practitioner, specialist in the health effects of radiofrequency radiation, and telecommunications industry consultant, in the early 20th century there had not been the same concern about radiofrequency radiation as there had been about ionising radiation, and it took longer for controls to be put in place:

> Right up until the Second World War, people accepted that RF could cause burns and electric shocks at high levels, but it was not really until after the Second World War and the 1950s that people started thinking that standards were needed to control these fairly obvious, and what are known as, direct effects. Standards were developed originally on a bit of a rule of thumb by just taking power flux density levels which seemed to be safe just based on anecdotal experience at the time. Those formed the first standards back in the 1950s.[1]

4.9 The intensity, (or power density), of electromagnetic fields can be expressed in terms of a unit of power relative to area (eg watts per square metre - W/m^2 or milliwatts per square centimetre - mW/cm^2)[2]. It was recognised that experimental animals died quickly at exposures of 100 milliwatts per square centimetre (100 mW/cm^2) and that the primary mechanism for injury was related to excess heating resulting from the absorption of the microwave energy in various tissues within the body.

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1 *Official Committee Hansard*, Canberra, 8 September 2000, p 56.

2 A watt is an electrical unit of power.

1 watt (1 W) = 1 000 milliwatts (1 000 mW) = 1 000 000 microwatts (1 000 000 μW)

1 W/m^2 = 0.1 mW/cm^2 = 100 $\mu W/cm^2$

4.10 In 1953, the US Navy adopted a maximum continuous exposure limit of 10 milliwatts per square centimetre (10 mW/cm^2) for all radiofrequency and microwave frequencies in use. This limit avoided burns and was a tenth of the level where short term fatal effects had been observed in experimental animals. The level is equivalent to 10,000 microwatts per square centimetre (10,000 $\mu W/cm^2$). This exposure level was later accepted by the entire US military and, in 1966, by the American National Standards Institute (ANSI).

4.11 The concept of safety in these early military and later ANSI standards was very basic and the concepts of dose that are used today are still based on thermal or heating effects and the SAR concept of dosimetry that is applied is flawed.

4.12 According to the ARPANSA draft standard,[3] early exposure standards were inadequate because they failed to account for important physical aspects of electromagnetic wave interaction with the body. In addition to the magnitude of the applied fields, absorption of radiofrequency energy depends on the physical geometry of the body relative to the direction of the applied fields and also upon frequency dependent electrical properties of the absorbing tissue. In particular, the body, or parts of it, can act like a tuned antenna with specific radiofrequency bands. This concept still fails to take into account more subtle interactions with biological systems that have nothing to do with the effects of absorbed energy being turned into heat.

4.13 The most damaging frequencies according to the SAR dosimetry model are those at resonance range of the human body which occurs at frequencies between about 30 megahertz (30 MHz) and 300 megahertz (300 MHz). This means that electromagnetic fields in this frequency range approach or coincide with the natural frequencies in the human body. This maximises their penetration of tissue and the absorption of energy in the body. The precise resonant frequency varies with individuals depending on their size and their orientation in relation to the field. An average man in free space has a resonant frequency of about 66 MHz. For taller individuals, the resonant frequency is somewhat lower, and for shorter adults, children, babies and seated individuals, it may exceed 100 MHz.[4]

4.14 Dr John Holt, Medical Clinician and Director of the Microwave Therapy Centre in Perth, pointed out in his evidence that cancer is electrically conductive, and that cancer, when exposed to 434 MHz, will resonate and fluoresce. Dr Holt informed the Committee that Professor Joines of the US discovered that at 180, 200 and 300 MHz cancerous tissue was six times more conductive than normal tissue.

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3 ARPANSA Radiation Protection Standard, Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, Draft for public comment, Schedule 1, Rationale, p 27.

4 ARPANSA Radiation Protection Standard, Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, Draft for public comment, Schedule 1, Rationale, pp 27 and 37; Annex 2, Coupling mechanisms between fields and the body, p 59, and CSIRO Australia, Status of research on biological effects and safety of electromagnetic radiation: Telecommunications frequencies, June 1994, p 126.

4.15 Biological responses from exposure to radiofrequency fields do not merely depend on the intensity of the fields outside the body, but on the subtle effects of the electromagnetic energy on the blood forming immune, nervous and endocrine systems inside the body. Exposure to a uniform electromagnetic field results in a highly non-uniform deposition and distribution of energy within the body. Research has shown that electromagnetic fields can be divided into four ranges, as regards absorption of energy by the human body[5] which illustrates the inadequacy of the SAR dosimetry system. It is currently assumed that different frequencies have different bioeffects because of the heating effects they cause. These frequency ranges and effects are:

- from about 100 kilohertz (100 kHz) to less than about 20 megahertz (20 MHz) (sub-resonance range), at which absorption in the trunk decreases rapidly with decreasing frequency, and significant absorption may occur in the neck and legs;
- frequencies in the range from about 20 MHz to 300 MHz (the resonant range), at which relatively high absorption can occur in the whole body, and even higher values if partial body (eg head) resonances are considered;
- frequencies in the range from about 300 MHz to several gigahertz (GHz), (hot spot range) at which significant local, non-uniform absorption occurs. The size of these 'hot spots' decreases from several centimetres to about 1 cm as the frequency increases; and
- frequencies above about 10 GHz (surface absorption range), at which energy absorption occurs primarily at the body surface.

Specific Absorption Rate (SAR)

4.16 During the 1950s, a dosimetric approach was being developed for chemical safety and nuclear safety. Dosimetry is the science of measuring exposure to an agent - whether that be a chemical or an amount of radiation. This approach was extended to non-ionising radiation research and resulted in the development of the concept of specific absorption rate (SAR), which defines the amount of power absorbed per body mass. It is measured in watts per kilogram (W/kg) and is the basis of high frequency standards today. The SAR is the rate of absorption of radiofrequency energy in a unit mass of tissue. It represents the energy actually absorbed and as such is one indicator of the effect of the dose of radiofrequency energy.

4.17 In the SAR system, the total amount, the distribution, and the rate of absorption of electromagnetic energy in a living system are the function of many factors. The quantities of energy, internal electrical field strength, induced body current, induced current density, and specific absorption rate are all interrelated. The

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5 ARPANSA Radiation Protection Standard, Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, Draft for public comment, Annex 2, Coupling Mechanisms between fields and the body, pp 58 and 59; CSIRO Australia, Status of research on biological effects and safety of electromagnetic radiation: Telecommunications frequencies, June 1994, p 126.

SAR is commonly used for comparisons of biological effects under different exposure conditions. It can be used to determine the internal (absorbed) energy distribution.[6]

4.18 There are problems with access to measurement with the SAR system. The SAR cannot be readily measured in routine exposure assessment, but requires special techniques to determine it, either in the laboratory or with computer estimations. It was not until the development of reasonably powerful computers and other technologies (such as high sensitivity thermal imaging cameras) in the mid 1970s, that significant advances could be made in the radiofrequency dosimetry area.[7] When the SAR is not known, characteristics of the radiofrequency field (eg power density, electric field strength, magnetic field strength, polarisation) are used to estimate exposure. These measurements are more readily available to people and give a reasonable and more practical idea of whether or not the levels present are hazardous.

4.19 In tissue, the specific absorption rate depends on the internal electric field strength. Average SAR and SAR distribution can be computed or estimated from laboratory measurements. Values of SAR depend on the following factors:

- the electromagnetic field parameters, ie, the frequency, intensity, polarisation and distance of the source from body it intercepts;
- the characteristics of the exposed body, ie, its size and internal and external geometry, and the non-conducting (dielectric) properties of the various tissues; and
- ground effects and reflector effects of other objects in the field near the exposed body.[8]

4.20 Work on specific absorption rate had settled on 4 watts per kilogram (4 W/kg) as a level of exposure which could result in an experimental rise in core body temperature of up to 1°C. A rise in core body temperature of more than 1°C is not well tolerated by the body and produces deleterious effects. Thermal Standards are based only on the relatively basic idea of preventing core body temperature increases and aim to keep exposures to radiofrequency fields below these levels. A factor of 10 was incorporated into where thermal effects were observed and this is the basis of the original benchmark of 0.4 watts per kilogram in the standards today.[9] The body is made up of very different tissue types and the absorption varies giving quite

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6 AS/NZS 2772.1(Int):1998, Interim Australian/New Zealand Standard, Radiofrequency fields, Part 1: Maximum exposure levels—3 kHz to 300 GHz, Standards Australia/Standards New Zealand, Appendix A, p 23.

7 ARPANSA Radiation Protection Standard, Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, Draft for public comment, Schedule 1, Rationale, p 26.

8 ARPANSA Radiation Protection Standard, Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, Draft for public comment, Annex 2, Coupling mechanisms between fields and the body, p 59.

9 Australian Parliamentary Library, Current Issues Brief No. 26, 1996-97, Rod Panter, Science and Technology Group, 19 June 1998.

unpredictable internal temperature increases so the measurement system leaves a considerable margin of uncertainty about what is really going on inside a human body exposed to radiofrequency radiation.

4.21 Given therefore the complexity and variability of the resonant properties of the human body, the Committee Chair questions the efficacy of artificial modelling as an adequate tool to define safety levels in wireless equipment.

Standards Australia International Limited

4.22 Standards Australia International Limited (Standards Australia) is recognised as Australia's peak national standards body through a Memorandum of Understanding with the Commonwealth Government. It was founded as an association in 1922 under the name of Australian Commonwealth Engineering Standards Association, but was changed to Standards Association of Australia in 1929. In 1950, the Association was constituted as a body corporate and politic, by way of a Royal Charter, and in 1988, the trading name Standards Australia was adopted. In 1999, it became an independent company and adopted the name Standards Australia International Limited.

4.23 Standards Australia prepares and publishes most of the voluntary technical standards used in Australia. These standards are developed through an open process of consultation and consensus, in which all interested parties are invited to participate. According to Mr Colin Blair from Standards Australia:

> … Standards Australia is a facilitator of a process for the development of standards which brings together experts from representative interest groups that work to formulate or revise standards. Standards Australia is a facilitator. We do not play an active part in the decisions of the committee, we do not have a vote on any standards that are prepared and we do not chair meetings.[10]

4.24 Although standards developed by Standards Australia are voluntary, they do become mandatory when referred to in legislation. This has occurred with the radio-frequency fields exposure standards.

Standards Australia Technical Committee TE/7

4.25 To formulate standards, Standards Australia convenes a technical committee representative of relevant stakeholders, by securing the participation of those interested parties concerned with a particular project. The majority of individuals who serve on technical committees are representatives of sectors of interest nominated by government bodies, industry associations, community-based and consumer organisations, trade unions and professional, technical or trade associations. Such

10 *Official Committee Hansard*, Sydney, 16 November 2000, p 281.

technical committees should operate under internationally accepted principles of transparency and consensus.

4.26 Standards Australia informed the Senate Committee that when nominees of organisations are appointed as committee members, it is their duty to ensure that their nominating organisations are kept informed of committee activities. Committee members are required to represent the views of their nominating organisations at the technical committee meetings, not personal or company views. Individuals, however, do not represent their employers, but they do represent the sectional interests of their employers. It is accepted that they will use the resources of their particular organisations to assist in the preparation of the most appropriate Standards.[11]

4.27 The Standards Australia technical committee responsible for considering standards for human exposure to electromagnetic radiation is the TE/7 Committee. It was established in 1984 and has been a joint Australian/New Zealand committee since 1992.

4.28 Four standards have been published as an outcome of TE/7 deliberations:

- AS 2772.1:1985 Radio frequency radiation - Part 1: Maximum exposure levels - 300 kHz to 300 GHz;
- AS2772.1:1990 Radiofrequency Radiation - Part 1: Maximum Exposure Levels - 100 kHz to 300 GHz;
- AS/NZS 2772.1(Int):1998 Radiofrequency fields - Part 1: Maximum exposure levels - 3 kHz to 300 GHz (commenced in March 1998 but was withdrawn by TE/7 vote, effective from 1 May 1999); and
- NZS 2772:Part 1:1999 Radiofrequency fields - Part 1: Maximum exposure levels - 3kHz to 300 GHz (effective from 1 May 1999 - New Zealand only).[12]

4.29 Because of the level of public concern about proposals to weaken the principles of radiation protection and increase the amount of radiation that Australians can be exposed to, no agreement was reached and so the increases were partly introduced by stealth when AS/NZS 2772.1(Int):1998 was issued as an Interim Standard before being finalised to allow further committee review and public comment. The subsequent public disquiet however, ended with the interim standard being withdrawn with effect from 1 May 1999 (see below).

Standards Australia Processes

4.30 Mr Blair, from Standards Australia, informed the Committee that the process of developing standards has three main components:

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11 Standards Australia International Limited, Submission 133, Attachment 6, *Preparing Standards, Standardization Guide No. 1*, Standards Australia, Standards New Zealand, March 1996, p 3.

12 Standards Australia International Limited, Submission 133, p 1.

> The first component is that it is an open and transparent process. The second component is that we have a balanced representation on our committees. This balance is a cross-section of all organisations that would potentially be used or influenced by the standard. Generally, when we look at that balance, we split it into groups along the lines of user, purchasing bodies, manufacturers-suppliers, independent professional and technical bodies, consumers, regulatory or controlling bodies, research and testing organisations and unions. The third component of our process is consensus. Really, the important part of the consensus process is when the formal postal ballot takes place after the document has been developed and been through the public comment stage.[13]

4.31 In order for a Standard to be published, there are three conditions that need to be met:

- 67 per cent of people who are eligible to vote, do actually vote on the document;
- of those who have voted, 80 per cent must be supportive of the document; and
- even if the 80 per cent positive vote is achieved, no major sectoral interest is to maintain a negative vote.[14]

4.32 Standards Australia argued that, through an open and transparent process, balanced representation on the committees and the consensus requirements, fair and reasonable documents are published at the end of the day. If consensus is not reached, the documents are not published.

History of the Australian Standard

4.33 Following the US military, a limit of 10,000 microwatts per square centimetre (10,000 $\mu W/cm^2$) had been informally adopted in Australia through various guidelines and rules imposed by most radiation generating authorities between 1955 and 1979, but there was no Australian Standard as such until 1985.

Australian Standard AS 2772: 1985, Maximum Exposure Levels - Radio-Frequency Radiation - 300 kHz to 300 GHz

4.34 In formulating AS 2772: 1985, the Standards Association of Australia technical committee (TE/7) reviewed but found inadequate an American National Standards Institute (ANSI) proposal for exposure limits in the frequency range 300 kilohertz (300 kHz) to 100 gigahertz (100 GHz).

4.35 The 1985 Australian Standard took a conservative approach to setting exposure levels. It differed from the maximum exposure levels proposed by ANSI by choosing lower exposure levels for the higher and lower frequency ranges; and an

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13 *Official Committee Hansard*, Sydney, 16 November 2000, p 281.

14 *Official Committee Hansard*, Sydney, 16 November 2000, p 282 [Blair].

averaging time of one minute was adopted for all exposure conditions, regardless of the field strength, rather than the six minute averaging time suggested by ANSI. It also contained reference to the ALARA Principle whereby all doses should be kept as low as reasonably achievable, economic and social considerations being taken into account.

4.36 Another useful feature of the 1985 Australian standard was to establish reduced exposure limits for the general population than for the occupationally exposed population. This is because the occupationally exposed population consists of adults who are exposed under controlled conditions, and who are supposed to be trained to be aware of potential risks and to take appropriate precautions. The duration of occupational exposure is limited to the length of the working day or duty shift per 24 hours, and the duration of the working lifetime.[15]

4.37 The general public (the non-occupationally exposed population) comprises individuals of all ages and different health status. The resonant range is different for adults and children and so is the distribution of radiofrequency energy absorption in various body parts. Some individuals may be particularly susceptible to radiofrequency radiation. In addition, members of the public are not always aware that exposure takes place and they can be exposed 24 hours per day, and over their entire lifetime. They cannot reasonably be expected to take precautions against radiofrequency and particularly burns and shocks. For these reasons lower basic (and derived) exposure levels are adopted for the non-occupational population than for the occupationally exposed population.[16]

4.38 The limits set out in the 1985 Standard are specified in basic restrictions which affected industries argued were difficult and, in many cases, impractical to measure

4.39 Dr Repacholi, suggested that the exposure levels in the Australian standard for the microwave region of the spectrum were set at levels which owed more to negotiations between the various parties than to the scientific evidence:

> I was involved in the early attempts to develop an Australian standard. The standard was developed primarily on the international standard at the time and follows the international standard except in one region, called the microwave region. There was so much discontent about this that the level ended up being a negotiated level. It was not based on the science. Everything was based on the science up to that point, but the last part was not based on the science - it was negotiated between the unions and the government at the time.[17]

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15 Interim Australian/New Zealand Standard, Radiofrequency fields, Part 1: Maximum exposure levels - 3kHz to 300 GHz, Standards Australia/Standards New Zealand, p 22.

16 Interim Australian/New Zealand Standard, Radiofrequency fields, Part 1: Maximum exposure levels - 3kHz to 300 GHz, Standards Australia/Standards New Zealand, p 22.

17 *Official Committee Hansard,* Canberra, 31 August 2000, p 8.

4.40 According to Mr Alexander Doull, a member of the TE/7 Committee, the 1985 Australian Standard tightened and reduced the then allowable exposure limits and incorporated explicit, fundamental principles of radiation safety. It also explicitly acknowledged:

- the limitations of a standard based only on preventing heating and burns; and
- a possibility of harmful non-thermal effects on living systems.[18]

4.41 The CSIRO informed the Committee that in recent years there have been various attempts to relax the acceptable limits of radiofrequency exposure in the Australian Standard. The rationale has been to align it with international guidelines although, according to the CSIRO, there is no substantial new scientific evidence on which to base such a proposed change.[19]

4.42 Mr Doull suggested that since 1985, the Australian Standard has come under sustained industry pressure to revert to much higher levels of exposure to radiofrequency radiation; to completely delete any references to fundamental principles of radiation safety; to minimise any explicit references to harmful effects; and to delete the previous acknowledgment of the existence of non-thermal effects on living organisms.[20] He believes that the changes in the official Standard that the industry has wanted would probably have the effect of protecting the industry from future litigation. Mr Doull referred to a precedent setting case of fatal microwave disease in New York which had been the first jurisdiction to recognise asbestos diseases in exposed workers.

4.43 In response to earlier questioning by the Committee about the issue of litigation, Dr Hugh Bradlow from Telstra, replied:

> I presume we have adequate liability coverage and, given that there is no identified effect, it is very hard to take out insurance against something that does not exist.[21]

4.44 The 1985 Standard had excluded devices which operated below 1 GHz and had a power output of below 7 watts from compliance with the Standard. It was decided that it would be unlikely that these devices could couple enough energy into any size human body such that the average whole body SAR of 0.4 W/kg would be exceeded. In addition, it would not be expected that there could be any spatial peak SAR in the human body exceeding 8 W/kg averaged over any one gram of tissue this

18 Mr Alexander Doull, Submission 113, p 1.

19 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 8.

20 Mr Alexander Doull, Submission 113, p 1.

21 *Proof Committee Hansard*, Canberra, 2 March 2001, p 387.

value being lower than spatial peak SAR which could arise when whole body exposure occurs at the maximum exposure levels.[22]

4.45 In 1988, the Standard was renamed Australian Standard 2772 - 1985 Radio Frequency Radiation Part 1 - Maximum Exposure Levels - 300 kHz to 300 GHz.[23]

AS2772.1-1990: Radiofrequency Radiation Part 1: Maximum Exposure Levels - 100 kHz to 300 GHz

4.46 The 1990 Standard superseded the 1985 standard and introduced changes which included extension of the frequency range down to 100 kHz, and included limits for body-to-ground radiofrequency currents. However, the limits for exposure to radiated fields for both occupational and non-occupational exposure remained unchanged.[24]

4.47 AS2772.1:1990 provided a 'deemed to comply' provision for all radiocommunications transmitters like mobile phones operating below the frequency 1 GHz. If the output power of the transmitter was less than 7 watts, the device was deemed to comply with the Standard. Concern was expressed that, because of the proximity of the radiating antenna to the head, mobile phones on the market were exceeding the exposure limits of the Standard for the general public despite being deemed compliant.[25]

4.48 In 1994, Amendment 1 introduced various corrections and changes, in particular, more explicit requirements for exposure limits for users of transmitters, including hand-held and mobile transmitters.[26] It also lowered the deemed to comply threshold for hand-held digital mobile phones to 0.7 watts and introduced a requirement to label devices.[27]

AS/NZS 2772.1(Int):1998 Interim Australian/New Zealand Standard, Radiofrequency fields Part 1: Maximum exposure levels - 3 kHz to 300 GHz

4.49 A periodic review on the 1990 Standard was begun in 1993 but agreement was not reached as the proposals put forward by industry were to significantly increase allowable exposure limits. It was therefore released as an Interim Standard, AS/NZS 2772.1(Int):1998, while being further considered.

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22 Standards Association of Australia, Australian Standard 2772 - 1985, Maximum Exposure Levels - Radio-Frequency Radiation - 300 kHz to 300 GHz, Appendix A, Rationale for the development of the maximum exposure levels for radio-frequency radiation, p 14.

23 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 9.

24 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 9.

25 Australian Communications Authority, Submission 100, p 6.

26 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 9.

27 Australian Communications Authority, Submission 100, p 6.

4.50 The Interim Standard was based on the International Radiation Protection Association (IRPA) Specific Absorption Rate (SAR) Guidelines, but covered an extended frequency range down to 3 kilohertz (kHz). The basic limits (whole body average SARs) between the Interim Standard and its predecessor standards did not change - occupational exposure limits to radiofrequency fields were based on 0.4 watts per kilogram (0.4 W/kg) and the non-occupational exposure limits were derived from values one-fifth (or less) those of the occupational limits (that is 0.08 W/kg).

4.51 However, there were changes in the derived exposure levels in the frequency range around 1 megahertz (1 MHz) to bring the Interim Standard into line with the recommendations of privately controlled international bodies. On the other hand, the derived exposure levels in relation to frequencies between 400 MHz and 2 GHz were set lower than other International Standards, in accordance with the precedent set in the 1985 Standard. Evidence suggested that the IRPA/ICNIRP methodology would lead to progressively rising derived levels and thereafter to a level which is constant with frequency between 400 MHz and 2 GHz. The TE/7 Committee did not support this approach.

4.52 The Chairman of TE/7 Committee, Dr Repacholi, proposed to use, as the basis for the Australian Standard, the World Health Organisation review of scientific literature which he had edited for the WHO. This WHO publication recommended the international guidelines on exposure limits published by the International Radiation Protection Association (IRPA 1988).

4.53 The Interim Standard was criticised by those concerned with the public interest because the limits were to be relaxed, and the peak exposures diluted by the use of the six minute averaging time rather than the 1 minute averaging time in the 1985 standard. The non-uniform exposure levels were also criticised.

4.54 One of the major objections to the standards was that they only take account of thermal effects of exposure to radiofrequency radiation, and not to non-thermal effects. The Electromagnetic Radiation Alliance of Australia states that:

> The existing standard is based on the erroneous presumption that adverse health effects occur only if the body is heated by 1°C.
>
> There is ample evidence that adverse effects occur at much lower, or athermal, levels that do not require heating of the body.[28]

4.55 Dr John Moulder, Director of Radiation Biology at the Medical College of Wisconsin, USA, emphasised how difficult it is to separate the thermal effects from any non thermal effects:

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28 Electromagnetic Radiation Alliance of Australia (EMRAA), Submission 80, p 17.

> It is probably absolutely impossible to prove that there is absolutely no heating, but with enough engineering wizardry you could probably establish that there could not be very much heating.[29]

4.56 The Mobile Manufacturers Forum argued that standards-setting bodies do not ignore the non-thermal effects in their deliberations:

> We would like to stress that when these standards bodies review the research they are looking at all the research, not just the established effects but the non-thermal as well as thermal effects …[30]

4.57 Dr David Black informed the Committee that the ICNIRP Guidelines do take athermal effects into account. He cited the example of neuro-stimulation which is the biological effect which, at low frequencies, is the effect that the exposure levels in the Guidelines aim to prevent. Neuro-stimulation can be generally regarded as an athermal effect.[31]

4.58 According to Mr Dan Dwyer from the Communication Electrical Plumbing Union, the use of derived exposure levels can result in an increase in exposures:

> What is disappointing is that all the research since the last standard was introduced appears to be aimed at exploiting the basic restriction (a rise in temperature by 1 degree) to the limit. Thus we have had to consider proposals from the manufacturers/telecoms for complex analysis of absorption rates at higher frequencies, averaging time, pulsed transmissions and even pregnant women. Whilst these studies may be mathematically consistent, it is inconsistent with a precautionary approach.[32]

4.59 Dr Repacholi however, disagreed with the need for any inclusion of precautionary principles and would have it that in Australia we are confused and wandering from the path of science:

> There is a confusion in the Australian standard at the moment. It says that the standard is 0.08, but in fact it is not. The limits that came out were not 0.08. Down here it is about 0.01. If you stick to the basic standard it will not be a relaxation. If you stick to the limits that were identified to get that, then yes, it will seem like a relaxation.[33]
>
> It [the standard] partly follows the science in the absorption curve. As you increase the frequency, the absorption changes and, at this point, it departs from the normal absorption curve, which is well known and well established

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29 *Proof Committee Hansard*, Canberra, 2 March 2001, p 319.

30 *Proof Committee Hansard*, Canberra, 2 March 2001, p 361.

31 Dr David Black, Submission 93, p 8.

32 Mr Dan Dwyer, Telecommunications Officers Association Branch, Communication Electrical Plumbing Union, Submission 66, Appendix 3, p 14.

33 *Official Committee Hansard,* Canberra, 31 August 2000, p 10.

> in science. The shape of the standard should follow the normal absorption curve for human beings. The negotiated point is the only point of departure from the science.[34]

4.60 When questioned about the consequences of setting a Standard which departs from his view of the science, Dr Repacholi replied:

> There is no effect on health. It is just that, from my viewpoint, I would like to see something that is science based and take away the subjectivity or the various opinions of people. Health is not negotiable; it should be based on something that is substantiated so that you know what level of protection you are providing to people.[35]

4.61 However the Committee Chair considers that the science is divided and uncertain at best and the mounting evidence of cancer risk associated with electromagnetic field exposures is of concern to rational people and that it is not responsible to increase human exposures in these circumstances.

4.62 Dr Repacholi advocates that Australia adopt international limits in line with standards world wide. The Committee notes that this campaign has not won universal support but industry groups favour this approach. The Australian Mobile Telecommunications Association (AMTA) said:

> From an industry's point of view, it is more efficient to provide consumers with safe and technologically advanced wireless communication devices if there is an opportunity, as now, to adopt the internationally accepted ICNIRP guidelines.[36]

4.63 However, in its submission, the CSIRO observed that:

> [t]he limits in the 1985 Australian Standard AS2772 were in place for more than 12 years and did not inhibit the introduction of new technologies or the extension of existing technologies.[37]

4.64 Mr Les Dalton provided the Committee with an example of where lower standards actually operate to encourage technological excellence:

> It is the same story with the exposure to magnetic field emissions from computer screens. Sweden was the first to set a standard of 2.5 milligauss for the electrofrequencies which come from the transformer of computers. This maximum was eventually adopted because schools in the United States, among others, insisted that this be their standard, too. The outcome was that they would not accept computers in schools unless their emissions

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34 *Official Committee Hansard,* Canberra, 31 August 2000, p 12.

35 *Official Committee Hansard,* Canberra, 31 August 2000, p 12.

36 Australian Mobile Telecommunications Association (AMTA), Submission 19, p 10.

37 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 3.

> were less than 2.5 milligauss. Eventually, that became the accepted standard. It only took the industry about 12 months to all be below that, because the technology was there to do it. It turned out that IBM had had a patent for five years to enable them to do it but had not done it. So a rigorous standard is always an encouragement for technological excellence.[38]

4.65 Faced with opposition to increased exposures AS/NZS 2772.1(Int):1998 introduced different 'deemed to comply' provisions for handheld and portable transmitters. The new provisions were based not only on output power, but also on the transmitter's duty cycle and the body-antenna separation distance. The result of the new provisions is that mobile phone handsets need testing to demonstrate compliance with the Standard.[39]

International Commission on Non-Ionizing Radiation Protection (ICNIRP) guidelines

4.66 The international limits to which the World Health Organization refers (above) are the guidelines drafted by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP was established in 1992 as a successor to the International Radiation Protection Association (IRPA/International Non-Ionizing Radiation Committee (INIRC).

4.67 Industry always stresses the independence of the ICNIRP:

> Membership of ICNIRP is restricted to scientists working from an independent academic basis, and the outputs of the committee are always published in a highly respected peer reviewed biophysics journal, Health Physics. As a result of following this process all of the outputs of the ICNIRP committee are themselves subjected to peer review before publication and normal scientific peer review after publication. In my opinion, this approach is particularly satisfactory as it means that this information which is later used to provide the basis for regulatory documents goes through a standard scientific process of rigorous appraisal.[40]

4.68 Dr Ken Joyner, from the Mobile Manufacturers Forum added:

> If you want to look at one standards body that has specifically excluded any industry representatives, there is the ICNIRP body. You cannot be a member of the ICNIRP panel if you are part of industry. They exclude you from that process.[41]

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38 *Official Committee Hansard*, Melbourne, 22 September 2000, p 174.

39 Australian Communications Authority, Submission 100, p 6.

40 Dr David Black, Submission 93, p 7.

41 *Proof Committee Hansard*, Canberra, 2 March 2001, p 370.

4.69 According to industry and government evidence the ICNIRP guidelines on limiting exposure to non-ionising radiation are based on comprehensive expert reviews of published scientific studies, and establish principles of non-ionising radiation protection for formulating international and national research programs. The ICNIRP used the World Health Organization health risk assessments to derive the guidelines.[42] The ICNIRP exposure guidelines for protecting the public from the adverse health effects of exposure to electromagnetic fields have been endorsed by the European Commission and recommended for adoption within the member states of the European Union (EU).

4.70 The ICNIRP guidelines specify basic restrictions on exposure levels to radiofrequency fields. Depending on the frequency, the physical quantities which are used to specify the basic restrictions on exposure to EMF are current density, SAR, and power density.

4.71 Different scientific bases were used in the development of basic exposure restrictions for various frequency ranges in the ICNIRP Guidelines:

- between 1 Hz and 10 MHz, basic restrictions are provided on current density to prevent effects on nervous system functions;
- between 100 kHz and 10 GHz, basic restrictions on SAR are provided to prevent whole-body heat stress and excessive localized tissue heating; in the 100 kHz – 10 MHz range, restrictions are provided on both current density and SAR; and
- between 10 and 300 GHz, basic restrictions are provided on power density to prevent excessive heating in tissue at or near the body surface.[43]

4.72 Reference levels of exposure (a different name for 'derived exposure levels' which were used in the Australian standards) are provided for comparison with measured values of physical quantities. Compliance with all reference levels given in the guidelines ensures compliance with the basic restrictions.

4.73 In setting limits, it was said that ICNIRP/IRPA identified radiofrequency field values above which adverse biological effects could be confirmed by laboratory studies. These values were used as benchmarks. A safety factor of 10 was then incorporated so that workers would not be exposed to more than 1/10th of the benchmark level. For the general public, an additional safety factor of 5 was incorporated into the exposure limits. Therefore the exposure limits for the general public are set at 1/50th of the benchmark level.

4.74 Because of the different ways in which radiofrequency fields affect the human body depending on their frequency, different parameters for field restriction are used

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42 *Official Committee Hansard,* Canberra, 31 August 2000, p 13.

43 ICNIRP Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), p 16.

at various frequencies (refer to paragraph 4.15 above). The ICNIRP Guidelines are said to identify the adverse effect which occurs at the lowest level of exposure for differing frequency ranges and use this effect as a limiting benchmark with an additional safety factor.

4.75 Dr Bradlow, Telstra, claimed that the changes in reference levels (derived exposure levels) have come about because of an improved understanding of the coupling[44] between radiofrequencies and biological systems since 1985.[45] This allows the exposure levels to be more precisely defined at the various frequency ranges.

4.76 The allowable general public exposure limits in the Australian Interim Standard were similar to those in the ICNIRP Guidelines except differences occurred in the higher frequencies where the lower levels in the 1990 standard were retained.

Objections to the ICNIRP Guidelines

4.77 The recommended exposure limits in the ICNIRP Guidelines take into account the fact that the effects of electromagnetic fields on the human body can vary depending on their frequency. One of the CSIRO's objections to the levels in the ICNIRP guidelines was that they increase for exposure to frequencies above 400 MHz. The CSIRO argued that there were economic drivers behind the lifting of the allowable exposure at the higher frequencies which happened, by 'sheer coincidence' to be around Telstra's frequency.[46]

4.78 ARPANSA informed the Committee that the reason for the 'dip' in the ICNIRP exposure levels is that the frequency range between 10 MHz and 400 MHz covers the human body's resonance range where the whole body absorption of electromagnetic fields achieves a maximum value. Above 300 MHz the fields are not so well absorbed by the human body.

4.79 Dr Neil Cherry, a New Zealand scientist and academic, asserted that the ICNIRP Guidelines are not based on a public health assessment of the evidence and they only take into account the thermal effects of RF radiation. He claimed he represented many scientists in Europe in criticising the ICNIRP Guidelines, saying that:

> They decide that there is no evidence of genotoxicity but they do not cite any studies that have been published that do show that RF microwaves damage chromosomes – and that is the classic test of genotoxicity. They do not even cite one study that is available in the literature that says it damages chromosomes. Secondly, when I looked at two of their studies on cancer, they said that two recent studies do not show any significant effects. I have

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44 The association of two circuits or systems in such a way that power may be transferred from one to the other.

45 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 379 and 380.

46 *Official Committee Hansard*, Sydney, 16 November 2000, p 229.

> those studies and they do show significant effects. … [I looked] at other studies, and they similarly misused them or they took the author's conclusion when the data contradicts the author's conclusion.[47]

4.80 Mr Alexander Doull also suggested that exposure limits are set to suit industry products rather than for health reasons. He asserted that the refusal of TE/7 members to support the Interim Standard was a rejection of:

> … the practice of setting numerical safety exposure limits to suit existing industry products and then dressing those limits up by retrospectively applying an inadequate, crude, supposedly 'scientific' rationale for those limits. This practice enables the telecommunications industry to increase limits bringing products like the mobile phone which failed to comply with previous public exposure standards within the boundaries of what can then be presented as responsible, acceptable and legally safe.[48]

4.81 This view was echoed by Dr David Mercer in a paper which he wrote on the radiofrequency standard setting process:

> … the push for harmonisation with ICNIRP was in part stimulated by the development of new RF-producing technological applications not covered by the Australian and New Zealand standard but actually built with the ICNIRP standard in mind. It was also suggested that exposures to these frequencies were pushing standard setters to consider frequencies even less well understood than existing ones.[49]

4.82 Mr Les Dalton concurred when he related how the existing radiofrequency standard was developed:

> We had a CSIRO representative on the standard setting committee. … He argued for a maximum public exposure of 40 microwatts per square centimetre. The industry eventually insisted that it be 100. But then they learned that some broadcasting antennas, and particularly one in Adelaide, were well above that. So what happened was that they made it 200. That is the reason we have 200 microwatts per square centimetre, today, for public exposure. It had little to do with science.[50]

4.83 Of the same view is Mr Don Maisch, EMFacts consultant, who claimed that in one of the ICNIRP epidemiological studies the high exposure group was diluted by the low exposure group and that this diluted the final result.

4.84 The CSIRO does not believe that the Australian Standard should more closely follow the limits proposed in the ICNIRP Guidelines:

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47 *Proof Committee Hansard*, Canberra, 2 March 2001, p 339.

48 Mr Alexander Doull, Submission 113, p 3.

49 Dr David Mercer, Submission 51, Attachment, p 52.

50 *Official Committee Hansard*, Melbourne, 22 September 2000, p 174.

> The ICNIRP limits are based solely on known thermal effects, and expressed as a maximum Specific energy Absorption Rate (SAR) in units of Watts per Kilogram. SAR is a difficult quantity to measure directly, and derived limits in terms of field-strength are often more useful. The field-strength limits derived from the ICNIRP model are direct relaxations of the 1985 Australian limits over much of the frequency range. ICNIRP also proposes that measurements be averaged over six minutes, which for intermittent or pulsed fields is an indirect relaxation of the one-minute averaging time of the 1985 Australian standard.[51]

4.85 In February 2000, Switzerland introduced stricter exposure limits in relation to emissions generated by stationary installations.[52] Although the scope of the Swiss Ordinance is limited (for example, it does not apply to emissions from mobile phones), the allowable exposure limits are many times below those in the ICNIRP Guidelines. For example, for transmission installations for cellular mobile telecommunication networks of more than 6 watts, operating at 900 MHz or 1800 MHz, the limit values for the rms[53] electric field strength, are 4.0 volts per metre (4 V/m) and 6 volts per metre (6 V/m) respectively. These levels are approximately 100 times stricter than the levels recommended in the ICNIRP Guidelines.

Claimed benefits of the ICNIRP Guidelines

4.86 The World Health Organization summarised the benefits in achieving harmonised standards for EMF exposure as follows:

- increases public confidence that governments and scientists agree on health risks;
- reduces debate and fears about EMF;
- ensures that everyone is protected to the same high level; and
- has economic benefits to trade that would result in benefits to health.[54]

4.87 The Mobile Manufacturers Forum (MMF) enumerated the benefits of harmonisation of standards, as it views them, for the Committee:

> First of all, there is an increase in public health agency confidence if there is only one standard and they are all saying the one thing. Consumers also gain confidence from one standard for all consumers—if there is no differentiation. The industry also gains because we can design a product once, we can test a product once and we can make that product available

51 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 8.

52 Ordinance relating to Protection from Non-Ionising Radiation (ONIR) of 23 December 1999 (as of 1 February 2000), 814.710.

53 root mean square

54 World Health Organization, Submission 56, p 3.

> everywhere. The World Trade Organisation agreement requires international acceptance of international standards when developing technical regulations amongst member countries.[55]

4.88 Dr Repacholi provided the example of the radiofrequency standard in the United States. There, exposure levels are higher than the international standard in many areas. The WHO feels that it does not incorporate sufficient safety factors.[56]

4.89 The Australian Mobile Telecommunications Association (AMTA) supports a global standard and believes Australia should adopt the international standard. It told the Committee that if this were done, there would be the following benefits to consumers:

> … products will be manufactured to the one standard and there will be a consistency of information that will be provided that will be important in terms of the SAR information. It will enable the manufacturers to have the economies of start scale that will allow a product to come to the market earlier and cheaper. We believe there are a lot of advantages to the community.[57]

Events culminating in the Interim Australian/New Zealand Standard expiring

4.90 The Interim Standard (AS/NZS2772.1(Int):1998) superseded AS2772.1-1990 Standard, and introduced significant changes to the exposure limits which had remained, till then, at the levels in the 1985 Standard (AS2772-1985). The increase in the public exposure levels allowed by these changes was opposed by the CSIRO and some other organisations. According to the CSIRO, it was because of this opposition that the Standard was published as an Interim Standard, scheduled to expire in March 1999. During the lifetime of the Interim Standard, Standards Australia attempted to persuade the TE/7 Committee to agree to a new standard.[58]

4.91 Between August 1998 and April 1999, the TE/7 Committee reviewed the need for a revised Standard to replace AS/NZS 2772.1(Int):1998. According to the Interim Standards document, the particular areas which the Committee was to review were:

- the treatment of non-thermal effects;
- the appropriateness of proposed radiation levels which are based on current World Health Organization (WHO) recommendations; and

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55 *Proof Committee Hansard*, Canberra, 2 March 2001, p 361.

56 *Official Committee Hansard,* Canberra, 31 August 2000, p 16.

57 *Official Committee Hansard*, Canberra, 8 September 2000, p 38.

58 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 9.

- the proposed measurement methods of time and spatial averaging.[59]

4.92 Before the review began, the constitution of the TE/7 Committee was changed to add three new nominating organisations to the Committee, bringing the size of the Committee to 30 stakeholder representatives. The new nominating organisations were: the Consumers' Federation of Australia (2 seats), the Australian Mobile Telecommunications Association (AMTA) (1 seat) and Cable and Wireless Optus (1 seat).[60] The composition of TE/7 appears below:

Table 4.1

Composition of TE/7 Committee[61]

Nominating Organisation	**No. of Representatives**
Adopt Radiation Controls Inc NZ	1
Australasian Faculty of Occupational Medicine	1
Australasian Radiation Protection Society	1
Australian Communications Authority	1
Australian Council of Trade Unions	2
Australian Electrical and Electronic Manufacturers Association	1
Australian Mobile Telecommunications Association	1
Australian Radiation Laboratory	1
Australian Telecommunications Users Group	1
Broadcast Communications Ltd NZ	1
Standards Committee TE/3 - Chairman	1
Communications, Electrical Plumbing Union	1
Consumers' Federation of Australia	2
CSIRO	1
Department of Communications and the Arts	1
Department of Defence	1
Electricity Supply Association of Australia	1

59 Interim Australian/New Zealand Standard, Radiofrequency fields, Part 1: Maximum exposure levels—3 kHz to 300 GHz, AS/NZS 2772.1(Int):1998, Standards Australia, Standards New Zealand, p. 2.

60 Standards Australia International Limited, Submission 133, p 2.

61 Standards Australia International Limited, Submission 133, Attachment 5.

Institution of Engineers Australia	1
Local Government New Zealand	1
Ministry of Commerce New Zealand	1
National Occupational Health & Safety Commission	1
National Radiation Laboratory New Zealand	1
New Zealand Association of Radio Transmitters	1
The NZ Institute of Occupational & Environmental Medicine	1
Optus Communications	1
Standards Australia	1
Standards New Zealand	1
Telecom New Zealand Limited	1
Telstra Corporation Limited	1
Wireless Institute of Australia	1
Total	**32**

Table 4.2

Committee Balance - Number of committee positions in each of the following groups[62]

Category	Australia	New Zealand	Total
User and Purchasing Bodies	3	1	**4**
Manufacturers/Suppliers	5	2	**7**
Independent Professional and Technical Bodies	4	1	**5**
Unions	3	–	**3**
Consumers	3	1	**4**
Regulatory or Controlling Bodies	3	1	**4**
Research Organisations	2	1	**3**
Standards Organisations*	1	1	**2**
	24	**8**	**32**

* The two members of Standards Australia and Standards New Zealand do not vote on the Standards.

4.93 The TE/7 Committee followed the accepted Standards Australia/Standards New Zealand process in reviewing the Standard which was said to have been done in the light of the most recent developments both in Australia and internationally. Two formal Committee meetings were held on 11/12 August 1998 in Sydney and 4/5 November 1998 in Wellington, New Zealand. The Committee supported adopting the maximum levels of radiation recommended by ICNIRP accompanied by a to-be-defined 'precautionary approach'.

4.94 A new draft Standard (DR 98627 Radiofrequency fields Part 1: Maximum exposure levels — 3kHz to 300 GHz) was prepared and released for public comment for a period of two months between 1 December 1998 and 31 January 1999. Free public seminars to inform the general public of the content of the proposed Standard were also held because of the public interest in the subject. These took place in Sydney and Melbourne on 9 December and 10 December 1998, respectively.

4.95 The TE/7 Committee considered the public comment and appropriate amendments were made to the draft. A major point of debate was the strength of the proposed 'precautionary approach' given in clause 10 of the Committee ballot draft.

4.96 A formal ballot of the TE/7 Committee was conducted on the modified document. The vote closed on 4 March 1999 without the Standards

62 Standards Australia International Limited, Submission 133, Attachment 5.

Australia/Standards New Zealand threshold of 80 per cent acceptance being reached in either Australia or New Zealand. The result was:[63]

Table 4.3

Result of ballot on draft standard DR 98627

	Accepted	Not accepted
Australia	14	7
New Zealand	6	2

4.97 A process of trying to change negative votes was conducted in accordance with Standards Australia and Standards New Zealand processes. The Interim Standard was due to expire on 5 March 1999 and this date was extended by a vote of the TE/7 Committee to provide time for further discussion. The currency of the Interim Standard was extended until 30 April 1999. Discussions were conducted with all TE/7 Committee members to try to broker a compromise, but Australian members were not persuaded to change their vote. The major sticking point was that negative voters wanted a stronger precautionary approach, but supporters of the ballot draft would not agree as they saw this to be in conflict with the ICNIRP guidelines.

4.98 New Zealand members met on 20 April 1999, when changes to the ballot draft were passed by the necessary 80 per cent acceptance (7 votes in favour, 1 vote against). The New Zealand members agreed that their modified document would be put forward as a New Zealand-only Standard if agreement could not be gained from Australian TE/7 members.

4.99 Agreement did not take place in Australia and a ballot failed to agree to a further extension of the Interim Standard. It was withdrawn on 30 April 1999 and the task of revising the Standard was removed from the Committee's responsibility. The TE/7 Committee has one project currently in abeyance: that is, the EMR testing standard which is part 2 of the AS2772 Standard. The future role of the TE/7 Committee is unclear.

4.100 Although there is now currently no Standards Australia standard for human exposure to electromagnetic radiation, the former Interim Standard continues to be mandated by ARPANSA and the Australian Communications Authority for regulatory purposes.

4.101 According to Standards Australia it is quite unusual for a Committee not to achieve consensus:

> It is very rare that we have not achieved consensus. We publish an average of 40 to 45 standards a month, every month of the year. In the last six or

63 Standards Australia International Limited, Submission 133, p 3.

> seven years, I have not known us not to achieve consensus in publishing standards. So this is a very rare event.[64]

4.102 When asked by the Senate Committee how he accounted for the failure of the TE/7 Committee, Mr Roger Lyle from Standards Australia replied:

> I think if you have a look in detail at the actual process, it really got down to the stage where they hardened their positions. Consensus building means coming up with compromises. After the third meeting of the committee, my view was that there probably would be an outcome. But a few weeks later when the postal ballot was held it was fairly obvious that various members on the committee had hardened their views, for whatever reason. For a period of about six weeks there was an impasse. When we get into a situation where we do not meet our hurdles we go through a process of trying to resolve the issues. We ask people when they vote in the negative to actually provide the reasons for that in order to help the committee try to work through compromises to be able to reach a consensus. It was fairly obvious that people just were not finding those compromises.[65]

4.103 Despite the fact that the TE/7 Committee was unable to achieve consensus in this instance, Dr Black argued that it should in no way reflect on Standards Australia nor on its processes:

> In my opinion the support from Standards Australia during this time was particularly good, and the committee worked well. The limiting factor was the fundamentally flawed idea that a scientifically based document could be produced by a democratic process of requiring virtual consensus from a group which deliberately included people with inevitably dissenting views. Nevertheless, I have no doubt that this was originally done with the best of intentions.[66]

4.104 The Committee notes that Standards Australia was unable to provide the Committee with any adequate reason for not accepting the negative votes from the dissenting members on whether or not to accept the ICNIRP guidelines:

> **CHAIR:** I think this goes to the heart of the whole question: why was it not possible then, having not got over those first two hurdles, to then say, 'There is disagreement on this committee, so let us stay with the current standards?' Why was it necessary to find that compromise and move on? What was the compelling reason for making the shift to the new standard?
>
> **Mr Lyle:** Our process obviously had to come to some sort of conclusion.

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64 *Official Committee Hansard*, Sydney, 16 November 2000, p 282.

65 *Official Committee Hansard*, Sydney, 16 November 2000, pp 283-284.

66 Dr David Black, Submission 93, p 10.

> **CHAIR:** Why couldn't it conclude with the decision for no change? Why couldn't it say, 'The committee does not agree with this direction, and we want to stay with the existing standard?'
>
> **Mr Blair:** To stay with the interim standard?
>
> **CHAIR:** Yes, or make the interim standard the permanent standard.
>
> **Mr Lyle:** We would not agree to it. It was put to a vote.
>
> **Mr Blair:** We went through that process as well, and there was not agreement.[67]

4.105 The Committee Chair is not persuaded that the proposed new standard was a scientifically-based document, however, neither have they found fault with the Standards Australia processes.

The Transfer of Responsibility for Setting a New Australian Standard to ARPANSA

4.106 ARPANSA was established on 5 February 1999 under the *Australian Radiation Protection and Nuclear Safety Act 1998*. The object of the Act is to protect the health and safety of people, and to protect the environment from the harmful effects of radiation. ARPANSA itself is an amalgamation of the Australian Radiation Laboratory, formerly part of the Department of Health and Aged Care, and the Nuclear Safety Bureau, formerly a statutory authority. It comes under the aegis of the Department of Health and Aged Care.

4.107 ARPANSA sought nominations for its Radiation Health Committee (RHC) Radiofrequency (Exposure Standard) Working Group from more than 20 organisations. The final composition of the Working Group is:

Table 4.4

Radiofrequency (Exposure Standard) Working Group[68]

Chair:	Dr Colin Roy, Director, NIR Branch, ARPANSA
Members:	Mr Vitas Anderson, Private Consultant, EME Australia Pty Ltd
	Dr Stan Barnett, Project Leader, Bioeffects of Non-Ionizing Radiation, CSIRO (*has resigned*)

67 *Official Committee Hansard*, Sydney, 16 November 2000, p 284.

68 Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Submission 128, p 9; ARPANSA Answer to question on notice; Australian Mobile Telecommunications Association (AMTA), Submission 19(a), Attachment E.

	Mr Wayne Cornelius, Head, EMR Section, NIR Branch, ARPANSA
	Mr Dan Dwyer, National Branch Secretary, Telecommunications Officers Association, Communications, Electrical & Plumbing Union
	Dr Bruce Hocking, Consultant in Occupational Medicine
	Dr Ken Joyner, Director, EME Strategy and Regulatory Affairs, Motorola Australia
	Mr John Lincoln, Convenor, Electromagnetic Radiation Alliance of Australia
	Mr David McKenna, National Organiser, Community and Public Sector Union (*has resigned*)
	Dr Andrew Wood, Senior Lecturer in Biophysics, Swinburne University
	Ms Jill Wright, Senior Inspector, Division of Workplace Health & Safety, Queensland Department of Training & Industrial Relations
Consultants	Dr David Black, Occupational & Environmental Physician
	Professor Mark Elwood, Director, National Cancer Control Initiative
Secretariat:	Mr Michael Bangay, Technical Officer, EMR Section, NIR Branch, ARPANSA
	Mr Alan Melbourne, Manager, Standards Development Section, ARPANSA
Observers:	Dr Graeme Dickie, Radiation Health & Safety Advisory Council, ARPANSA
	Mr Ken Karipidis, EMR Section, NIR Branch, ARPANSA
	Ms Judith Lawson, Manager, Research Coordination Unit, Prevention Strategies and Facilitation Branch, National Occupational Health and Safety Commission
	Mr Ian McAlister, Manager, Radiocommunications Standards, Australian Communications Authority

4.108 The ARPANSA Radiation Health Committee (RHC) oversees the work of the Radiofrequency (Exposure Standard) Working Group by setting the terms of reference

and providing guidance and arbitration where necessary. The RHC provides final approval of the Standard and may make amendments at its own discretion.[69]

4.109 Submissions were mixed when addressing this part of the terms of reference. The telecommunications industry, the Australian Communications Authority and other government agencies supported the development of a new standard by ARPANSA:

> It is the ACA's view that given ARPANSA's resources, experience and statutory backing, it is most suited for the standard development task.[70]

4.110 In addition, ARPANSA's expertise in dealing with radiation issues was thought to be invaluable:

> … I believe that the interim standard should be revised to include the ALARA Principle and that the responsibility for doing this should be given to a body with more expertise in dealing with radiation matters, such as ARPANSA.[71]

4.111 The Radiation Advisory Committee of the Victorian Department of Human Services made the point that ARPANSA's international experience in setting standards would be valuable:[72]

> The RAC is of the view that the Australian Radiation Protection and Nuclear Safety Agency would be the most suitable organisation to assume responsibility for developing new Australian Standards for EMR. Several members of staff of this Agency have extensive international experience of setting standards through their involvement in IAEA, ICRP, ICNIRP, etc. They can bring the required scientific rigour to the important tasks involved in setting exposure standards that will protect the Australian population.

4.112 Some submissions provided ideas on the composition of standards setting working groups. For example, Mr Les Dalton stated that:

> … there should be representation on that committee covering the whole spectrum of scientific interpretation of the results as they are at the moment. Also, there should be community representation in order that they can see the process at first hand. There should also be, I believe, not only people who are experts in the technical sense but people who come out of the field of environmental health and perhaps other biological areas. It should be very broad.[73]

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69 Australian Mobile Telecommunications Association (AMTA), Submission 19(a).

70 Australian Communications Authority, Submission 100, p 7.

71 Professor Philip Jennings, Submission 122, p 1.

72 Radiation Advisory Committee of the Victorian Department of Human Services, Submission 106, p 2.

73 *Official Committee Hansard*, Melbourne, 22 September 2000, pp 175-176.

4.113 Mr Dalton believes that it is vital to have sufficient community representation on a standards-setting committee:

> This is where the community has a vital interest in what is decided. Experts are no more able to judge what risk we should be prepared to take than is the community itself. Practising a scientific specialty does not qualify a person to deal with the broader issues associated with the quality of life.[74]

4.114 Other witnesses were opposed to any representatives from the telecommunications industry being on standards-setting committees at all:

> I believe that industry should be excluded. I do not think that industry has a role on standards committees; I think industry should be encouraged to meet whatever standards, from a public health perspective, are decided are appropriate.[75]

4.115 Dr Repacholi informed the Committee that the World Health Organization does not allow industry to participate in either standard setting or in health risk assessment. The WHO takes the view that there cannot be industry representation on standard setting working groups. There cannot be someone on the working group who is having an influence on health effects for an industry when they derive benefit from that industry. He acknowledged, however, that in the United States and Australia a different approach is followed whereby all stakeholders are represented to set standards in order to achieve consensus with the standard.[76] This can be seen by the membership of the Standards Australia TE/7 Committee (see Tables 4.1 and 4.2) and the ARPANSA Radiation Health Committee Radiofrequency (Exposure Standard) Working Group (see Table 4.4).

4.116 Dr Ken Joyner, from the Mobile Manufacturers Forum, thought that excluding industry representatives would have a negative impact on the standards-setting committee:

> I think it would be a very negative impact in that the committee that was set up to, say, look at standards would not be aware of the ease or the ability of some of these requirements to be implemented, would not be aware of what the industry has already done, would not be aware of lots of the data that is already out there. Industry brings lots of experience and knowledge to these forums, and whether they are there as voting members or expert advisers, I think it certainly should not diminish the value that they bring to these bodies.[77]

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74 *Official Committee Hansard*, Melbourne, 22 September 2000, p 172.

75 *Official Committee Hansard*, Sydney, 16 November 2000, p 252.

76 *Official Committee Hansard,* Canberra, 31 August 2000, p 26.

77 *Proof Committee Hansard*, Canberra, 2 March 2001, p 370.

4.117 Those submissions which were opposed to the transfer of responsibility to ARPANSA for devising a new Australian standard, felt that ARPANSA had too close a link to the industry which was pushing for higher exposure levels:

> We are strongly opposed to ARPANSA gaining sole control over the setting of new Australian Standards. We are not convinced that ARPANSA will represent Community concerns and Consumer rights properly and fairly.
>
> ARPANSA appears to us as being market driven and we have no faith whatsoever that they will retain a necessary degree of independence and impartiality under this current Federal Government.
>
> New Standards should only be set by a team that has equal representation from all sectors of the community with equal decision making powers.[78]

4.118 Mr Dan Dwyer, from the Telecommunications Officers Association Branch of the Communications Plumbing Electrical Union, thought that the process used by the Australian Communications Authority to establish the ARPANSA Working Group was flawed. He believed that ARPANSA was not the appropriate organisation to devise the Standard because it had taken a corporate decision to support increased exposures by adopting the ICNIRP Guidelines, as could be seen from the results of the final Standards Australia vote. [79]

4.119 In addition, Mr Dwyer asserted that there is an apparent bias in the ARPANSA Working Group which stems from the selection process for Working Group members not being an open process, with an invitation for inclusion in the group being sent to a chosen few.

4.120 Others thought that ARPANSA could make a profit out of standard setting:

> A new standard must be … set only by a truly independent body, free from industry pressures and financial self-interests. There is no merit in transferring this responsibility to the biased Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). Any organisations who, directly or indirectly stand to profit from electro-magnetic radiation (like ARPANSA), will, naturally, try to impose more lenient standards.[80]

4.121 Dr Loy, Chief Executive Officer, ARPANSA, believed that it is necessary to involve people with an industry background on standards setting bodies, not only because there is a smaller pool of expertise from which to draw in Australia than the rest of the world, but also because it is appropriate:

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78 The Maple Street Cooperative Society Ltd, Submission 90, p 2.

79 Telecommunications Officers Association Branch of the Communications Plumbing Electrical Union, Submission 66, p 9.

80 Ms Sarah Newsome, Submission 12, pp 1-2.

> … you can take a pragmatic view that says that, given the level and the spread of expertise on these issues in this country, if you want to draw up a standard you are inevitably going to have to involve people who have some industry background; otherwise the breadth of knowledge is simply not enough to write the standard. But, having said that, I think you can also say that it is appropriate that people with industry backgrounds be involved because they bring to the issue of the preparation of a standard views and knowledge about how the industry actually works, so that a standard not only protects the public health but does so in a way that will be effective and also allow the benefits of the industry to be offered. That is always a balance. The industry people need to be there to put their side of the case, if you want to view it that way.[81]

4.122 Dr Loy also acknowledged the importance of community representatives on these bodies:

> It is also absolutely important that on the drafting groups there are people from community backgrounds who have an interest in and knowledge about the issues but who do not come from an industry background and who have a community view. That is absolutely important and you should not draw up these standards without that. The other sine qua non is a process of wider public involvement. The issue cannot be resolved behind closed doors; it has to go out to the public widely, and matters that the public bring forward have to be dealt with and be seen to be dealt with.[82]

4.123 Although ARPANSA is a relatively new body, submissions felt that the history of the Nuclear Safety Bureau effectively ruled it out as being an independent and impartial standard setting body. According to Mr Alexander Doull:

> New regulatory agencies are often simply made up of the same people who have been effectively influenced by the very industries they are supposed to regulate, trading under a new name. … this change must not proceed if it has the effect of placing the standard setting process even more securely into the hands of the sectional interests which generate the radiation in the first place and further remove the whole process from public interest and sceptical scrutiny.[83]

4.124 The CSIRO told the Committee:

> ARPANSA was charged with helping to write the new Australian standard and constituted a committee to do that. The CSIRO representative … concluded that the committee seemed intent on adopting the ICNIRP guidelines for RF exposure in Australia without due consideration of all the available evidence and seemed keen to simply adopt that international standard. He therefore resigned from the committee. The conclusions: as I

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81 *Proof Committee Hansard*, Canberra, 2 March 2001, p 344.

82 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 344-345.

83 Mr Alexander Doull, Submission 113, pp 3 and 4.

> said, CSIRO, being a conservative organisation, would always err on the side of prudence and keep exposure levels as low as technically, socially and economically feasible.[84]

4.125 The Committee notes that in the event of a dispute or lack of agreement in the ARPANSA working group over the new Standard including such matters as the inclusion of the precautionary approach, the Standard would be elevated to the Radiation Health Committee who would then take the decision.

4.126 The Committee Chair is of the view that this would negate the advantages of having a fair representation of the various stakeholders on the working group, and it is not persuaded that the TE/7 group's decision not to support the new Standard should have been effectively rejected.

4.127 For this reason, the Committee Chair holds that the process adopted by ARPANSA, particularly with regard to the absence of the CSIRO, has not been an improvement on that of the Standards Australia TE/7 Committee and is not in the interests of public health.

4.128 The Committee Chair remains concerned that members with industry interests on the ARPANSA working group are, despite having no voting rights, in a position to influence the discussion.

Precautionary Approaches

4.129 According to submissions, the major areas of disagreement between the members of the TE/7 Committee and the reason why the new standard was not supported, related to the incorporation of a precautionary approach, and the relaxation of the exposure limits in the proposed Standard. Mr Dwyer from the CEPU said:

> … I oppose adoption of the standard. … In short the proposed standard only pays lip service to the precautionary approach and then sets out to allow even higher exposure levels.[85]

4.130 Because of the growing body of scientific studies that show effects of radiofrequency emissions, as well as the public apprehension with the safety of the technology, people advocated a precautionary approach be incorporated in standards.

4.131 Dr Repacholi argued that present exposure limits are set well below levels at which known adverse health effects are possible: '[t]his is already an application of a 'cautionary policy' and it is important to recognise it as such'.[86]

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84 *Official Committee Hansard*, Sydney, 16 November 2000, p 222.

85 Telecommunications Officers Association, A Branch of the Communications Electrical Plumbing Union, Submission 66, Appendix 3, p 14.

86 World Health Organization, Submission No 56, Appendix: *Background Document Electromagnetic Fields and Public Health, Cautionary Policies* [Draft], p 5.

4.132 The World Health Organization takes the view that whilst technology standards can be used effectively to implement a precautionary approach, until technologies to control exposure are well understood, effective and not unreasonably costly, the precautionary approach is not appropriate for limiting EMF exposures. The WHO submission says that this is because exposures to EMF are so common and occur under such a variety of circumstances that specifying a small number of technologies for controlling exposures would be impractical.[87]

4.133 The Australian Council of Trade Unions (ACTU) was a member of the TE/7 Committee. It did not support the adoption of AS/NZ 2772.1 for the following reasons:[88]

- there was too much reliance in the proposed standard on the ICNIRP guidelines, which are based only on thermal effects and make no allowance for possible non-thermal effects;
- the ICNIRP and its processes have been widely criticised as being far too secretive;
- the proposal to allow increased exposure from mobile telephones for no good reason; and
- the downgrading of the precautionary approach, which was needed in the light of uncertainty regarding the non-thermal risks associated with radiofrequency radiation.

4.134 The ACTU was also concerned that the proposed Standard would allow higher levels of radiation to the head of 25 times the level allowed to the whole body and also, the increase in averaging times from 60 seconds to six minutes. According to the ACTU, these changes would allow higher peak SARs.

4.135 The CSIRO opposed the adoption of the Draft Standard because it considered it imprudent to increase exposures or averaging times above those adopted in Australia in 1985.[89]

4.136 Mr Dan Dwyer from the Telecommunications Officers Branch of the Communications Electrical Plumbing Union was convinced that with the advent of new technologies there will be an increase in radiofrequency exposure even without allowing an increase in levels in the Standard. He cites significant new energy sources such as Fixed Radio Access technology (WLL), high definition television, satellite transmissions and new mobile phones. In addition:

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87 World Health Organization, Submission No 56, Appendix: *Background Document Electromagnetic Fields and Public Health, Cautionary Policies* [Draft], p 5.

88 Australian Council of Trade Unions (ACTU), Submission 89, p 8.

89 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 8.

> The profits from these technologies will be enormous. The benefits will be mostly to multinationals. This has to be balanced against a risk to public safety.[90]

4.137 Whilst many submissions to the inquiry advocated the inclusion of the Precautionary Principle in the Standard, the effect that this would have in practice was not made clear. It is reasonable to assume, however, that people want to be assured that the Government and the telecommunications industry were working to keep emissions to a minimum and that developments should proceed with caution.

4.138 Dr Repacholi warned against departures from the ICNIRP so-called science based standards. He said:

> … a few countries are now introducing additional ad hoc safety factors into the science-based standards as a precautionary measure. This undermines hundreds of millions of dollars worth of science that went into developing the standards, for no apparent benefit to health.[91]

4.139 Dr Repacholi advocated that the precautionary principle be addressed through a separate policy of voluntary precautionary measures:

> These voluntary measures can be through increased research, encouragement of manufacturers to keep exposures to the minimum needed for the technology, better risk communication, targeting audiences with honest and accurate information, public involvement in decision making, and the siting of facilities to minimise public exposure and concerns. People would generally be happy with those sorts of measures because it has their involvement and they do not feel taken out of the equation.[92]

4.140 However the Committee Chair considers that, in view of the internationally accepted definition of the precautionary principle, public consultation does not constitute a precautionary approach unless it is followed by mandatory precautionary action.

4.141 This voluntary approach has been adopted in Australia through the Radiofrequency Electromagnetic Energy Program and a Code of Practice for the Deployment of Radiocommunications Infrastructure, which will be developed and operate in parallel to the proposed new Standard for Exposure to Radiofrequency Fields.

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90 Telecommunications Officers Association, A Branch of the Communications Electrical Plumbing Union, Submission 66, Appendix 3, p 14.

91 *Official Committee Hansard,* Canberra, 31 August 2000, p 6.

92 *Official Committee Hansard,* Canberra, 31 August 2000, p 6.

The Precautionary Principle

4.142 The Precautionary Principle is applied in circumstances where there is scientific uncertainty. It reflects the need to take action for a potentially serious risk without awaiting conclusive scientific research.[93]

4.143 An internationally accepted definition of the Precautionary Principle was summed up in 1992 at the United Nations conference on Environment and Development in Rio de Janeiro.

> Where there are threats of serious or irreparable damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

4.144 Australia's Intergovernmental Agreement on the Environment (IGAE) notes:

> Essentially, the Precautionary Principle offers administrators advice about how to act responsibly in the face of uncertainty and lack of full scientific knowledge. Under this principle, policy makers are advised to use great care when authorising resource use where the outcomes of that use cannot be predicted with confidence, where one or more of the possible outcomes could have extremely adverse implications for future generations, or where no known substitutes exist for the resource being used.

4.145 The European Commission Communication on the Precautionary Principle states:

> The Precautionary Principle applies where scientific evidence is insufficient, inconclusive or uncertain – and preliminary scientific evaluation indicate that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the high level of protection chosen by the EU.

4.146 According to the draft Background Document from the World Health Organization:

> The Precautionary Principle may be adopted where there is "sufficient evidence" that an action or substance is harmful. Various actions can be taken depending on the strength of evidence, the seriousness of the harm that may be caused, and the degree of uncertainty about whether the harm is likely to occur. Possible choices for action range from prevention or elimination of exposure, to intermediate measures that reduce exposure only when it is cost-effective to do so, to taking no action unless stronger evidence is developed that harm is likely to occur.[94]

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93 World Health Organization, Submission No 56, Appendix: *Background Document Electromagnetic Fields and Public Health, Cautionary Policies* [Draft], p 2.

94 World Health Organization, Submission No 56, Appendix: *Background Document Electromagnetic Fields and Public Health, Cautionary Policies* [Draft], pp 2 and 3.

Prudent Avoidance

4.147 Prudent Avoidance prescribes taking low-cost measures to reduce exposure, in the absence of any scientifically justifiable expectation that the measures would reduce risk. Such measures are generally framed in terms of voluntary recommendations rather than fixed limits or rules.

As Low As Reasonably Achievable (ALARA)

4.148 ALARA is an acronym for As Low As Reasonably Achievable. It is a policy used to minimise known risks, by keeping exposures as low as reasonably possible, taking into consideration costs, technology, benefits to public health and safety and other social and economic concerns. ALARA is mainly used in the context of ionising radiation protection where there is no real lower threshold below which effects do not occur.

4.149 Dr Repacholi maintains that ALARA is not an appropriate policy for EMF (either powerline or radiofrequency fields) because no dose-response relationship has been established at low exposure levels and no mechanism of action is known that could cause any health problems at low levels. The Australian Standard 2772—1985 however incorporated the ALARA principle. According to Dr David Black, this application of the principle has been much criticised since. Reference to it was removed from the draft standard in 1998 and, according to Dr Black, it is not a feature of other international standards.[95]

4.150 Regardless of the names given to the various precautionary policies, submissions to the inquiry made it clear that people want to feel that they are not being exposed to harmful amounts of radiofrequency.

4.151 Those members of the TE/7 Committee who did not support the draft Standard, argued that the precautionary approach had been watered down to an unacceptable level. According to Mr Lyle from Standards Australia, the disagreement arose not over whether a precautionary approach should be included in the Standard, but about the wording of that precautionary approach:

> I think we said that, in the first meeting back in August 1998, that there was general agreement to use ICNIRP with a yet to be worked out precautionary approach. It was in the actual words of that precautionary approach. For the people who voted no, the issue was that it was getting watered down beyond a level which they thought was actually useful at all. It was in the wording, rather than whether it be included or not.[96]

95 Dr David Black, Submission 93, p 14.

96 *Official Committee Hansard*, Sydney, 16 November 2000, p 292.

Inclusion of precaution in the various standards

4.152 Radiofrequency Standards have in the past included reference to precautionary approaches.

AS 2772:1985

4.153 The 1985 Australian Standard included a precautionary approach in the form of the ALARA Principle. In its Preface it stated:

> Moreover it is recommended that the level of all electromagnetic fields should be kept as low as reasonably achievable.[97]

4.154 Clause 2, stated:

> Nevertheless, because of the increasing use of equipment generating radio-frequency radiation and the potential for exposure of individuals, all possible efforts should be made to keep such exposure as low as reasonably achievable (ALARA), below the prescribed limits. The overall economic and social consequences associated with the reduction of exposure to the individual and the public in general shall be taken into account.[98]

4.155 The ALARA Principle is further referred to in Appendix A (Rationale for the development of the maximum exposure levels for radio-frequency radiation) of the 1985 Standard.

AS2772.1:1990

4.156 The 1990 Standard included reference to the ALARA Principle in its Foreword as well as the recommendation that the level of all electromagnetic fields should be kept as low as reasonably achievable.[99] Other references to the principle remained the same as for the 1985 Standard.

AS/NZS 2772.1(Int):1998

4.157 The 1998 Interim Standard omitted reference to the ALARA Principle and instead, referred to the principle of Prudent Avoidance:

> While industry should not exceed the limits in this Interim Standard, exposure to workers and to the public should be kept to the lowest levels that can be achieved consistent with best international contemporary

97 Australian Standard 2772—1985, Maximum Exposure Levels—Radio-Frequency Radiation—300 kHz to 300 GHz, Standards Association of Australia, p 2.

98 Australian Standard 2772—1985, Maximum Exposure Levels—Radio-Frequency Radiation—300 kHz to 300 GHz, Standards Association of Australia, p 5.

99 AS2772.1-1990, Australian Standard, Radiofrequency radiation, Part 1: Maximum exposure levels—100 kHz to 300 GHz, p 5.

> practice and cost effective achievement of service objectives. This approach is consistent with the principle of prudent avoidance. …
>
> **SUBJECT TO THE CONDITIONS OUTLINED ABOVE, EXPOSURES SHALL BE KEPT TO A MINIMUM.**[100]

4.158 The CSIRO in its submission quotes its 1994 report *The Status of Research of Electromagnetic Radiation*: "The problem is that the standards imply safety thresholds but it is not possible to identify these on the basis of current equivocal or disparate research". Furthermore: "Only when a solid database of independently verified quantified bioeffects is available will meaningful safety standards be developed and reassurance of the public be achieved".[101]

DR 98627

4.159 The draft Australian/New Zealand Standard which was put forward for comment as a replacement for the Interim Standard, included reference to a precautionary approach, but this was omitted from the ballot document which was subsequently voted on and for which consensus could not be achieved.

4.160 The Foreword to the draft contained the words:

> This Standard draws extensively on the ICNIRP Guidelines and emphasises the need for a precautionary approach. …
>
> So while the basic restrictions in this Standard shall not be exceeded, the manufacturer/supplier, installer, employer/service provider and user must be able to demonstrate that exposure to workers and the general public is being kept to the lowest level that can be achieved, consistent with best contemporary practices and the cost effective achievement of service objectives. This is consistent with taking a precautionary approach.
>
> This precautionary approach involves application of best contemporary practice in achieving service, or process requirements to minimise incidental RF exposure.[102]

4.161 These words were repeated in clause 10 but later replaced, in the ballot draft with clause 10(d):

> Minimising, 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.

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100 AS/NZS 2772.1(Int):1998, Interim Australia/New Zealand Standard, Radiofrequency fields, Part 1: Maximum exposure levels—3 kHz to 300 GHz, p 5.

101 CSIRO Australia, Telecommunications & Industrial Physics, Submission 95, p 3.

102 DR 98627, Draft Australian/New Zealand Standard for comment, p iv.

> NOTE: Notwithstanding that ICNIRP considers that the basic restrictions and reference levels in this Standard provide adequate protection, it is recognized that community concerns over RF exposure may be able to be addressed by further minimization of exposure in accordance with the requirements of Clause 10(d).[103]

ACIF Code of Practice

4.162 In response to the failure of the Standards Australia process to agree to the new Australian Standard, responsibility was given to ARPANSA to formulate the Australian Standard. In addition, a code of practice was to be developed in parallel with the ARPANSA Standard by the Australian Communications Industry Forum (ACIF). According to the Australian Communications Authority (ACA), '[t]his complementary approach is intended to address both the need for hard exposure limits as well as non-technical matters that are also of concern to the community'.[104]

4.163 The ACIF is the peak telecommunications industry body in Australia which, according to the Australian Communications Authority, plays a critical role in assisting the self-regulation of industry through its work program of industry codes and technical standards.[105]

4.164 The ACA informed the Committee that the Code of Practice will take into account community concerns and draw carriers and service providers into agreement across the area.[106] It is intended that the Code will be registered by the ACA under section 117 of the *Telecommunications Act 1997*. Following registration the obligations on suppliers will become mandatory. The ACA may issue a written notice to a supplier to direct them to comply with the Code under section 121 and/or impose financial penalties for non-compliance.[107]

4.165 The ACIF has established a Radiocommunications Infrastructure Working Committee to develop the Code of Practice regarding electromagnetic radiation for the installation and operation of radiocommunications infrastructure. The Working Committee's task is to identify best practice which keeps radiofrequency exposure to the lowest practical level whilst still delivering a mobile telecommunications service that is cost effective. Design, risk communication and mitigation, and operations will be addressed.[108]

4.166 Members of the Working Committee come from the following organisations:

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103 Committee Ballot draft, p 27.

104 Australian Communications Authority, Submission 100, p 7.

105 Australian Communications Authority, Submission 100, Attachment A, p 13.

106 *Official Committee Hansard*, Sydney, 16 November 2000, p 307.

107 ACIF Draft Industry Code, The Deployment of Radiocommunications Infrastructure, DR ACIF C564, p b.

108 Electromagnetic Energy Public Health Issues Committee (CEMEPHI), Submission 127, p 20.

Table 4.5

Members of the ACIF Radiocommunications Infrastructure Working Committee[109]

Australian Communications Authority	Electromagnetic Radiation Awareness Network
Australian Local Government Association	EMR Alliance of Australia
Australian Telecommunications Industry Association	National Transmission Limited
Cable & Wireless Optus	Orange Hutchison
Communications Electrical Plumbing Union	Telstra Research Laboratories
	Vodafone

4.167 ARPANSA submitted that the Code of Practice will be complementary to the Standard and it is needed for the communications industry to set out how the Standard is met in various settings:

> Such a code may also deal with matters such as public consultation and industry practices taking into account cautionary approaches. … Additional codes of practice will be developed as required for relevant industrial, scientific and medical areas.[110]

4.168 However the Code requires limited public consultation processes and will not be prescriptive as to precautionary measures. Ultimately, this Code gives no assurance that the carriers will not site installations in sensitive areas.

Low impact facilities

4.169 The Committee received numerous submissions which were concerned with the siting of telecommunications towers and especially with the provisions of the low-impact facilities determinations. Ms Gail Darby said:

> I feel strongly that communities must be consulted about the location of all mobile phone towers, including those classified as "low impact". All towers must be subject to a development application to the relevant council. It is unacceptable that current legislation allows industry to completely ignore state and local planning considerations in erecting infrastructure. The government's policy of allowing industry to duplicate infrastructure

109 Australian Communications Authority, Submission 100, Attachment A, p 19.

110 Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Submission 128, p 8.

> systems, power lines or telecommunications, often many times over, exposes the public to multiple electro magnetic radiation (EMR).[111]

4.170 In order to develop Australia's first mobile phone networks in the early 1990s, Australia's telecommunications carriers were given wide-ranging immunities to town planning laws. With deregulation in 1997, some of these immunities were removed. Guidelines for building visible network infrastructure were set out in a national code devised and implemented by the ACA.

4.171 New or significant additions to towers and buildings were made subject to normal town planning approval and the consultative processes involved. However, under Schedule 3 to the *Telecommunications Act 1997*, those telephone companies licensed by the ACA as carriers, were permitted to install a limited range of facilities without seeking state or territory planning approval. The most common of these are known as low impact facilities and, according to submissions to this inquiry, have become a cause of angst for many people in the community. The Warrimoo Citizens Association said:

> Our Association recently had a confrontation with OPTUS, who without prior consultation, intended erecting Mobile Phone Antennae in the centre of the Village Precinct. A Public Meeting unanimously condemned this action and with the support of our Federal Member and unanimous support of the Councillors from the Blue Mountains City council OPTUS decided to locate in a more isolated area.[112]

> The majority of the citizens of Maleny (Queensland) were upset about the installation of a Digital Mobile Phone antennae on their water tower, because of the unknown effects of the digital radiation on human existence. That water is located in a residential area and only 150 metres from a hospital![113]

4.172 The issue can have broader social concerns in relation to schools and other community bodies that stand to benefit financially from allowing the placement of a tower on their grounds or buildings. Mr John Hyde commented:

> … we are seeing neighbours pitted against neighbours, churches against neighbouring pre-school centres, as telecommunications companies offer building owners money to host these roof-top facilities … Under-funded schools, community groups, churches and strata building owners are tempted by the seemingly high rental a mobile phone company will offer for you to allow them to erect a tower or transmitters on your roof.[114]

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111 Ms Gail Darby, Submission 34, p 1.

112 Warrimoo Citizens Association, Submission 4, p 1.

113 Maleny Residents' Action Group, Submission 86, p 1.

114 Mr John Hyde, Submission 137, p 1.

4.173 The Telecommunications (Low-impact Facilities) Determination 1997 lists those types of facilities defined as 'low impact'. These are facilities which, because of their size and location, are considered to have a low visual impact and do not raise significant planning, heritage or environmental concerns.[115]

4.174 Submissions observed that low impact only refers to low visual impact and not to the amount of electromagnetic radiation emitted. The maximum height of a low impact facility is 6.5 metres and the most commonly installed facility is 5.8 metres high. Overhead cabling and mobile phone towers (which are generally 25 – 30 metres high) are not classified as low impact facilities and their installation requires local council approval. Some other examples of low impact facilities are:

- small radiocommunications dishes and antennae;
- microcell installations;
- in-building coverage installations which are wholly contained and concealed in a building;
- extensions to towers not exceeding 5 metres in height (providing there have been no previous extensions to the tower);
- co-located radio facilities where the total volume of the co-located facilities is no more than 25 per cent greater than the volume of the original facility or the original infrastructure;
- underground cabling; and
- public payphones.

4.175 The Determination also defines where low impact facilities may be installed based on zoning considerations. For example, a facility that is deemed low impact in an area zoned rural or industrial may not be low impact if it is installed in a residential area.[116]

4.176 If a facility is to be installed in an environmentally significant area it cannot be a low impact facility. Areas of environmental significance are identified in the Determination as the following:

- an identified property for section 3A of the *World Heritage Properties Conservation Act 1983*; [the *World Heritage Properties Conservation Act 1983* has since been repealed]

115 Australian Communications Authority, Fact Sheet, *Installation of telecommunications facilities — A guide for consumers*, FSC 30 11/2000, http://www.aca.gov.au/licence/fsc30.pdf.

116 Australian Communications Authority, *Telecommunications Facilities, information for local government*, December 2000, at http://www.aca.gov.au/licence/3352towe.pdf

- an identified property (within the meaning of section 3A of the *World Heritage Properties Conservation Act 1983*); [the *World Heritage Properties Conservation Act 1983* has since been repealed]
- a place that Australia is required to protect by the terms of a listed international agreement;
- an area that is legally designated as a reserve for nature conservation purposes and the principal purpose of the designated reserve is for nature conservation;
- an area that is legally protected from significant environmental disturbance;
- an area that is entered in the Register of the National Estate or the Interim List for that Register;
- an area that is entered in a register relating to heritage conservation; and
- an area that is legally entered in a register or otherwise identified as being of significance to Aboriginal persons or Torres Strait Islanders, in accordance with their traditions.

4.177 A carrier authorised under the Act to install a low impact facility is immune from town planning and environmental laws. When installing low impact facilities, however, the carriers have certain obligations, including:

- taking all reasonable steps to ensure as little damage and inconvenience as practicable is caused;
- taking all reasonable steps to ensure that the land is restored to a condition that is similar to its condition before the installation began;
- acting in accordance with good engineering practice;
- notifying the owner and occupier of the land at least 10 business days before commencing the installation; and
- taking all reasonable steps to co-locate facilities with the existing facilities of other carriers and public utilities.

4.178 Many community groups have been formed with the main objective of opposing the installation of a low impact facility. The major complaints are that these facilities are installed without consultation, they are placed near sensitive places such as schools, nursing homes and hospitals, and in residential areas. The Municipal Association of Victoria is concerned that the low impact facilities determination exemption allows the carriers to bypass the requirements for high impact facilities:

> Councils have reported that Carriers are making minor modifications to high impact facilities so that they resemble low impact facilities and don't require planning approval.[117]

4.179 Suppliers seeking to enjoy the benefits of the low impact facility exemptions must comply with registered Codes.[118] If low impact facilities are deployed without compliance with the ACIF Code of Practice after it is registered with the ACA, they will become subject to state and territory town planning laws.

4.180 For the Committee's recommendation relating to the low impact facility determination, see Chapter 2, Recommendation 2.5.

4.181 Dr Repacholi said he recognises that the public is concerned about mobile telephones and their infrastructure:

> I know that the public has tremendous concerns, and I empathise with those concerns, because the technology has been propagated into people's working and living environments without very much consultation. It is a technology that very few people know much about and, quite reasonably, when such base stations are placed in schools, parents would ask, 'Are there any health effects?' and if we are in a period of debate about the science then that is not very reassuring for parents.[119]

4.182 According to the Australian Mobile Telecommunications Association (AMTA), the industry attempts to limit the amount of mobile phone base stations and to minimise their visual impact:

> There are a large number of base stations in the nation. We recognise that, and the industry is very aware of the visual impact that that creates. There is a concerted effort by industry to co-locate. In fact, there is almost a national average of two carriers per site, per tower. Where we cannot co-locate the industry looks to locate on existing structures such as water tanks and HV [high voltage] powerlines if we can. Again, it has to fit in with the honeycomb network and only where necessary do we opt for a new tower in the area.[120]

4.183 The Australian Mobile Telecommunications Association (AMTA) informed the Committee that it has undertaken three initiatives in relation to concerns over telecommunications infrastructure: a national collocation taskforce, a code of conduct and a 'Know Your Rights' booklet. AMTA informed the Committee that:

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117 Municipal Association of Victoria, Submission 148, p 4.

118 ACIF Draft Industry Code, The Deployment of Radiocommunications Infrastructure, DR ACIF C564, p b.

119 *Official Committee Hansard,* Canberra, 31 August 2000, p 2.

120 *Official Committee Hansard*, Canberra, 8 September 2000, p 33.

> [w]e have become aware that our processes of working with each other to facilitate collocation have not been as good as they could be. We have established a national group to review that and in fact established regional groups in each city to review our processes for collocations to see whether we can do even better.[121]

4.184 The National Collocation Taskforce is designed to get the carriers to work together so that when there has to be a new tower in an area, they go to a local council in twos and threes rather than singly. However, some submissions argue that co-location means an accumulation of radiofrequency emissions. The Sutherland Shire Council, in its submission, outlined the following problem with adding low impact facilities to existing infrastructure:

> After the installation of the high impact facility - additional antennae and dishes may be added to the existing structure as 'low impact' facilities. This can dramatically change the visual impact and EMR emissions associated with the structure which can significantly change the conditions under which approval was granted for the original high impact facility.[122]

4.185 With respect to mobile phone base stations, the Standard requires the aggregate of radiofrequency electromagnetic emissions coming from all antennas on a single tower, or group of towers, to comply with the exposure limit set by the Standard.

4.186 The second AMTA initiative has been the development of the Code of Conduct within the Australian Communications Industry Forum (ACIF), and the third initiative which has been undertaken is to develop a 'Know Your Rights' booklet that is a layperson's guide to the various regulations and regulators to assist communities in understanding their rights in relation to the building of telecommunications infrastructure.[123]

Labelling of phones

4.187 One of the issues relating to a precautionary approach, was a call in the submissions and by witnesses for the labelling of mobile phones. While the debate about safety of radiofrequency radiation continues, the public should be alerted to the fact that the phones do emit radiofrequency radiation and that they should be used with caution.[124]

4.188 The Consumers' Telecommunications Network (CTN), believes that consumers have the right to make informed choices about the purchase and usage of

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121 *Official Committee Hansard*, Canberra, 8 September 2000, p 35.

122 Sutherland Shire Council, Submission 130.

123 *Official Committee Hansard*, Canberra, 8 September 2000, p 35 [Havyatt].

124 Telecommunications Officers Association Branch of the Communications Electrical Plumbing Union, Submission 66, p 8.

mobile phones. It proposes that a mobile phone handset testing and labelling regime be mandated and extra warnings be implemented in relation to the sale of mobile phones to children and young people:

> Many people have concerns or differing perceived needs relating to mobile phones. In an open, competitive market, consumers ought to be able to make informed choices about the product that best suits their needs. Provision of information about choices does not imply that any one option is a health risk. Mobile phone handsets should be labelled with warning information about potential health risks. Information should also be provided about hands-free kits and other adaptive or 'protective' devices intended for use in conjunction with a mobile phone. [125]

4.189 The CTN suggested that, because many factors influence the levels of radiofrequency radiation experienced by the user of a mobile phone, an EME rating scale should be devised and that this EME rating should be indicated on the handset:

> A rating of a number between say, 1 and 10 could be allocated for each factor and added to give a total score. Thus a handset which is very good on one factor and not so good in others might obtain a better score than one which is all round average.[126]

4.190 According to the CTN, the phone should be accompanied by a point of sale leaflet included in the packaging with details of how the rating is calculated.

4.191 The Committee recognises the difficulty in attempting to compare phones because of the complexity of the technical details which the consumer is being asked to assess. Depending on the technology used, there are differences in the output of radiofrequency energy between digital handsets and analogue units, as well as between GSM and CDMA mobile phones. In addition, the output of the most modern handset is adaptively determined by the base station. Consequently, a user's exposure to radiofrequency energy from a high-SAR phone in a region of strong base station signal might easily be lower than from a low-SAR phone in a weak signal area. Although both GSM and CDMA phones are power controlled, when the GSM phone is operating, it is not power controlled to the same extent as the CDMA phone.[127]

4.192 There are also complexities in using the Special Absorption Rate (SAR) to distinguish phones. A decision has to be made whether the peak SAR in the head should be chosen or the 1-gram or 10-gram averaged SAR. An analogue unit which emits continuous wave energy with an SAR near regulatory limits needs to be compared with a digital unit, which emits energy in brief pulses and whose peak SAR

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125 Consumers' Telecommunications Network, Submission 101, p 2.

126 Consumers' Telecommunications Network, Submission 101, p 2.

127 *Proof Committee Hansard*, Canberra, 2 March 2001, p 384 [Bundrock].

might exceed the average SAR from the analogue unit.[128] When a phone is tested in laboratories to determine its SAR, it is done so at its maximum power.[129] The SAR in its normal operation may be significantly lower than this.

4.193 The NATA accredited company Electrical Compliance Testing Association (ECTA), while supportive of a labelling regime which provided SAR values for mobile phones, added the following caution:

> The benefits of publicly available SAR values will only be achieved if:
>
> i. SAR Testing [is] accredited and independent.
>
> ii. A standardised test method [is] used.[130]

4.194 In August 2000, the Australian Communications Authority (ACA) announced that it had reached agreement with AMTA and industry representatives to make information about the maximum emission levels of mobile phones more readily available. This will be a voluntary scheme but the hope is that participating manufacturers will gain a competitive advantage in joining and this will encourage involvement in the scheme.

4.195 According to AMTA, participating AMTA members will make available to consumers information on the SAR of mobile phones.[131] The introduction of this initiative is dependent on the development of an internationally accepted SAR testing methodology and suitable testing equipment becoming available. AMTA expects that resolution of these issues will be some time after April 2001.

4.196 The draft proposal for the mobile phone labelling scheme involves manufacturers placing a label on the outside packaging of the mobile phones. This label will exhibit an 'A-tick' and the text:

> The A-Tick (*show A-tick*) shows this phone complies with all current ACA standards, including for exposure to radio frequency energy.
>
> More information is inside this package or at http://www.amta.org.au/sar

4.197 In addition, participating manufacturers will include information within the product packaging which reiterates that the phone complies with the ACA limits and includes general information on SAR, the standards, as well as the maximum SAR value of the particular phone. This information may be included as an insert or leaflet to be located with the user manual.

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128 Paul Slovic, *Are mobile phones safe? Will people believe mobile phones are safe?* at www.spectrum.ieee.org/publicfeature/aug00/prad.html

129 *Proof Committee Hansard*, Canberra, 2 March 2001, p 366 [Joyner and Harrison].

130 Electrical Compliance Testing Association, (ECTA), Submission 98, p 2.

131 Australian Mobile Telecommunications Association (AMTA), Submission 19(a).

4.198 AMTA also informed the Committee that all manufacturers in AMTA will have a web site that will provide SAR information on their own individual models.

4.199 Whilst the Committee is supportive of any moves by the industry to inform consumers about its products, the AMTA scheme does not seem likely to provide Australian consumers with world's best practice in labelling schemes. The depiction of the A-tick to show compliance with the Standard is already an ACA regulatory requirement for the labelling of mobile phones.

4.200 Generally, submissions to this inquiry wanted SAR information to enable consumers to make an informed choice between phones, and not necessarily to prove compliance with the Standard. If consumers can easily compare emission levels between phones, market forces will act to encourage manufacturers to minimise these levels as those phones with lower outputs may be favoured by consumers. The Committee is of the view that SAR information should be available at the point of sale and not inserted inside the packaging only to be discovered after the phone has been purchased.

4.201 The Committee Chair recommends the following points to convey to purchasers of mobile phones:

- because there is a growing body of evidence indicating biological effects from mobile phones that, as a precautionary measure, it would be advisable to make fewer and shorter calls and to avoid operating mobile phones in situations where they need to use maximum power;
- a graphic illustration of the absorption into the head of radiofrequency radiation;
- specific absorption rate (SAR) values of particular phones and the relevance as a measure of exposure; and
- the effect of hands-free kits and shielding devices on limiting emission levels.

4.202 The Committee notes the contrast between the provision of this information and that proposed by AMTA in its leaflet.

4.203 In addition, the Committee concurs with the recommendations of the Stewart Report:

> 6.77 We recommend that information on SAR values for mobile phones must be readily accessible to consumers:
>
> - at the point of sale with information on the box,
> - on leaflets available in stores giving comparative information on different phones and with explanatory information,
> - as a menu option on the screen of the phone, and as a label on the phone,

- on a national web site, which lists the SAR values of different phone types.[132]

Testing for compliance with the Standard

4.204 The Australian Communications Authority Standard (Radiocommunications (Electromagnetic Radiation—Human Exposure) Standard 1999) is the current Australian Standard with which equipment must comply.

Portable devices

4.205 The manufacturer or distributor of portable devices is responsible for compliance with the Standard. Mobile phones are designed as either Category A or Category B. Category A phones are low power devices with little risk of exceeding the mandatory Standard. Manufacturers of these devices must meet the limits of the Standard but are not required to demonstrate compliance. However, there may be circumstances where the ACA may request evidence of compliance.[133]

4.206 Category B phones are devices that require routine evaluation against the Standard according to the test method given in the Standard. An accredited body must do the test.

Transmitter installations

4.207 Transmitter installations are also divided into two classes, Category 1 and Category 2. The licensee is responsible for compliance with the Standard.

4.208 Category 1 installations are deemed compliant with the Standard for reasons such as low power or inaccessibility, but are not exempt from compliance with the Standard. If there is a reasonable suspicion that an installation is not compliant, the ACA may require the licensee to demonstrate compliance.[134]

4.209 Category 2 installations must be assessed for compliance with the standard. Self assessment of compliance may be permitted.

Criticism of compliance framework

4.210 The Electrical Compliance Testing Association (ECTA) considered that the ACA audits of compliance documentation are not rigorous enough to detect non-compliance:

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132 Independent Expert Group on Mobile Phones (IEGMP), *Mobile Phones and Health*, 2000, p 119.

133 Australian Communications Authority, Submission 100, Attachment A, p 14.

134 Australian Communications Authority, Submission 100, Attachment A, p 14.

> Anecdotal evidence suggests that the audits are simply paper audits that do not scrutinise the technical content of the reports, which are the technical basis for EMR compliance.[135]

4.211 ECTA asserted that the quality of some of the EMR testing is of dubious validity, particularly when carried out by the manufacturers themselves, or by poorly equipped laboratories that do not have adequate test equipment or sufficient expertise. The reports from such laboratories may appear valid but careful scrutiny often shows that the EMR compliance of the subject mobile phone is questionable.

4.212 ECTA believed that the major manufacturers of mobile phones are generally diligent, but it is concerned that the current system is not transparent to the public:

> Our experience is that the top end of town is usually very diligent in what they do with regard to the quality of their testing and compliance requirements. I have to emphasise that. However, the closer you get to the bottom end of the market, the more you will find that the requirements are often ignored. Sometimes they take shortcuts, sometimes they do not bother to do anything and sometimes they just fill out a declaration of conformity without having any basis for that, like a test report. So there is a wide gap between those that are absolutely diligent and those that are just interested in commercial realities, in surviving the next day.[136]

4.213 Dr Repacholi told the Committee that although he has had assurances that mobile phones in Australia comply with the Standard, he would like to see testing of mobile phones:

> If you have a standard, you should determine compliance with it. I do not trust the manufacturers to say, 'Yes, we're doing it'.[137]

Testing of shielding devices

4.214 The Committee received evidence about devices which purport to reduce emissions from mobile phones and other electronic equipment. In some cases, far from reducing emissions, these products can actually increase them. Mr Chris Zombolas, Vice-President, Electrical Compliance Testing Association, told the Committee:

> … a lot of devices are being sold on the market that claim to reduce radiation and hence reduce cancer and all those other effects. We have done a lot of testing for these same suppliers and, in our view, most devices do not work. Perhaps one or two have some basis but, in general, these devices will increase the exposure rather than do what they claim - that is, decrease it. Not only do they increase the exposure but they affect the performance of

135 The Electrical Compliance Testing Association, Submission 98, p 1.

136 *Official Committee Hansard*, Melbourne, 22 September 2000, p 157.

137 *Official Committee Hansard,* Canberra, 31 August 2000, p 13.

> the phone, so you get drop-outs happening very often. The battery goes flat really quickly because it has to raise its power level.[138]

4.215 The Committee is concerned that there is no applicable standard for these devices and nor is there a requirement to test their effectiveness in reducing exposure. For the Committee's recommendations in this regard, see chapter 2, Recommendation 2.4.

Other precautionary measures

4.216 Despite the assurances of AMTA that'[p]resent scientific information does not indicate the need for any special precautions for the use of mobile phones …',[139] the Committee has heard from numerous individuals who wish to apply precautionary measures to their mobile phone usage. According to the IEGMP, they can do this by ensuring that the phone's antenna is fully extended and held away from the head; and by using an approved, hands-free set.[140] In addition, the phone should not be placed against any part of the body when it is turned on.[141] According to the CSIRO, tests done on phones under worst-case conditions (ie with the antenna touching the head) have exceeded the recommended limit in standards, and so it is important that people are made aware of this.[142] The Committee notes newer phones do not have extendable antennas and that many users keep phones clipped close to their bodies for lengthy periods.

Occupational Standards

4.217 Standards Australia originally prepared AS 2772 at the request of the communications industry, to cover both occupational and non-occupational exposure to non-ionising radiation. In the late 1980s it was agreed that AS 2772.1 would be amended to exclude occupational limits if, and when, the National Occupational Health and Safety Commission (NOHSC) published a national standard to cover occupational exposure limits. However the NOHSC working group which was formed to prepare these standards failed to arrive at a consensus solution, and so the Standards Australia standard was never amended in this way.[143]

4.218 The Consumers Telecommunications Network advised the Committee that it had received few inquiries from employers about the possible health risks to

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138 *Official Committee Hansard*, Melbourne, 22 September 2000, p 159.

139 *Official Committee Hansard*, Canberra, 8 September 2000, p 33.

140 Independent Expert Group on Mobile Phones (IEGMP), *Mobile Phones and Health*, 2000, p 119.

141 *Official Committee Hansard*, Melbourne, 22 September 2000, p 158-159.

142 CSIRO Australia, Status of research on biological effects and safety of electromagnetic radiation: Telecommunications frequencies, June 1994, p 129.

143 Standards Australia International Limited, Submission 133, p 1.

employees who are required to use mobile phones for their work. The Committee considers that occupational exposure is potentially a significant health concern.

4.219 The Committee received submissions which criticised both the inclusion of occupational and general standards in the one document and the fact that the occupational standard allows higher exposure than does the general population standard.

4.220 The Committee heard evidence from OneSteel Market Mills which manufactures steel pipe, tube and structural profiles. OneSteel is concerned that its range of magnetic induction heating and welding units has been caught up by the exposure Standard for radiofrequency fields, and that this is inappropriate. OneSteel's concerns extended to the wider metal-manufacturing industry which it contends is generally unaware of the likely consequences, or indeed the existence of the exposure standards. OneSteel advocates that there be a separate standard for the metals industry.[144]

4.221 However, the ARPANSA draft standard is intended to cover the equipment of the metals industry, as Mr Wayne Cornelius from ARPANSA, informed the Committee:

> I see a precautionary approach applying more to the high power industrial uses of radiofrequency, like RF welders, over which we would like to see a bit more control as perhaps significant areas where people may right now be overexposed, as we would see it.[145]

4.222 The Community and Public Sector Union advocated that occupational limits in the Standard should be set at the lower general public exposure limits.[146] It cited research showing that workers operating radiofrequency welders, dryers and induction heaters are being exposed to radiofrequency radiation in excess of the exposure limits.

4.223 The ACTU challenged the assumption that occupational radiofrequency exposures are 'controlled' and that this justifies higher exposures for workers:

> The ACTU would warn against any assumption that occupational exposures to RFR are currently being adequately identified, let alone 'controlled'. There is no justification for workers being exposed to a hazard at levels higher than is allowed for the general public.[147]

4.224 The Committee notes evidence provided by Dr Hocking in relation to the termination of his employment as Chief Medical Officer with Telstra. While the Committee does not wish to comment on this individual case, it supports

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144 BHP Structural and Pipeline Products [OneSteel Market Mills], Submission 77.

145 *Proof Committee Hansard*, Canberra, 2 March 2001, p 347.

146 Community and Public Sector Union (CPSU), Submission 110, p 3.

147 Australian Council of Trade Unions (ACTU), Submission 89, p 13.

Dr Hocking's concern that Chief Medical Officers in any organisation should be able to investigate health issues without interference, in accordance with guidelines to ensure that sound OH&S practices are followed, and employees' health safeguarded.

4.225 The World Health Organization initiative to harmonise EMF standards is, in part, a response to the fact that many countries from the former Soviet Union and Eastern bloc countries are now considering new EMF standards. The Committee has been told that these countries often have exposure levels many times below those of western countries.[148] Dr Repacholi advised that if the limits in those countries were actually complied with, no modern technology would be able to operate.[149]

4.226 Globalisation of trade and the rapid introduction of mobile telecommunications worldwide, have focussed attention on the differences which exist between standards. Differences between standards in Eastern European and Western countries can be large. For example, the levels in the Russian standard are about a thousand times below those in international standards. As emissions from mobile phones are approximately 100 times the levels in this standard, it becomes obvious that the Russian standard cannot be complied with, regardless of its exposure levels.[150] The differences between levels in various countries' standards raise concerns about their safety and have led to public anxiety about increasing EMF exposures from the introduction of new technologies.

4.227 Mr Don Maisch told the Committee that the Russian standards were based on actual effects on workers, whereas the West has concentrated more on the results from high level animal studies when establishing its standards.[151]

ARPANSA Working Group Draft Standard

4.228 The ARPANSA Working Group released its Standard (Radiation Protection Standard Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz) as a draft for public comment on 3 March 2001.

4.229 Dr John Loy, Chief Executive Officer, ARPANSA, emphasised that the draft will be widely available and public comment will be sought by 11 May 2001. After comment is received, the working group will be charged with reviewing the public comment and making such further changes to the draft as it considers warranted. The Radiation Health Committee will receive a revised draft standard from the working group together with a description about how each of the public comments has been addressed.[152] The Committee supports this approach.

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148 Mr Don Maisch, Submission 20.

149 *Official Committee Hansard*, Canberra, 31 August 2000, p 13.

150 *Proof Committee Hansard,* Canberra, 31 August 2000, p 13.

151 *Official Committee Hansard*, Melbourne, 22 September 2000, p 98.

152 *Proof Committee Hansard*, Canberra, 2 March 2001, p 341.

4.230 The Draft Standard determines a number of basic restrictions. These are limits to exposures expressed in fundamental measures, and compliance with these limits would be mandatory. The restrictions are intended to prevent harm at various frequency ranges, arising from electrostimulation of excitable tissue; whole body heat stress; excessive localised temperature rise in tissue; annoying or startling auditory effects; and excessive heating in tissue at or near the body surface.[153] The limits in the draft standard would prevent local temperature rises of no more than about 0.1°C, and there would not be any observable core temperature rises.

4.231 Dr John Loy, Chief Executive Office, ARPANSA, informed the Committee that the Draft Standard defines indicative reference levels from measurable quantities derived from the basic restrictions. These reference levels are required because the mandatory basic restrictions are often specified as quantities that are impractical to measure. The reference levels are intended to be conservatively formulated such that compliance with them ensures that the basic restrictions are met. The reverse does not necessarily apply. It could be that there would be circumstances where reference levels are exceeded but the operator could demonstrate compliance with the basic restrictions:

> In summary, the basic restrictions are the black-letter law; the reference levels are intended to be measurable quantities. If you fall within the reference levels, you are clearly in compliance with the basic restrictions.[154]

4.232 The basic restrictions with their corresponding reference levels appear in the table below:

Table 4.6

ARPANSA Draft Standard - Basic restrictions and corresponding reference levels

Basic restriction	**Corresponding reference levels**
Instantaneous spatial peak current density (3 kHz - 10 MHz)	Instantaneous E and/or H (3 kHz - 10 MHz) and instantaneous contact currents (3 kHz - 10 MHz)
Whole body average SAR (100 kHz - 6 GHz)	Time averaged E and/or H (100 kHz - 6 GHz)

153 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 341-342 [Loy].

154 *Proof Committee Hansard*, Canberra, 2 March 2001, p 342 [Loy].

Spatial peak SAR in limbs (100 kHz - 6 GHz)	Time averaged E and/or H (100 kHz - 6 GHz) and/or induced limb currents for the legs and arms (10 MHz - 110 MHz) and contact point currents (100 kHz - 110 MHz)
Spatial peak SAR in head & torso (100 kHz - 6 GHz)	Time averaged E and/or H (100 kHz - 6 GHz)
Instantaneous spatial peak SAR in head & torso (10 MHz - 6 GHz)	Instantaneous E, H or power flux density (10 MHz - 6 GHz)
Spatial peak SA in the head (300 MHz - 6 GHz)	Instantaneous E , H or power flux density (300 MHz - 6 GHz)
Time averaged and instantaneous power flux density (6 GHz - 300 GHz)	Time averaged and instantaneous E or H (6 GHz - 300 GHz)

4.233 The basic restrictions are intended to prevent harm at various frequency ranges as follows:

- electrostimulation of excitable tissue (3kHz-110 kHz);
- whole body heat stress (100kHz-6GHz);
- localised temperature rise - head, torso and limbs (100kHz-6GHz);
- microwave hearing effect (300MHz-10GHz); and
- excessive tissue heating at/near body surface (6-300GHz).[155]

4.234 Dr Loy told the Committee that the Draft Standard adopts the ICNIRP restrictions and reference levels, but it extends the ICNIRP Guidelines in several ways. The Draft Standard includes additional basic restrictions to protect against pulses, and a reduced frequency cut-off for specific absorption rate and specific absorption from 10 gigahertz to 6 gigahertz, which gives better protection against surface heating. There is better continuity in the reference levels across the frequency bands, in addition, it is more conservative at some point frequencies. Finally, the draft standard has been rigorously defined to work as a standard rather than simply as guidelines - it provides unambiguous limits for exposures.[156]

4.235 Mr Wayne Cornelius, Manager, EMR and Laser and Optical Radiation Branch, ARPANSA, elaborated on these points for the Committee:

155 ARPANSA/CEMEPHI, Overhead presentation at hearing on 2 March 2001, Canberra.

156 *Proof Committee Hansard*, Canberra, 2 March 2001, pp 342-343.

> … instantaneous spatial peaks are an additional basic restriction that we have added. It is implied in the ICNIRP guidelines, but it is something that we have had to identify clearly as being part of the standard and as a basic restriction. Also spatial peak specific absorption in the head, as related to very short pulses, was something that was implied in a footnote to one of the ICNIRP basic restriction tables, but we have drawn it out to clearly show that that is what is intended.[157]

4.236 These additional basic restrictions should address the concerns expressed by witnesses about averaging times. In the draft standard it is clear that high bursts of EMR which go above the basic restrictions will not be permitted by the standard.

4.237 Despite claims in submissions and by witnesses that the ARPANSA Working Group had been directed not to include a precautionary approach in the new Standard, the draft document does include a form of precautionary approach. Section 5 of the Standard (Protection - Occupational and general public exposure) states:

> It is generally sensible in achieving service or process requirements to minimise unnecessary or incidental RF exposure, provided it does not introduce other risks and can be achieved at modest expense.[158]

4.238 In addition, Annex 6 to the Draft Standard discusses 'A public health precautionary approach to radiofrequency radiation'. There are also additional precautions for pregnant workers who should advise their employer when they become aware of their pregnancy, after which they must not be exposed to RF fields exceeding the general public limits. This is to reduce the risk of accidental exposure to RF fields in excess of the occupational limits.

4.239 The very recent release of the Draft Standard has meant it has not been possible for the Committee Chair to check the validity of ARPANSA's assurances.

Conclusion

4.240 Having reviewed the evidence, the Committee Chair does not support the decision to transfer the responsibility for setting a new Australian Standard for electromagnetic radiation to the Australian Radiation Protection and Nuclear Safety Agency.

4.241 The Committee Chair does not have a view as to which body should be charged with the responsibility for standard setting but believes that the process should ensure that the scientific advice which informs the decision-making should be completely independent of commercial interests and that consumers and other non-commercial stakeholders should be involved in the voting process.

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157 *Proof Committee Hansard*, Canberra, 2 March 2001, p 343.

158 Radiation Protection Standard Maximum exposure levels to radiofrequency fields — 3kHz to 300GHz, ARPANSA, Draft for Public Comment, p 22.

4.242 The Committee Chair, on reviewing the evidence, does not support the implementation of standards which are in line with the ICNIRP Guidelines, but instead recommends that the level of 200 microwatts per square centimetre in the expired Interim Standard (AS/NZS 2772.1(Int):1998) be retained in the Australian Standard.

Recommendation 4.1

The Committee Chair recommends that the radiofrequency standard be defined and administered by a process similar to that used by Standards Australia.

Recommendation 4.2

The Committee Chair recommends that the level of 200 microwatts per square centimetre in the expired Interim Standard (AS/NZS 2772.1(Int):1998) be retained in the Australian Standard.

GOVERNMENT MEMBERS COMMENTS

1.1 The Government members wish to make the following comments about the Report.

1.2 While there may be some ***biological*** effects from low levels of RF radiation, Government members consider that, in contrast to the conclusions drawn at paras 2.104 and 2.140, it would be more appropriate to conclude from the evidence that the possibility of biological effects (and thus possibly *health* effects) argues for a precautionary approach.

1.3 Government members are concerned at the Report's lengthy criticism of the NHMRC processes and the funding decisions made. Government members do, however, agree with the conclusion, which was only grudgingly reached in the Report, that the Committee did not find evidence that the NHMRC has been deficient or biased in its allocation of the research funds (see para 3.101).

1.4 Government members support the conclusion, grudgingly arrived at in the Report, that the Committee did not find evidence of industry bias within the NHMRC (see para 3.80 of the Report).

1.5 Government members are opposed to the enormous increase in funding for research – to $40 million – recommended in the Report.

1.6 Government members note that while the Report reaches the conclusion that the RF standard should be set by a process similar to that adopted by Standards Australia, this process was unsuccessful in revising the Standard recently.

1.7 Government members also note that the Report has ruled ARPANSA out of the standards setting process apparently because of the history of the Nuclear Safety Bureau, its precursor (see para 4.123) and because there are members with industry interests on the ARPANSA working group. However, it is not clear to Government members why that should be considered inappropriate for ARPANSA but acceptable in the Standards Australia process. Government members support the role of ARPANSA in the standards setting process.

1.8 Government members support the following recommendations:

Recommendation 2.4 — testing, labelling and regulating shielding and hands-free devices

> Many of these products are sold on the basis of claims that they reduce electromagnetic radiation. Consumers need to be protected against unscrupulous merchants who take advantage of people's fears, and especially against those products which, rather than decreasing emissions, may have the effect of increasing them. In addition, Government members are concerned

that the use of these devices may negate the compliant status of the product to which the shielding device is attached. This situation needs to be addressed.

Recommendation 2.6 — development of an industry code of practice for handling consumer health complaints

Government members consider that the current situation, where it is unclear where consumers should go with a health complaint related to mobile phone use, is a cause for concern. Government members consider that it is important for the telecommunications industry to be prepared to respond to consumer concerns by having appropriate procedures in place for dealing with mobile phone related health complaints.

Recommendation 2.7 — the establishment of a centralised complaints mechanism

Government members, while recognising that research is being undertaken to investigate the causes of a range of symptoms attributed to mobile phone use, nevertheless consider that the development of a database of reports of adverse health effects from mobile phones and other sources of radiofrequency radiation would assist researchers in formulating future research hypotheses, and contribute to public confidence in measures being adopted to minimise health risks associated with EMR.

Recommendation 2.8 — sponsoring of consensus conferences by the Commonwealth Government

Government members believe that the perceived disenfranchisement of some members of the public may be redressed by enabling their participation in conferences aimed at informing the community about the current status of research into the effects of electromagnetic radiation and the implications for human health.

1.9 Government members make the following comments in relation to the remaining recommendations:

Recommendation 2.1 — encouragement of additional research into extremely low frequencies and TV/radio tower exposure

To the extent that this recommendation relies on the recent 'Doll' report, the issue is one of an *association* between *magnetic fields* and childhood leukaemia, not powerlines per se. The Committee did not hear much evidence on this issue and, in this light, the basis for the recommendation could be queried. In addition, the Committee's terms of reference specifically relate to telecommunications applications, and therefore this recommendation falls outside the scope of this inquiry.

A national survey of domestic magnetic fields would, however, be useful.

Recommendation 2.2 — precautionary measures for the placement of powerlines

See comments on Recommendation 2.1. While the association between magnetic fields and childhood leukaemia needs to be taken seriously, the strength of the evidence and the effect, if real, may not warrant expensive further precautions at this stage. In addition, the Committee was informed that the electricity industry already adopts a prudent avoidance approach in the design and operation of its electricity generation, transmission and distribution systems.

Furthermore, the Committee's terms of reference specifically relate to telecommunications applications and therefore this recommendation falls outside the scope of this inquiry.

Recommendation 2.3 — that the Commonwealth Government considers developing material to advise parents and children of the potential risks associated with mobile phone use

It is debatable whether there is such a 'growing body of research' referred to in this recommendation. The public should be made aware that mobile phones do emit electromagnetic radiation and that they should be used prudently. Therefore, the development of independent material to advise people about what is known about mobile phone radiation is supported.

Recommendation 2.5 — that the Government review the Telecommunications (Low-impact Facilities) Determination 1997

The LIF Determination was last reviewed in 1999 and that an ACIF (Australian Communications Industry Forum) Code currently being developed provides for greater consultation with community groups on the siting and operation of telecommunications equipment including low impact facilities.

Recommendation 2.9 — listing of a study into *p53* mice to encourage future research applications

It is questionable whether the Committee has the expertise to make a judgment about the value of such a study.

Recommendation 3.1 — collection of $5 per annum for each mobile phone in use

The Government members believe it is appropriate that the present levy and funding ($1 million per annum) continue.

Recommendation 3.2 — maintenance of $4 million per annum for the NHMRC-administered research program, with the balance to be used by the CSIRO to establish a research program and specialised research unit

> See comments on Recommendation 3.1. It should be noted that the CSIRO Division of Telecommunications and Industrial Physics has an annual budget of $60 million and apparently spends none of it on RF health research. If the CSIRO sees such research as a priority, presumably it would have already undertaken such a program.

Recommendation 4.1 — formulation and administration of the radiofrequency standard by a process similar to that used by Standards Australia

> The Parliament has set up ARPANSA and the Radiation Health Committee to, inter alia, prepare national standards to protect the health of people against harmful effects of radiation. ARPANSA's expertise and international experience in setting standards are considerable. In addition, the ARPANSA process includes expert independent working groups involving people from community groups. There is a clear process of public input going on at present with the draft RF standard. Given ARPANSA's resources, experience and statutory backing, it is the Government members' view that ARPANSA should be left to get on with the job.

Recommendation 4.2 — that the level of 200 microwatts per square centimetre in the expired Interim Standard be retained in the Australian Standard

> The Standard is based upon known health effects largely based upon heating effects. The Standard should be set scientifically on this basis, and if earlier Standards were incorrectly based, they should not stand simply on the basis of a precautionary approach. A Standard is 'black letter law'. Precautionary approaches – that may be warranted by scientific uncertainty about athermal effects – should apply outside the Standard.
>
> As part of its formulation of an Australian Standard, ARPANSA re-examined the basis of the Standard by reviewing standards throughout the world. It determined, from a scientific point of view, what would be the most applicable standard. Government members support the approach taken.

1.10 In addition to the recommendations already supported, Government members believe that purchasers of mobile phones should have information to allow them to make informed choices about personal exposures resulting from their use of mobile phones. Government members therefore support the labelling of mobile phones and information at point of sale along similar lines to that recommended by the Stewart Report (see para 4.203 of this Report).

Senator John Tierney (**Deputy Chair**)
Senator for NSW

MINORITY REPORT BY LABOR SENATORS

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RECOMMENDATIONS OF LABOR SENATORS

Research:

Labor Senators conclude there is justification to some of the criticisms of past studies of the physical and health effects of EMR. Accordingly, Labor Senators support ongoing research into potential adverse effects of EMR. (Chapter 4, p 209)

Labor Senators note that in the light of the limited resources available for research into health issues where causes are identifiable, and given the existing inconclusiveness of the many completed studies into EMR, the funding available for EMR research does not appear to be inadequate. (Chapter 3, p 196)

Labor Senators conclude that there does not seem to be an identifiable problem with expenditure of funding by NHMRC on the evidence. (Chapter 3, p 195)

Standards Setting:

Labor believes that Standards Australia should be the primary body for setting standards. However, in this case, Labor Senators conclude that Standards Australia failed to achieve an outcome. This is because the structure of Standards Australia in this instance allowed a small proportion of participants to exercise a veto on any outcome. Accordingly, this ongoing failure warranted the transfer of responsibility for setting a standard to an alternate body such as the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). (Chapter 5, p 217)

Labor Senators find no substantial criticism of the transfer of the responsibility for setting a new Australian standard for electromagnetic emissions to ARPANSA. (Chapter 6, p 226)

Labor Senators support a standard setting process consistent with existing science on the health effects of EMR, and ongoing research into potential adverse health effects arising from non-thermal levels of exposure. (Chapter 4, p 206)

Labor Senators support the inclusion of precautionary measures in the new standard, and consider the approach taken in the draft standard to be sensible. (Chapter 6, p 226)

Given that the draft RF standard produced by ARPANSA incorporates a precautionary approach, and recognises the need for ongoing research, Labor Senators conclude that there is no justification for this Committee to recommend alternative courses of action. (Chapter 4, p 207)

Labor Senators conclude that there is currently no scientific evidence to support the proposition that maintaining lower permissible levels of RF radiation in the

standards will decrease the potential for health effects, and that therefore there is no compelling scientific argument for such action at this time. However, Labor Senators support ongoing research in this area. (Chapter 5, pp 219-220)

Other:

Labor Senators endorse the ACA's role in monitoring the dissemination of information to the public, and seek that the ACA table 12 monthly statements in the parliament which detail industry adherence to this voluntary undertaking and public or consumer complaints or comments about this process. (Chapter 4, p 208)

Although acknowledging the problem of inclusion of frequencies employed by the metals industry in the draft RF standard, Labor Senators consider that the issue would more appropriately be raised in the standard setting process being undertaken by ARPANSA. (Chapter 5, p 220)

1. INTRODUCTION

1.1 The Senate has referred the following matters to the Environment, Communications, Information Technology and the Arts References Committee for inquiry and report:

a) an examination of the allocation of funding from the Commonwealth's $4.5 million fund for electromagnetic radiation research and public information;

b) a review of current Australian and international research into electro-magnetic radiation and its effects as it applies to telecommunications equipment, including but not limited to, mobile telephones;

c) an examination of the current Australian Interim Standard [AS/NZS 2772.1 (Int): 1998], as it applies to telecommunications;

d) an examination of efforts to set an Australian Standard dealing with electro-magnetic emissions;

e) an examination of the merits of the transfer of the responsibility for setting a new Australian standard for electro-magnetic emissions to the Australian Radiation Protection and Nuclear Safety Agency.

1.2 The issue of the effects of exposure to electromagnetic radiation, particularly from mobile phones, has received considerable media attention in recent times. This is partly due to the pervasiveness of mobile phone usage in modern society. The evidence to this Inquiry has been extensive. Yet it is impossible to establish any consensus on major issues by experts in the field.

1.3 The evidence has derived from a range of sources – medical and scientific researchers, academics, medical practitioners, epidemiologists, the mobile phone industry, government bodies and research organisations and EMR organisations. This breadth of sources has given rise to an even broader range of views and opinions.

1.4 Those who gave evidence to the Committee have justified their arguments on various grounds. Often assertions were justified by reference to studies that have been criticised in peer-reviews, that have not been replicated, and that are of dubious applicability to conclusions about health effects of RF radiation and mobile phones.

1.5 This makes the Committee’s task particularly challenging, as the evidence presented is clearly inconclusive. There are however a number of conclusions and recommendations that can be reached on the balance of the evidence. This report presents those conclusions reached by Labor Senators.

2. CRITIQUE OF CHAIR'S REPORT

2.1 Labor Senators note that the Chair's report to this Inquiry is not supported by any other voting member of the Committee. Its conclusions and recommendations should be read in that context.

2.2 Labor Senators find some of the observations, interpretations of the evidence, conclusions, and recommendations contained in the Chair's report untenable. As a consequence, Labor Senators determined it necessary to table this Minority Report, which expounds our conclusions and recommendations based on the evidence before the Committee. The conclusions and recommendations of Labor Senators are substantially different from those reached by the Chair of the Committee.

2.3 Labor Senators find the Chair's report untenable because certain recommendations, conclusions and evidence in the body of the report are erroneous and specious considering the actual evidence. The basis of this judgment by Labor Senators is that in the Chair's report:

a) Some recommendations and evidence are outside the terms of reference of the Inquiry, whilst other evidence that was also outside the terms of reference is not in the report.

b) Some recommendations and conclusions are nonsensical and unfounded in the light of the evidence, some contradict the evidence presented to the Committee and some even contradict the Chair's own conclusions on the evidence.

c) Certain evidence has been given undue weight notwithstanding dubious credibility of witnesses or weight of evidence to the contrary.

d) Evidence has been distorted or taken out of context.

e) Other recommendations do not seem to have been clearly thought out, as they lack detail or are imprecise.

2.4 Each of these criticisms is discussed in detail at Appendix 1. The pervasive flaws, errors and misinterpretations in the Chair's report necessitate this Minority Report which represents Labor Senators conclusions based on evidence to the Inquiry.

3. TERM OF REFERENCE (A) - ELECTROMAGNETIC RADIATION RESEARCH FUNDING ALLOCATION

3.1 In October 1996 the Australian Government announced funding of $4.5 million over 5 years for the Radiofrequency (RF) Electromagnetic Energy (EME) Program, for research and public information into health issues associated with mobile phones, mobile phone towers and other communications devices and equipment.[1]

3.2 The National Health and Medical Research Council (NHMRC) advised the Committee that the Government Program has three components:[2]

- research on possible health effects of RF EME exposure, focussing on those issues of particular relevance to the Australian environment to complement overseas research;
- public dissemination of up-to-date information about RF EME public health issues; and
- Australia's contribution to and participation in the WHO EMF Research Coordination Project, assessing the health and environmental effects of EME Exposure.

3.3 Of the $4.5 million allocated for the Program, an amount of $3.15 million was allocated for research managed by the NHMRC, with the remainder identified for public information and the WHO collaboration. The research component was later increased to $3.4 million.[3]

3.4 An examination of the allocation of funding from the $4.5 million fund requires analysis of the three criticisms that have been raised in this regard during the Inquiry. Those three criticisms relate to the NHMRC's:

1. decision-making processes for the distribution of research funding;
2. the timeframe for distribution and use of funds;
3. allegedly inappropriate expenditure of funds.

1. Decision-making processes for the distribution of research funding

3.5 First, criticism has been directed at the NHMRC's decision-making processes for the distribution of research funding. In particular, accusations of bias or improper

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1 NHMRC, Submission 69, pp 3-4.

2 NHMRC, Submission 69, p 4.

3 Ibid.

process by those involved in decision-making[4] and of a failure to give reasons why proposals were refused[5] have been made.

3.6 NHMRC detailed its evaluation processes that have been followed for both the first and second rounds of grants funding EMR research and indicated no allegations of bias have been formally raised with the Committee or the Board.[6]

3.7 The decision-making processes demonstrate awareness of and attention to issues of bias by the NHMRC. It is clear that there is a limited number of experts in this field in Australia and that there will inevitably be some perception of bias on a panel like this as a number of experts will have attained such status through some involvement in the industry or other roles which give rise to that perception.[7]

3.8 The funding that NHMRC distributes is derived from a government levy on the spectrum used. It comes to NHMRC totally unencumbered and is independent and at arms-length from industry.[8] This fact suggests, and evidence to the Committee clearly demonstrated, that the NHMRC pays considerable attention to avoiding bias and ensuring the independence of research and of the allocation of funding for such research.

3.9 CSIRO complained that research funding is generally inadequate and considered that it is not NHMRC's fault that worthy projects were rejected. Rather, the ad hoc distribution of funding was a consequence of inadequate funding for research generally. CSIRO added that there was no improper behaviour by individuals involved in NHMRC in the gaining of grants or in the carrying out of their research. The process simply gave rise to a public perception of bias.[9]

2. Timeframe for distribution and use of funds

3.10 The second criticism was that the distribution/use of funds has been excessively slow and it was alleged that only a small proportion of the fund has been

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4 CSIRO, *Proof Committee Hansard*, 16/11/00, pp 226-227, 232; Dr Hocking, *Proof Committee Hansard*, 22/9/00, p 93.

5 Dr Hocking, *Proof Committee Hansard*, 22/9/00, pp 93, 94.

6 *Proof Committee Hansard*, 8/9/00, pp 44ff; p 51.

7 *Proof Committee Hansard*, 8/9/00, p 45. Similar allegations of perceived bias have been raised in the context of standards setting by ARPANSA. ARPANSA responded to objections at involvement of persons from academia, telecommunications companies and industry generally by stating that "given the level and spread of expertise on these issues in this country, if you want to draw up a standard you are inevitably going to have to involve people who have some industry background; otherwise the breadth of knowledge is simply not enough to write the standard" per Dr Loy, *Proof Committee Hansard*, 2/3/01, p 344. This pragmatic argument applies equally in the context of NHMRC's decision making – the breadth of knowledge and expertise necessitates involvement of persons who may have had involvement with industry.

8 NHMRC, *Proof Committee Hansard*, 2/3/01, p 395.

9 *Proof Committee Hansard*, 16/11/00, p 232.

used. The NHMRC's response to this allegation was that the process of allocating funding was time-consuming and the stages of decision-making were dependent on completion of pilot projects and the like. In order to ensure impartiality the NHMRC's first step was to undertake external community consultation. Those consultative processes and the process of analysis for expressions of interest were extensive and thorough, and consequently time consuming.[10]

3.11 The complexity of the studies, the NHMRC's assessment processes, and the fact that many are, of their very nature, long-term studies, have meant that expenditure of the funds could not be properly achieved in a short timeframe.[11]

3. Inappropriate expenditure of funds

3.12 Thirdly, it was alleged in a submission to the Inquiry from the Electromagnetic Radiation Alliance of Australia (EMRAA) that "a good proportion" of the funds allocated in 1996 (that is, the $4.5 million fund) had been inappropriately spent on a misdirected PR campaign and that "vast amounts of money have been spent to convince the public that there are no adverse health effects from EMR".[12]

3.13 In response to a question during public hearings, EMRAA advised that the Department's figure for the cost of the public information campaign of $12,483 was the sum to which it was referring when it used the expressions "vast amounts of money" and a "good proportion" of the funds.[13]

Labor Senators conclude that there does not seem to be an identifiable problem with expenditure of funding by NHMRC on this evidence.

Adequacy of research funding

3.14 A number of submissions to this Inquiry called for increased funding for independent research into the effects of electromagnetic radiation.[14] Evidence from the NHMRC showed that Australia's contribution to EME research is comparable to or exceeds that of the WHO, the United States and the United Kingdom on a per capita basis.[15]

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10 *Proof Committee Hansard*, 2/3/01, pp 399-400.

11 *Proof Committee Hansard*, 2/3/01, p 397.

12 EMRAA, Submission 80, p 4.

13 EMRAA, *Proof Committee Hansard*, p 254.

14 Mr Maisch, *Proof Committee Hansard*, 22/9/00, p 76; Dr Hocking, *Proof Committee Hansard*, 22/9/00, p 93; Mr Dalton, *Proof Committee Hansard*, 22/9/00, p 153.

15 NHMRC, *Proof Committee Hansard*, 2/3/01, p 395.

3.15 Furthermore, compared with funding grants in other areas of research, EME funding grants are larger.[16]

3.16 Although arguments for greater research funding are understandable and research funding in many areas is often criticised as inadequate, it seems that Australia's contribution to funding is sensible and adequate when compared to those of other developed nations.

3.17 The failure of studies to prove any conclusive evidence of health effects from powerlines lead to a 1997 editorial in the prestigious *New England Journal of Medicine* to declare it time to stop "wasting" resources on research that produced inconclusive inconsistent studies and "considerable paranoia but little insight and no prevention".[17]

Labor Senators note that in light of the limited resources available for research into health issues where causes are identifiable, and given the existing inconclusiveness of the many completed studies into EMR, the funding available for EMR research does not appear to be inadequate.

16 NHMRC, *Proof Committee Hansard*, 2/3/01, p 394.

17 Quoted in Melissa Sweet, "The topic of cancer", *The Bulletin*, 27/3/01, p 39.

4. TERM OF REFERENCE (B) - REVIEW OF RESEARCH

4.1 This term of reference requires a review of current Australian and international research into electromagnetic radiation and its effects as it applies to telecommunications equipment, including but not limited to, mobile telephones.

Expert evidence: contradictory

4.2 The effect of EMR as it applies to telecommunications equipment is an area of contention for scientists, researchers and medical experts. Evidence from experts in this field has been inconclusive, contradictory, inconsistent and hotly contested by all parties.

4.3 There are two ways in which health could be affected as a result of exposure to RF radiation. Health consequences could result from thermal (heating) effects and from possible non-thermal (or athermal) effects of RF radiation.

4.4 There is an extensive body of research, conducted over several decades, that relates to the effects of electromagnetic radiation. The studies relate to various frequencies, some are laboratory tests in vitro, others in vivo, there are experiments with a variety of animal species, and epidemiological studies.

Scientific value of studies

4.5 The value of these studies and their applicability to the present issue of health effects of telecommunications equipment has been the subject of considerable comment throughout this Inquiry.[1] Similarly the weight that can be accorded evidence arising from a study that has not been replicated or confirmed has been discussed in detail particularly since shortcomings in methodologies and a lack of agreement between results have been identified.

4.6 Evidence from Dr David Black noted that it is never possible to scientifically prove that something cannot happen. In evidence to the Committee Dr Black stated:

> …if people say the question is to prove that something does not happen then you are trying to use science to prove a negative, and you really can never do that. So the only way you can ever continue to look at the safety of this approach is to continually set up hypotheses of things that might happen and then test to see if they do.[2]

4.7 Dr Repacholi, WHO, expressed the same view that it is necessary:

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1 For example, applicability of ELF studies to EMR issues was dismissed by Dr Moulder, *Proof Committee Hansard*, 2/3/01, pp 317-318. Whilst Dr Moulder also dismissed any analogy between electromagnetic interference issues and biological effects (*Proof Committee Hansard*, 2/3/01, p 318); Dr Cherry considered that opinion 'completely wrong': *Proof Committee Hansard*, 2/3/01, p 332.

2 Dr Black, *Proof Committee Hansard*, 8/9/00, p 65.

> …to look at the strength of the evidence, because you can never prove that something does not happen…[3]

4.8 On the issue of the strength of the evidence, Dr Moulder informed the Committee that:

> There are a lot of studies in this area which are very poor science…[4]

4.9 Dr Moulder's submission evaluated the weight of evidence and concluded that the evidence for a causal association between exposure to RF radiation and cancer is weak to non-existent.[5] Other witnesses suggest the contrary.[6] Evaluation of the weight of evidence requires an assessment of the credibility of the various studies.

4.10 Dr Repacholi gave evidence of the importance of verifying the validity of results of a study through confirmation or replication.[7] Dr Moulder agreed that:

> 'confirmation' ... is critically essential to all areas of science. … that you cannot confirm and replicate [a result] implies that there is something at least slightly wrong with the original – not necessarily totally wrong but something did not happen the way the authors think it happened. At the first stage of an attempt to confirm, where you have somebody reporting something and somebody else saying they cannot confirm it, you really cannot necessarily believe either study.[8]

4.11 Professor Elwood and the MMF also stressed that replication of studies is critical to their probative value, and to ensure that results are not due to chance variation.[9]

4.12 The disagreement between scientists on the conclusions they have reached on existing evidence seems to come down to their assessment of existing studies and the weight they accord those various studies. Where one scientist or researcher has considered a particular study to be probative of a certain effect, another has doubted that it has any probative effect at all due to methodological deficiencies or a lack or failure of replication or confirmation.

4.13 It is not within this Committee's competence to analyse the methodologies of relevant studies to ascertain their probative value. Instead, we rely on the conclusions that experts have reached, and these vary considerably from one to the next.

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3 *Proof Committee Hansard*, 31/8/00, p 4.

4 Submission 60, p 34.

5 Submission 60, pp 33-34.

6 For example Dr Cherry, *Proof Committee Hansard*, 2/3/01, p 330.

7 *Proof Committee Hansard*, 31/8/00, p 11.

8 *Proof Committee Hansard*, 2/3/01, p 317.

9 Prof Elwood, *Proof Committee Hansard*, 22/9/00, pp 110-1; MMF, Submission 75, p 6.

4.14 Complicating any determination of the weight of evidence are questions that have been raised about the reliability of research in this field. These allegations further obfuscate any possible consensus among experts. Mr Stewart Fist advised the Committee that he believes there has been a systematic corruption of the science relevant to the cellphone industry, particularly in the United States.[10] However, Mr Fist stated that the science in Australia, England and Sweden is particularly good.[11] Yet even Australian experts are unable to reach a consensus on the health effects of EMR.

4.15 Mr Fist conceded that "It is not that there is proof that cellphones are dangerous...".[12] And that is the crux of the dilemma – in the absence of proof that there are any harmful health effects from levels within the guidelines, what action should be taken?

4.16 Mr Fist concluded that:

> I do not think the ICNIRP standard is any better or any worse than any other standard. The only thing it lacks is honesty: it needs a precautionary statement. It needs to say: these standards are set in the absence of evidence, not in the presence of evidence, and therefore you are wise to limit your use of these things, especially if you are a young person.[13]

4.17 Labor Senators agree a precautionary approach is preferred.[14]

Witness conclusions – EMR effects

4.18 The scientific evidence upon which witnesses have formed their various conclusions, has led them to conclusions that can basically, for present purposes, be categorised as follows:

- that EMR, at non-thermal or athermal levels, has a proven biological effect and that this gives rise to a possibility/likelihood of adverse health consequences;[15]

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10 *Proof Committee Hansard*, 16/11/00, p 189.

11 *Proof Committee Hansard*, 16/11/00, p 189.

12 *Proof Committee Hansard*, 16/11/00, p 193.

13 *Proof Committee Hansard*, 16/11/00, p 193.

14 Although the Committee has received no evidence of the extent of use of mobile phones by children, the billing practices of the major service providers suggests extensive use of mobile phones by children would lead to exorbitant accounts. In addition, many parents are happy to provide mobile phones for their children as a safety tool with restricted access or use arrangements. As always, it is a balancing mechanism.

15 Dr Cherry, *Proof Committee Hansard*, 2/3/01, p 334; Dr French, *Proof Committee Hansard*, 16/11/00, p 269 (although there is no definitive evidence for a link between EMR and cancer: p 262); Mr Maisch, *Proof Committee Hansard*, 22/9/00, pp 75, 77.

- that EMR has no proven adverse effect on health, and biological effects of EMR at non-thermal or athermal levels (proven or not) are not likely to have adverse health effects as none have been demonstrated.[16] There is no proven link between RF and cancer.[17]

4.19 There are no proven adverse health effects resulting from any biological effects of EMR at non-thermal or athermal levels. The different conclusions lead to divergent recommendations as to the appropriate courses of action in respect of human exposure to EMR.

International research reviews

4.20 There have been two significant international reviews by expert panels of the literature and research on electromagnetic radiation in recent times which are valuable to this Committee's deliberations. These reviews took into account considerable volumes of evidence in reaching their conclusions.

4.21 The first review was released in March 1999 and was prepared at the request of the Royal Society of Canada.[18] The Independent Expert Group on Mobile Phones established by British Government and chaired by Professor Sir William Stewart released the second of these reports in May last year ("the Stewart Report").[19]

4.22 The expert panel report published by the Royal Society of Canada[20] states that:

> Overall, the results of the currently available clinical and epidemiological studies are inconsistent and provide no clear pattern of adverse health effects related to RF exposure. … At the same time, this evidence is inadequate to permit a comprehensive assessment of potential health risks.[21]

4.23 The Stewart Report reached the conclusion that:

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16 Dr Holt, *Proof Committee Hansard*, 8/9/00, p 86; Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 28; ARPANSA, *Proof Committee Hansard*, 2/3/01, pp 343-4; ACA, Submission 100, p 2; Royal Society of Canada Report "A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices", March 1999, Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada. Available at http://www.rsc.ca/english/RFreport.pdf; "Mobile Phones and Health", May 2000, Independent Expert Group on Mobile Phones. Available at http://www.iegmp.org.uk/IEGMPtxt.htm

17 Prof Elwood, *Proof Committee Hansard*, 22/9/00, p 143; Dr Black, *Proof Committee Hansard*, 8/9/00, p 56; Dr French, *Proof Committee Hansard*, 16/11/00, p 262.

18 "A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices", March 1999, Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada. Available at http://www.rsc.ca/english/RFreport.pdf

19 "Mobile Phones and Health", May 2000, Independent Expert Group on Mobile Phones. Available at http://www.iegmp.org.uk/IEGMPtxt.htm

20 "A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices", March 1999, Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada. Available at http://www.rsc.ca/english/RFreport.pdf

21 Ibid, at p 10 (Executive summary), quoted by NHMRC, Submission 69, p 19.

> The balance of scientific evidence to date suggests that exposures to RF radiation below … ICNIRP guidelines do not cause adverse health effects to the general population.[22]

4.24 Both of these prominent reviews reached conclusions, on the balance of evidence, that RF radiation does not have an adverse health effect.

4.25 Both reviews did, however, express some reservations, given gaps in knowledge about the conclusiveness of existing evidence.

4.26 The Royal Society of Canada Report[23] stated that:

> Non-thermal exposure levels can result in biological effects but there is insufficient information to conclude that these are adverse health effects.

4.27 The Stewart Report reached a similar conclusion, but went much further:

> We conclude therefore that it is not possible at present to say that exposure to RF radiation, even at levels below national guidelines, is totally without potential adverse health effects, and that the gaps in knowledge are sufficient to justify a precautionary approach.[24]

4.28 Precautionary approaches to health issues have become particularly popular in Britain in recent times. A recent article in *The Sydney Morning Herald* stated:

> [Professor Bruce Armstrong, Research Director of The Cancer Council of NSW] … senses a shift in the national psyche in Britain, where environmental and agricultural health scares have been coming thick and fast in recent years. If people live in a place "where it's suddenly not safe to eat meat" – amid mad-cow and foot-and-mouth epidemics – it was harder to accept risk with equanimity.[25]

4.29 In this context, it is easy to see why the British emphasis on precautionary measures is particularly evident in their conclusions on the effects of mobile phones on human health.

International research

4.30 There are three epidemiological studies that have been published very recently which are of particular relevance to the subject of this Inquiry. These studies are particularly noteworthy, as their results were not released prior to the completion of

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22 "Mobile Phones and Health", May 2000, Independent Expert Group on Mobile Phones, Chapter 1, p 3. Available at http://www.iegmp.org.uk/IEGMPtxt.htm

23 Available at http://www.rsc.ca/english/RFreport.pdf

24 "Mobile Phones and Health", May 2000, Independent Expert Group on Mobile Phones, Chapter 1, p 3. Available at http://www.iegmp.org.uk/IEGMPtxt.htm

25 Julie Robotham, "Something in the air", *The Sydney Morning Herald*, 10/3/01.

the two major expert reviews of international research[26] discussed above. Furthermore these studies were more extensive and conclusive than previous epidemiological studies. Dr Moulder sent the Committee an additional submission summarising these studies, and the Mobile Manufacturers Forum discussed their results in evidence to the Committee on the final day of public hearings.[27] Those studies are:

- A large cohort mortality study among employees of Motorola, a manufacturer of wireless communication products ("Motorola study").[28]
- A study done as part of a larger study by the National Cancer Institute (part of the National Institute of Health in the US) compared mobile phone use of patients with brain tumours and controls who were patients in the same hospitals with non-malignant conditions ("US Hospital study").[29]
- A retrospective cohort study of cancer incidence in Denmark of all users of cellular telephones during the period from 1982 through 1995 (more than 420,000) ("Danish study").[30]

Motorola study

4.31 The first is the occupational study of nearly 200,000 employees of the Motorola company. The study classified employees according to their level of RF exposure through their job and divided them into four groups. The study examines all major causes of mortality with brain cancers, lymphomas, and leukaemias as *a priori* outcomes of interest.[31] The analysis takes account of gender differences, age differences and length of follow-up.

4.32 The study concluded that "Although this study is limited by the use of a qualitative exposure matrix and the relatively young age of the cohort, our *findings do not support an association between occupational RF exposure and brain cancers or lymphoma/leukaemia*".[32] [Italics added]

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26 Royal Society of Canada Report and IEGMP (Stewart) Report.

27 Dr Moulder, *Proof Committee Hansard*, 2/3/01, p 315; MMF, *Proof Committee Hansard*, 2/3/01, p 359.

28 Morgan et al, "Radiofrequency Exposure and Mortality from Cancer of the Brain and Lymphatic/Hematopoietic Systems", *Epidemiology*, March 2000, Vol.11, No.2, p 118.

29 Inskip et al, "Cellular-Telephone use and Brain Tumors", *New England Journal of Medicine,* 11 January 2001, Vol. 344, No. 2. Available at http://www.nejm.com/content/2001/0344/0002/0079.asp

30 Referred to by Dr Swicord, MMF, *Proof Committee Hansard*, 2/3/01, p 359; Johansen et al, "Cellular Telephones and Cancer – A Nationwide Cohort Study in Denmark", *Journal of the National Cancer Institute*, Vol.93, No.3, 7/2/01.

31 Morgan et al, "Radiofrequency Exposure and Mortality from Cancer of the Brain and Lymphatic/Hematopoietic Systems", *Epidemiology*, March 2000, Vol.11, No.2, p 118.

32 Morgan et al, "Radiofrequency Exposure and Mortality from Cancer of the Brain and Lymphatic/Hematopoietic Systems", *Epidemiology*, March 2000, Vol.11, No.2, p 118.

4.33 Overall, Professor Elwood concluded that "none of [the] results [in the Motorola study] are statistically significant".[33]

4.34 The magnitude of this study, the fact that the results allow for a 10-year latency, and the methodology used make it an important study, according to Professor Elwood.[34]

US Hospital study

4.35 This study examined the use of cellular telephones in a case-control study of intracranial tumours of the nervous system conducted between 1994 and 1998. The study included 782 patients with brain tumours in hospitals in Phoenix, Arizona, Boston and Pittsburgh, and 799 controls who were patients admitted to the same hospitals as the patients with brain tumours for a variety of non-malignant conditions.[35]

4.36 The study concluded that:

> These data do not support the hypothesis that the recent use of hand-held cellular telephones causes brain tumours, but they are not sufficient to evaluate the risks among long-term, heavy users and for potentially long induction periods.[36]

Danish nationwide study

4.37 This nationwide study in Denmark examined cancer incidence of all users of mobile phones from 1982 through 1995. Subscriber lists from the two Danish operating companies identified 420,095 cellular telephone users. Cancer incidence was determined by linkage with the Danish Cancer Registry.[37]

4.38 The study concluded that:

> The results of this investigation, the first nationwide cancer incidence study of cellular phone users, do not support the hypothesis of an association

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33 *Proof Committee Hansard*, 22/9/00, p 140.

34 *Proof Committee Hansard*, 22/9/00, p 140.

35 Inskip et al, "Cellular-Telephone use and Brain Tumors", *New England Journal of Medicine,* 11 January 2001, Vol. 344, No. 2. Available at http://www.nejm.com/content/2001/0344/0002/0079.asp

36 Inskip et al, "Cellular-Telephone use and Brain Tumors", *New England Journal of Medicine,* 11 January 2001, Vol. 344, No. 2, 79-86.

37 Johansen et al, "Cellular Telephones and Cancer – A Nationwide Cohort Study in Denmark", *Journal of the National Cancer Institute*, Vol.93, No.3, 7/2/01 at p.203.

> between use of these telephones and tumours of the brain or salivary gland, leukemia, or other cancers.[38]

4.39 Another notable epidemiological study was done in Sweden where the mobile phone usage patterns of over 217 patients with brain tumours were compared with those of a control group of 439 people of the same age and gender who were healthy. The main result of that study was that for practical purposes the use of cellphones was identical, for practical purposes. The results showed that "there is no relationship overall between use of cellphones and brain tumours in this study".[39]

Conclusions of international research

4.40 These major, recent and extensive epidemiological studies have been unable to find an association between cancers and mobile telephone usage. This is the most reliable and conclusive evidence of the effect of mobile phones on human health. Animal studies and biological studies have dubious relevance for human health.

4.41 Dr Swicord, Research Director for the MMF, reached the conclusion that "our findings do not support an association between occupational RF exposure and brain cancer, lymphoma and leukaemia", based on the Motorola, Danish and US hospital studies.[40]

Conclusions in evidence to the Committee

4.42 Several submissions to the Committee identified studies that have concluded that EMR has a biological effect at non-thermal or athermal levels and a number of medical researchers gave evidence of recent findings of non-thermal and athermal effects.[41] It is important to note that interpreting those studies cannot give rise to any conclusion that EMR has any effect on health. The link between a biological effect and health effect has not been established.

4.43 Other witnesses emphasised the importance of looking at the effects of EMR in a whole human being rather than at results in vitro.[42] This is particularly so when we are contemplating standards for the protection of human health.

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38 Johansen et al, "Cellular Telephones and Cancer – A Nationwide Cohort Study in Denmark", *Journal of the National Cancer Institute*, Vol.93, No.3, 7/2/01.

39 *Proof Committee Hansard*, 22/9/00, p 142.

40 *Proof Committee Hansard*, 2/3/01, p 360.

41 Dr David Black, *Proof Committee Hansard*, 8/9/00, p 56; Dr French (heat shock response), *Proof Committee Hansard*, 16/11/00, p 263; Dr Moulder, *Proof Committee Hansard*, 2/3/01, p 323; Dr Cherry, *Proof Committee Hansard*, 2/3/01, pp 330-1: (melatonin reduction, altering calcium ion signalling, damage to genes, chromosomes, and DNA – indicates genotoxicity).

42 Dr Holt, *Proof Committee Hansard*, 8/9/00, p 86; Dr Black, *Proof Committee Hansard*, 8/9/00, p 59.

4.44 CSIRO indicated that the existence of health effects from exposure to low levels of RF radiation remains unconfirmed and contentious.[43] Certainly a few cell or animal studies have reported results suggesting some biological effects, but these have yet to be replicated (that is, the results have not been duplicated by subsequent studies which are part of the process of substantiating scientific research).[44]

4.45 Different experts have reached a variety of different, often contradictory, conclusions, on a number of issues relevant to this Inquiry.

4.46 Dr Holt concluded that EMR increases the speed of growth of myeloid leukaemia or any other cancer, and will reduce the survival rate, even though it cannot be proven that mobile phone use will contribute to the creation of cancer.[45]

4.47 The draft RF standard produced by ARPANSA does in fact incorporate a precautionary approach. On that basis, Labor Senators conclude that there is no justification for this Committee to recommend alternative courses of action.

4.48 Due to the conflicting opinions of experts and apparent inconclusiveness of scientific evidence on this issue, it is clear that, at this point in time, there is a great deal of uncertainty whether electromagnetic radiation has health effects at non-thermal levels. In the absence of conclusive evidence showing health effects at levels below those prescribed in extant standards, it would be inconsistent with existing knowledge and science to require lower levels of EMR than those contained in standards.

4.49 As Professor Elwood stated in evidence to the Committee: [46]

> The summary is basically that, overall — and I think the overall assessment is the important thing — I do not see any consistency in relationships between cancer and radio frequencies. There are quite a lot of studies, so there are some positive results which require further assessment. The studies are limited by lack of information on exposure, lack of control for other factors and, in some studies, biases in the data.
>
> My impression is that the better studies … are the ones that show no association. Very often it is the weaker studies, with much smaller numbers and much weaker study designs, that tend to show unusual results which therefore need testing. So, overall, my conclusion is that there is no consistent evidence relating radiofrequency exposures and cancer in humans, in terms of current research.

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43 *Proof Committee Hansard*, 16/11/00, p 222.

44 ARPANSA Fact Sheet, "Government action on electromagnetic energy public health issues", available at http://www.health.gov.au/arpansa/pubs/eme_comitee/fact1.pdf

45 *Proof Committee Hansard*, 8/9/00, pp 85-89.

46 Professor Elwood, *Proof Committee Hansard*, 22/9/00, p 123.

4.50 Professor Elwood summarises the present research in a way that accords with the perception of Labor Senators, from the evidence presented to the Committee.

4.51 A majority of expert witnesses, and government agencies, reached the conclusion that, based on existing research, there is no proof that exposure to RF radiation below ICNIRP guidelines causes adverse health effects.[47]

For this reason, Labor Senators support a standard setting process consistent with existing science on the health effects of EMR, and ongoing research into potential adverse health effects arising from non-thermal levels of exposure.

Recommendations based on conclusions

4.52 On the basis of the various conclusions that have been drawn from the existing research, witnesses before the Committee advocated a number of recommended courses of action.

4.53 CSIRO recommended a precautionary approach to the use of mobile phones, and stated that prudence demands that exposure levels to RF radiation be kept as low as possible, within what is technically, socially and economically feasible.[48]

4.54 Dr Repacholi of the World Health Organisation stated that Governments need to address public concerns through a policy of precautionary measures including increasing research, encouraging manufacturers to minimise exposure levels, communicate risks, targeting audiences with honest and accurate information, involving the public in decision making, and siting facilities to minimise public exposure and concerns.[49]

4.55 Considerable support for continued investigation and research into non-thermal effects of RF was conveyed to the Committee by the industry, experts in medical and scientific fields and consumer organisations.

4.56 The real issue in this current debate is the precise degree of precaution we should apply to standards. It is clear that the current precautionary approach in ARPANSA's draft standard is sufficient given the state of the most recent evidence made available to the Committee.

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47 Dr Holt, *Proof Committee Hansard*, 8/9/00, p 86; Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 28; Dr Black, *Proof Committee Hansard*, 8/9/00, p 60; Dr Moulder, *Proof Committee Hansard*, 2/3/01, p 326; ARPANSA, *Proof Committee Hansard*, 2/3/01, pp 343-4; ACA, Submission 100, p 2; AMTA, Submission 19, p 33; MMF, *Proof Committee Hansard*, 2/3/01, p 361; Royal Society of Canada Report "A Review of the Potential Health Risks of Radiofrequency Fields from Wireless Telecommunication Devices", March 1999, Expert Panel Report prepared at the request of the Royal Society of Canada for Health Canada. Available at http://www.rsc.ca/english/RFreport.pdf; "Mobile Phones and Health", May 2000, Independent Expert Group on Mobile Phones. Available at http://www.iegmp.org.uk/IEGMPtxt.htm

48 *Proof Committee Hansard*, 16/11/00, p 222.

49 *Proof Committee Hansard*, 31/8/00, p 13.

Given that the draft RF standard produced by ARPANSA incorporates a precautionary approach, and recognises the need for ongoing research, Labor Senators conclude that there is no justification for this Committee to recommend alternative courses of action.

Recommendations of consumer and community groups

4.57 The primary theme in submissions from consumer and community groups was the need for more publicly available research and information at point of sale for consumers, including some kind of EME labelling on mobile phones.[50]

4.58 The Consumers' Telecommunications Network, a national coalition of consumer and community groups, stated that its primary concern is public disclosure of potential health and safety issues, since if the public is informed, they make their own choices about the ***potential*** health risks.[51]

4.59 The Australian Communications Authority (ACA) announced, in August last year, an agreement it had made with industry to make information about the maximum emission levels of mobile phones more readily available by voluntarily providing emission levels as part of the mobile phone packaging.[52]

4.60 At that time, the Australian Mobile Telecommunications Association (AMTA) indicated that it would "consult with its overseas counterparts to devise a consistent method for reporting [maximum SAR measurements of mobile phones] … to reduce any potential for confusion." AMTA also said it was "awaiting the development of an international standard for measuring SARs, which was expected within the next few months".[53]

4.61 The European Committee for Electrotechnical Standardization (CENELEC) has recently finalised the technical standards for the measurement of SAR from mobile phone handsets.[54] Manufacturers are taking steps to acquire and commission the new test equipment and procedures specified in the standard. Apparently, there are presently only very few suppliers of some of the necessary test equipment upon which all manufacturers are relying.

4.62 The provision of EMR information with new models of mobile phones will commence when the necessary test equipment is available, in line with the product

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50 CTN, *Proof Committee Hansard*, 16/11/00, p 213.

51 CTN, *Proof Committee Hansard*, 16/11/00, p 216.

52 ACA Press Release "Information on mobile phone energy emissions to be made available" 2/8/00, available at http://www.aca.gov.au/media/2000/41-00.htm

53 AMTA Press Release "Mobile phone industry to provide information on phone emission levels", 2/8/00, available at http://www.amta.org.au/files/media/mr00_7.htm

54 Although it will not be published until ratified by the CENELEC Technical Board.

launch plans of manufacturers. It is anticipated that this will commence in the second half of this year for new models of mobile phones as they enter the market.

4.63 When implemented this will, it seems, address those concerns raised by consumer groups on the issue of informing the public of emission levels. The ACA undertook to monitor this system to ensure that public information needs are adequately met.[55] This is particularly important in view of the voluntary nature of adherence to the scheme.

4.64 In any event, the value of this consumer measure, whether fulfilled or otherwise, is questionable. There are several reasons for this:[56]

- The maximum SAR measurement does not reflect actual exposure levels because mobile phones automatically adjust to the minimum power level required to connect and maintain a quality call, and this depends on factors such as the distance to the nearest base station.
- There is no credible evidence of health effects from phones that meet EMR exposure standards and no evidence supporting the proposition that a phone with a lower maximum SAR reduces the potential for health effects.[57]

Labor Senators endorse the ACA's role in monitoring the dissemination of information to the public, and seek that the ACA table 12 monthly statements in the parliament which detail industry adherence to this voluntary undertaking and public or consumer complaints or comments about this process.

4.65 Another community organisation, the Electromagnetic Radiation Alliance of Australia (EMRAA), advised that although "we cannot prove that low levels of electromagnetic radiation cause health problems" there are "good reasons … [why] many studies that show that they do not".[58]

4.66 EMRAA suggested that studies fail to find effect for a number of reasons:[59]

- difficulties in measuring EMR;
- different genetic susceptibilities;
- long latency periods for some relevant diseases;
- industry funding affecting outcomes.

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55 Footnote 52.

56 Footnote 53.

57 See Recommendation - Chapter 5, p.5. For example, MMF, *Proof Committee Hansard*, 2/3/01, p 362.

58 *Proof Committee Hansard*, 16/11/00, p 241.

59 EMRAA, *Proof Committee Hansard*, 16/11/00, p 240.

Labor Senators conclude there is justification to some of these criticisms of past studies of the physical and health effects of EMR. Accordingly, Labor Senators support ongoing research into potential adverse effects of EMR.

4.67 EMRAA concluded that "new standards are urgently needed",[60] and that there is "already enough evidence that low levels of electromagnetic radiation are dangerous to warrant immediate precautions".[61]

However, Labor Senators also conclude below that "there is currently no scientific evidence to support the proposition that maintaining lower permissible levels of RF radiation in the standards will decrease the potential for health effects, and that therefore there is no compelling scientific argument for such action at this time. However, Labor Senators support ongoing research in this area." [62]

Powerlines and leukaemia

4.68 The conflicting nature of evidence that has been presented to the Committee is exemplified by research into a link between powerlines and leukaemia. Various conclusions have been reached on the same evidence and media reports on relevant studies have been far more sensational than the actual findings.[63]

4.69 This is not to deny that there have been potential concerns arising from the results of some studies. Dr Repacholi indicated that the low frequency area is of particular concern for the World Health Organisation at the moment as a result of two studies:

> One is that there are some studies suggesting that workers seem to have lower heart rates. Some studies suggest increases in leukemia and brain tumours by working with power frequency fields. But the most worrying to me is the residential studies where children living near powerlines seem to have a higher incidence of leukemia. That is what we are concentrating our research on now.[64]

4.70 However the subsequent results of a British study, chaired by Sir Richard Doll, into a possible link between extremely low frequency (ELF) electromagnetic fields (from powerlines) and cancer, were not as sensational as media reports suggested.[65]

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60 EMRAA, *Proof Committee Hansard*, 16/11/00, p 240.

61 EMRAA, *Proof Committee Hansard*, 16/11/00, p 241.

62 Recommendation – Chapter 5, p 5.

63 Melissa Sweet, "The topic of cancer", *The Bulletin*, 27/3/01, p 39.

64 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 18.

65 For example articles pre-empting the release of the report: Brendan O'Malley, "Boost for powerline protesters", *The Courier Mail*, 7/3/01; John Kerin, "Wooldridge warning on powerlines", *The Australian*,

The study analysed the results of a number of substantial large epidemiological studies carried out in Scandinavia, America, Canada and Britain.

4.71 In a recent interview Professor Doll responded to the question "Can we extrapolate that there is indeed a link between powerlines and cancer?" by stating that:[66]

> No we can't and that is one of the things that we say very clearly that you cannot conclude that this radiation, and I must emphasise that its not just powerlines, that's one source of it. .. But we're quite clear that you cannot say that it definitely causes cancer.
>
> The experimental studies and studies done in laboratories on cells, provide absolutely no reason to think that there might be any hazards.

4.72 Notably, some Australian press reports had given the impression that the study had reached the opposite conclusion.[67] This typifies the sensationalist press responses in this subject area when the evidence is inconclusive.

4.73 The express findings of the study included the statement that:

> *Laboratory experiments have provided no good evidence that extremely low frequency electromagnetic fields are capable of producing cancer, nor do human epidemiological studies suggest that they cause cancer in general.* There is, however, some epidemiological evidence that prolonged exposure to higher levels of power frequency magnetic fields is associated with a small risk of leukaemia in children. In practice, such levels of exposure are seldom encountered by the general public in the UK. In the absence of clear evidence of a carcinogenic effect in adults, or of a plausible explanation from experiments on animals or isolated cells, the epidemiological evidence is currently not strong enough to justify a firm conclusion that such fields cause leukaemia in children.[68] [Italics added]

4.74 In short, it is clear from the above quote that epidemiological evidence does not support a link between cancer and ELF EMF. Labor Senators advocate a precautionary approach where evidence is inconclusive.

7/3/01; Joseph Kerr, Deborah Jopson, "Cancer and powerlines: painful questions return with the grief", *The Sydney Morning Herald*, 6/3/01; Michelle Paine, "Transend looks closely at powerline leukaemia link – Calm urged over pylons", *The Mercury*, 7/3/01.

66 Interview by Angela Catterns on ABC 702 2BL, 7/3/01.

67 For example articles pre-empting the release of the report: Brendan O'Malley, "Boost for powerline protesters", *The Courier Mail*, 7/3/01; John Kerin, "Wooldridge warning on powerlines", *The Australian*, 7/3/01; Joseph Kerr, Deborah Jopson, "Cancer and powerlines: painful questions return with the grief", *The Sydney Morning Herald*, 6/3/01; Michelle Paine, "Transend looks closely at powerline leukaemia link – Calm urged over pylons", *The Mercury*, 7/3/01.

68 "ELF Electromagnetic Fields and the Risk of Cancer", Vol 12, No.1, 2001, National Radiological Protection Board (UK) Advisory Group On Non-Ionising Radiation, Chapter 7, para (15). Available at http://www.nrpb.org.uk/Absd12-1.htm

4.75 A recent article in *The Economist* published the conclusion that the Doll study found that "exposure to EMF is linked to a modestly elevated risk of a very rare disease in a small section of the population" and "even if EMF is associated with childhood leukaemia, that does not mean that it causes it".[69]

4.76 In response to the Doll report, an article in *The Bulletin* recently observed that:

> more than 20 years of research into electromagnetic fields and cancer has yielded few definitive answers. So much so that a 1997 editorial in the prestigious *New England Journal of Medicine* went to the extreme of declaring it time to stop "wasting" resources on research that produced inconclusive inconsistent studies and "considerable paranoia but little insight and no prevention.[70]

4.77 Professor Bruce Armstrong, the research director of The Cancer Council of NSW, was recently quoted as calculating the risk as equating to a single case of leukaemia related to powerlines every six years in Australia. He commented that "It seems to be very minimal in terms of a probability…".[71]

4.78 The recent article in *The Bulletin* quoted Sydney scientist Bernard Stewart as having stated "People should be aware that the hazard exists but rank it with lightning strikes, shark attacks and other very low-profile hazards".[72]

4.79 Those comments put the potential risk into perspective, and illustrate the extent of exaggeration of the risk, which has fuelled public fears.

4.80 The relevance of the evidence relating to ELF EMF studies has been doubted. In response to a question asked by Senator Allison[73] during public hearings, ARPANSA advised the Committee that in general ELF studies were not investigated by the RF Working Group in its deliberations on the RF draft standard because the standard covers the RF spectrum – that is frequencies in the range 3kHz – 300kHz. The ELF range is 50 to 60Hz.

4.81 The applicability of ELF studies to effects of RF radiation were dismissed by Dr Moulder who, in response to a question from Senator Bishop about the extent to which the results from ELF studies could be applied to RF, stated:

> The first and simplest answer is that they cannot be applied at all .. [b]ecause the biophysics of interaction is completely different … in general, if you want to know about the health effects or the biological effects of

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69 Dr Anthony Swerdlow, Epidemiologist, Institute for Cancer Research London in "Current concerns - Power Lines and Cancer", *The Economist*, 10/3/01, p 89.

70 Melissa Sweet, "The topic of cancer", *The Bulletin*, 27/3/01, p 39.

71 Julie Robotham, "Something in the air", *The Sydney Morning Herald*, 10/3/01.

72 Melissa Sweet, "The topic of cancer", *The Bulletin*, 27/3/01, p 39.

73 *Proof Committee Hansard*, 2/3/01, p 348.

> something, you try to use basically the same agent you are interested in. So in terms of radiofrequency radiation where we are particularly, I think, interested in telecommunications, the best data is the data done at telecommunications frequencies.[74]

4.82 The conclusions reached in respect of ELF EMF mirror those that have been reached regarding the effects of EMR from mobile phones. The evidence is inconclusive, and if any effect is suggested, its incidence verges on statistical insignificance and in any case there is inadequate evidence to demonstrate a causal relationship.

Planning issues – telecommunications and electricity infrastructure

4.83 Term of reference (b) confines this inquiry to examining research relating to "telecommunications equipment, including but not limited to, mobile telephones". As such, even though a significant number of submissions addressed planning issues for telecommunications and electricity infrastructure, those are outside the scope of this inquiry.

4.84 The concerns raised in submissions on planning issues related to the inadequacy of the requirements for community consultation and involvement in issues of location of mobile telephone towers. Local Governments and individuals within local communities have expressed dissatisfaction with the planning framework under the *Telecommunications Act 1997*. Those concerns relate to a lack of appropriate local community consultation – particularly where infrastructure is situated near schools, hospitals and residential areas, a lack of sharing or joint location of facilities and a lack of national regulatory oversight.

4.85 The ALP has indicated its support and the urgent need for significant improvement in the local and national planning framework for the construction of mobile telecommunications towers.[75] Changes that must now be urgently adopted by the Industry and Government include:[76]

> a) Requiring carriers to advise and consult with the relevant Local Authority over the proposed construction of a low impact facility;
>
> b) Requiring carriers to share or co-locate proposed or existing facilities on a case by case basis;
>
> c) Providing for the relevant Local Authority or Authorities to seek a determination from the ACA about whether a proposed facility is a high or low impact facility;

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74 *Proof Committee Hansard*, 2/3/00, p 318.

75 Press Release, Stephen Smith, Shadow Minister for Communications, 24/7/00.

76 Ibid.

d) Providing for the relevant Local Authority or Authorities to seek a determination from the ACA about whether the proliferation or density of multiple existing or proposed low impact facilities can be deemed to be a high impact facility; and

e) Providing for the ACA to determine or arbitrate disputes arising out of the planning framework.

4.86 Labor's consultation process would ensure that carriers provide local communities with sufficient evidence concerning the levels of EMR from their facilities.

4.87 Labor Senators recognise the necessity for better balancing industry development which is crucial to maintain national state of the art communications facilities and services, and the concerns of local communities across the nation. The Government, on the other hand, has so far failed to take action to address these issues.

4.88 The Australian Communications Industry Forum (ACIF) has been developing a Code of Practice which, it is anticipated, will seek to address the concerns raised during this Inquiry such as consultation and sensitive use issues. It remains to be seen whether this industry initiative will resolve those issues.

4.89 Although not within the terms of reference of this Inquiry, Labor Senators recognise the legitimate concerns raised with the Committee on the issue of the planning framework for communications infrastructure and strongly encourage Government action to solve the problems.

4.90 A number of submissions were received by the Inquiry in which concerns at the health effects of powerlines were raised. The present inquiry is, however, limited to the "effects of electromagnetic radiation as it applies to telecommunications equipment, including but not limited to, mobile telephones". Clearly this kind of infrastructure falls outside the scope of this term of reference.

5. TERMS OF REFERENCE (C) & (D) - THE CURRENT AUSTRALIAN INTERIM STANDARD [AS/NZS 2772.1 (INT): [1998], AS IT APPLIES TO TELECOMMUNICATIONS & EFFORTS TO SET AN AUSTRALIAN STANDARD DEALING WITH EME

History of setting standards relating to EMR in Australia

5.1 The Australian Communications Authority (ACA) introduced a standard in February 1999 setting public exposure limits to radiofrequency EMR. The ACA has powers to make standards under the *Radiocommunications Act 1992*. Pursuant to the Act, the ACA's standards can cover protection of the health and safety of people who operate, work on, use, or are reasonably likely to be affected by the operation of radiocommunications transmitters or receivers.[1]

5.2 The ACA standard based public exposure limits on those of the lapsed technical standard developed by Standards Australia (AS /NZS 2772.1 (Int): 1998). Standards Australia formulated the interim standard but failed to achieve the requisite consensus to make the standard permanent,[2] and the interim standard lapsed leaving no standard.[3]

5.3 The attempt by Standards Australia to set a standard relating to RF exposure limits provides an important background to the present Australian standard setting efforts. Standards Australia advised the Committee, in considerable detail, of the procedures it undertook in attempts to formulate a standard for human exposure to EMR.

5.4 Standards Australia gave evidence that it is an independent organisation which prepares standards through an internationally recognised process of transparency and consensus. Australian standards are voluntary documents, unless referenced in legislation and Standards Australia is a facilitator and does not play an active part in the decisions of the committee formed to formulate standards, does not have a vote on any standards and does not chair meetings.[4]

5.5 The submission to this Inquiry from Standards Australia detailed the process for creating a standard as follows:[5]

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1 *Proof Committee Hansard*, 16/11/00, p 298.

2 Standards Australia, *Proof Committee Hansard*, 16/11/00, pp 282-283; ACA, *Proof Committee Hansard*, 16/11/00, p 306.

3 Standards Australia, *Proof Committee Hansard*, 16/11/00, p 295.

4 *Proof Committee Hansard*, 16/11/00, p 281.

5 Submission 133.

- To formulate standards, Standards Australia convenes a balanced technical committee of relevant stakeholders which operates under internationally accepted principles of transparency and consensus.
- Since 1984, Standards Australia has had a technical standards committee (TE/7) considering standards for human exposure to EMR. The committee has been a joint Australian/New Zealand committee since 1992.
- Standards Australia originally prepared AS 2772.1 at the request of the communications industry to cover both occupational and non-occupational exposure to non-ionising radiations.
- As community interests came to the fore, problems arriving at a consensus manifested with Committee TE/7, that prepared AS 2772.1 and was responsible for its maintenance and update.
- Between August 1998 and April 1999, TE/7 reviewed the need for a revised standard to replace AS/NZS 2772.1 (Int):1998. A review to ensure there was a balance of relevant interests was undertaken and four new members were added – two from Consumers Federation of Australia, one from AMTA and one from Cable and Wireless Optus.
- To enable a standard to be published there are three hurdles that need to be cleared:

    1. 67 per cent of the people who are eligible to vote need to actually vote on the document.
    2. Of those who have voted, 80 per cent of them need to be positive.
    3. Even with that 80 per cent, no major sector interest is to maintain a negative vote.

- The major sector interests on the TE/7 Committee are:
    - User and purchasing bodies;
    - Manufacturers-suppliers;
    - Independent professional and technical bodies;
    - Consumers;
    - Regulatory or controlling bodies;
    - Research and testing organisations; and
    - Unions.
- In the standards setting process for EMR, the TE/7 Committee did not achieve the second step of achieving an 80 per cent positive vote.

5.6 Standards Australia indicated that it is very rare for it not to achieve consensus. It publishes 40 to 45 standards a month, on average, and Mr Blair observed that in the last six or seven years "I have not known us not to achieve consensus in publishing standards. So this is a very rare event".[6]

5.7 It was suggested that the reason for the committee's inability to achieve consensus was that:

> … in this case we have got a combination of technical issues and I suppose community issues, and it was trying to marry those together to get an outcome, and unfortunately it was not successful.[7]

5.8 There was broad representation of stakeholder interests on the TE/7 Committee and the Committee failed to publish a standard. Standards Australia indicated that, in the case of it revisiting this issue, it would seek to reduce the size of the Committee.[8]

5.9 Clearly the failure of the Standards Australia standard setting processes was due to the inability of the structure of the system to deal with the contentious issues. A major point of debate was the strength of the proposed 'precautionary approach' in the draft standard.[9]

5.10 AS2272.1 (Int): 1998, was extended beyond its original expiry of 5 March 1999 until 30 April 1999 by a vote of TE/7 to give time to resolve the issue. Continuing failed attempts to resolve the impasse were fruitless and the Interim Standard was withdrawn from 1 May 1999.[10]

5.11 The ACA has indicated its intention to continue to mandate the standards it has made until the new technical standard being developed by ARPANSA is finalised.[11]

Labor believes that Standards Australia should be the primary body for setting standards. However, in this case, Labor Senators conclude that Standards Australia failed to achieve an outcome. This is because the structure of Standards Australia in this instance allowed a small proportion of participants to exercise a veto on any outcome. Accordingly, this ongoing failure warranted the transfer of responsibility for setting a standard to an alternate body such as ARPANSA.

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6 *Proof Committee Hansard*, 16/11/00, p 282.

7 Mr Blair, Standards Australia, *Proof Committee Hansard*, 16/11/00, p 287.

8 *Proof Committee Hansard*, 16/11/00, p 289.

9 Standards Australia, Submission 133, p 2.

10 Standards Australia, Submission 133, pp 3-4.

11 *Proof Committee Hansard*, 16/11/00, p 298.

The appropriate standard

5.12 The current interim standard has been criticised for not being science-based, but supported because it permits lower levels of emissions than the ICNIRP guidelines. The International Commission on Non-Ionising Radiation Protection (ICNIRP), a non-government organisation (NGO), published guidelines in 1998 that cover exposure to RF radiation.

5.13 The ICNIRP guidelines are the current international standards based on studies that ascertained thresholds at which actual effects could be repeatedly seen, and then a margin for safety and uncertainty (of 50) was applied to those thresholds.[12] The ICNIRP guidelines are based on the need to avoid known adverse health effects.

5.14 Essentially the arguments for the adoption of the ICNIRP guidelines are international consistency, consumer certainty, they have a factual basis, still prescribe very safe levels, and will potentially result in a reduction of phone cost because of the economies of an international market.

5.15 The benefits of international harmonisation of standards include:[13]

- increased public confidence;
- reduction of debate and fears;
- protection of people to the same high level;
- benefits to health care would be expected to result from having harmonised standards;
- consumer information advantages, including consumer benefits arising from consistency in product information provided;
- global consistency takes away misunderstanding.

5.16 Another argument for the science-based standards is that they take away the subjectivity or various opinions of people, and provide consistency with the notion that standards should be based on something substantiated.[14]

5.17 In the case of EMR there is a threshold below which no health effects are found but above which there are. This threshold is the basis for the health-based standard.

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12 Dr Black, *Proof Committee Hansard*, 8/9/00, p 56 and Submission 93, [21], [52]; Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 9.

13 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 6; AMTA, *Proof Committee Hansard*, 8/9/00, pp 37-38, MMF, *Proof Committee Hansard*, 2/3/01. pp 361-2.

14 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 12.

The standard is set at 50 times below the level at which health effects are starting to be seen.[15]

5.18 The case for harmonisation of standards is based on the fact that there is no known health benefit from reducing EMR levels (there being a threshold below which no health effect is seen), however lowering levels will incur costs, and technologies which could be very beneficial to health will be impeded, including emergency services and the like.[16]

5.19 The World Health Organisation recommends the ICNIRP (international) standard, because it is a science-based standard and WHO supports standards harmonisation.[17]

5.20 Arguments before the Committee for retaining the emission levels in the existing interim standard are that the levels are lower and safer (higher safety margin) and as they are achievable there is no reason to allow higher levels - setting lower permissible levels of emissions encourages industry to be innovative in safety.[18]

5.21 CSIRO expressed scepticism about the scientific basis of the ICNIRP standards and suggested that it is not just coincidental that the ICNIRP limits are very convenient for the telecoms industry.[19] Arguably, the potential for health effects at EMR levels below the ICNIRP guidelines justifies maintenance of existing standards that are, in some respects, higher.

5.22 It is noted that other witnesses attested to "serious flaws" in the current ICNIRP guidelines.[20]

5.23 Labor Senators are confident that ARPANSA has taken all of the issues into account in formulating the draft standard and has made an independent assessment of issues relevant to applying a precautionary approach.

Labor Senators conclude that there is currently no scientific evidence to support the proposition that maintaining lower permissible levels of RF radiation in the standards will decrease the potential for health effects, and that therefore there is no compelling scientific argument for such action at this time. However, Labor Senators support ongoing research in this area.

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15 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 14; Dr Black, *Proof Committee Hansard*, 8/9/00, p 60.

16 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, pp 16-17.

17 *Proof Committee Hansard*, 31/8/00, p 13.

18 Mr Dalton, Submission 40, *Proof Committee Hansard*, 22/9/00.

19 *Proof Committee Hansard*, 16/11/00, p 229.

20 Mr Maisch, *Proof Committee Hansard*, 22/9/00, p 74; Mr Fist, *Proof Committee Hansard*, 16/11/00, p 192 (flawed because "we make our standards on the basis of evidence accumulated in corrupt countries"); Dr Cherry, *Proof Committee Hansard*, 2/3/01, p 339.

Metals industry and EMR standards

5.24 OneSteel Market Mills gave evidence to the Committee that there is an apparent anomaly in the interim standard as it includes frequencies employed by the metals industry for induction heating applications and manufacturing of steel tube[21] which are qualitatively different from applications in the communications industry.[22]

5.25 OneSteel seeks a separate standard for the frequency range utilised in the metals industry which recognises the distinct nature of the exposures.[23] The terms of reference of this Inquiry explicitly require an examination of the current Australian Interim Standard *as it applies to telecommunications*, and clearly this issue falls outside the breadth of that term.

5.26 ARPANSA has indicated, however, that the inclusion of the relevant frequency range is not an anomaly in the standard, rather the standard is intended to regulate exposures in the industries utilising those frequencies.[24]

Although acknowledging the problem, Labor Senators consider that the issue would more appropriately be raised in the standard setting process being undertaken by ARPANSA.

21 *Proof Committee Hansard*, 16/11/00, p 204.

22 *Proof Committee Hansard*, 16/11/00, pp 205, 210.

23 *Proof Committee Hansard*, 16/11/00, p 212.

24 *Proof Committee Hansard*, 2/3/01, pp 341-2, 347.

6. TERM OF REFERENCE (E) - ARPANSA'S STANDARD SETTING RESPONSIBILTY

6.1 The fifth term of reference for this inquiry requires an examination of the merits of the transfer of the responsibility for setting a new Australian standard for electromagnetic emissions to the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

Draft ARPANSA Standard

6.2 Australian Standard setting efforts are presently being coordinated by ARPANSA, and a draft standard (Radiation Protection Standard - Maximum exposure levels to radiofrequency fields - 3kHz to 300GHz) has been released for public comment until 11 May 2001.

6.3 The draft standard has been prepared under the auspices of the Radiation Health Committee, established pursuant to the *Australian Radiation Protection and Nuclear Safety Act 1998*. A working group set up by the Radiation Health Committee has undertaken the work of drafting the standard.[1]

ARPANSA's role in standard setting - appropriateness

6.4 ARPANSA's role and processes for formulating the standard have been criticised,[2] its independence questioned, and the lack of public input/community consultation has been considered inappropriate.[3]

6.5 The ongoing failure of Standards Australia to achieve an outcome was predominantly due to the failure of Standards Australia's structures and procedures to enable it to overcome contentious issues. This seemingly warrants a change in the composition of the decision-making body from that of Standards Australia if outcomes are to be achieved.

6.6 On the other hand, witnesses indicated support for ARPANSA's role because the Committee is comprised of experts in the field, is independent, and well-informed and positioned to make an unbiased decision regarding the appropriate standard for

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1 *Proof Committee Hansard*, 2/3/01, p 340.

2 CSIRO, *Proof Committee Hansard*, 16/11/00, pp 234, 245; Dr French, *Proof Committee Hansard*, 16/11/00, p 264; Mr Maisch, *Proof Committee Hansard*, 22/9/00, pp 100-101.

3 Mr Dalton, Submission 40 and *Proof Committee Hansard*, 22/9/00, pp 152, 153; Mr Maisch, *Proof Committee Hansard*, 22/9/00, p 81; EMRAA, *Proof Committee Hansard*, 16/11/00, p 249.

Australia.[4] It is most suited for the task of standard development by virtue of its resources, experience and statutory backing.[5]

6.7 Mr Lincoln of the EMRAA suggested that there was a fair representation of the Australia community on the ARPANSA Working group and that it did not have "any disagreement with it".[6] However Mrs McLean, also of the EMRAA, stated:

> I believe that industry should be excluded. I do not think industry has a role on standards committees; I think industry should be encouraged to meet whatever standards, from a public health perspective, are decided are appropriate.[7]

6.8 In response to that comment Mr Lincoln indicated "My difficulty is that we are talking about a fairly technical subject and there are few people outside industry who would understand it in any way".[8] Mr Lincoln also concurred that "necessarily, to have an effective working committee devising regulations and standards you would have to draw on resources from those areas [experience in industry or academia]".[9]

6.9 The limited number of people with adequate expertise in the issues that need to be resolved in the standard setting process necessitates this approach.

ARPANSA Draft and prudent avoidance/precautionary approach

6.10 Criticism has emerged that members of the ARPANSA working group were advised not to take prudent avoidance into account in the course of developing the new standard.[10]

6.11 Prudent avoidance and "the precautionary principle" are issues that have arisen a number of times throughout this Inquiry. A number of witnesses before the Committee have urged adoption of a precautionary approach to mobile phone standards and use.[11] Although witnesses used the expression 'precautionary

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4 AMTA, *Proof Committee Hansard*, 8/9/00, p 34; ACA, *Proof Committee Hansard*, 16/11/00, pp 298-299, p 308 and Submission 100, p 2; ntl, *Proof Committee Hansard*, 2/3/01, p 390.

5 ACA, *Proof Committee Hansard*, 16/11/00, p 298.

6 EMRAA, *Proof Committee Hansard*, 16/11/00, p 244.

7 *Proof Committee Hansard*, 16/11/00, p 252.

8 *Proof Committee Hansard*, 16/11/00, p 252.

9 *Proof Committee Hansard*, 16/11/00, p 252.

10 Dr Hocking, *Proof Committee Hansard*, 22/9/00, p 94; CSIRO, *Proof Committee Hansard*, 16/11/00, p 234.

11 For example Mr Maisch, *Proof Committee Hansard*, 22/9/00, p 76; Dr Hocking, *Proof Committee Hansard*, 22/9/00, p 108; Assoc Prof Fisher, *Proof Committee Hansard*, 22/9/00, p 164; Mr Fist, *Proof Committee Hansard*, 16/11/00, p 193; CSIRO, *Proof Committee Hansard*, 16/11/00, p 221; Mr Dwyer, CEPU, *Proof Committee Hansard*, 16/11/00, p 274. See further footnote 24 below.

principle', the measures they favoured amounted to a precautionary/cautionary approach rather than an invocation of the actual principle.

6.12 The precautionary principle has its origins in UN debates and is formally embodied in the Rio Declaration on Environment and Development. It has subsequently been incorporated into a number of documents – most recently the Biosafety Protocol on the mutually supportive relationship between the WTO Agreement and Environmental Agreements.

6.13 The precautionary principle is set out in Principle 15 of the 1992 *Rio Declaration*, to which Australia is a signatory:

> In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. When there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.[12]

6.14 The Organisation for Economic Cooperation and Development (OECD) paper entitled *Environmental principles and concepts* states:

> The "Precautionary Principle" evolved from the recognition that scientific certainty often comes too late to design effective environmental policy responses; it thus recommends action in responding to potential environmental threats instead of waiting for absolute scientific proof. Formulations vary widely.[13]

6.15 In February 2000, the European Commission adopted a *Communication*[14] on the Precautionary Principle, in order to reach a legal definition. This includes discussions about the underlying concepts of 'risk' and 'scientific certainty'. The intention of the document was to establish conditions under which the European Union could invoke the Precautionary Principle. The EC Communication states that:

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12 'Rio Declaration on Environment and Development', In *Report of the United Nations Conference on Environment and Development*, *Rio de Janeiro, 3-14 June 1992*, [New York]: United Nations, 1992, available at: http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

13 OECD, *Environmental principles and concepts*, 6 November 1995, Paris, (OCDE/GD(95)124, p.15), available at:

http://www.olis.oecd.org/olis/1995doc.nsf/c56e3fc6689dd81d4125669e003b67bc/beab041cd98a7de3c125626c006be6f3/$FILE/11E50299.ENG

14 *Communication from the Commission of the European Communities on the precautionary principle,* COM(2000)0001, 2/2/2000, Brussels. Available at:

http://www.europa.eu.int/comm/off/com/health_consumer/precaution.htm

> …the precautionary principle is a general one which should in particular be taken into consideration in the fields of environmental protection and human, animal and plant health.[15]

6.16 In Australia, the precautionary principle was included as a principle in the 1991 Intergovernmental Agreement on the Environment (IGAE) and was subsequently signed off by Federal and State Governments in the 1992 Ecologically Sustainable Development (ESD) Strategy. The most notable example of the principle being incorporated in Australian legislation is the *Environment Protection and Biodiversity Act 1999*.[16]

6.17 There was considerable debate before the concept "lack of full scientific certainty" was included in the *Gene Technology Act 2000* (section 4aa) in December 2000.

6.18 During the 9 December 1998 Senate debate on the Australian Radiation Protection and Nuclear Safety Bill 1998 the precautionary principle was mentioned, however, the concept is not referred to in the *Australian Radiation Protection and Nuclear Safety Act 1998.* The object of the Act is to:

> Protect the health and safety of people, and to protect the environment, from the harmful effects of radiation.[17]

6.19 There is a growing movement to adopt precautionary approaches to manage health risks with scientific uncertainty. The World Health Organisation indicated that it does not normally advise national authorities to go beyond established knowledge, rather it sets health assessments based on accepted knowledge.[18]

6.20 On the other hand, CSIRO indicated that "there are particular areas where we must be sensitive to certain issues and therefore need to err on the side of caution",[19] for example, where public safety is concerned. The basis for incorporating a precautionary approach into the standard is "to make the point that this is not absolutely protective – that the standard is based on available evidence relating to thermal effects. These other low level effects are still uncertain".[20]

6.21 That is, since "the jury is still out on this debate … a precautionary principle would seem a good idea … in this area".[21]

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15 Ibid. At p.10.

16 Pursuant to section 391 the Minister must consider precautionary principle in making decisions.

17 Section 3.

18 *Proof Committee Hansard*, 31/8/00, p 6.

19 *Proof Committee Hansard*, 16/11/00, p 236.

20 CSIRO, *Proof Committee Hansard*, 16/11/00, p 236.

21 CSIRO, *Proof Committee Hansard*, 16/11/00, p 236.

6.22 The World Health Organisation advised the Committee that the European Commission's criteria for using the precautionary principle lead to the conclusion that it should not be applied to EMF. This does not preclude precautionary measures – it is just that you cannot invoke an established principle like the precautionary principle.[22]

6.23 Normally, uncertainty is dealt with in a science-based way by using safety factors that incorporate reductions in the exposure levels to account for the uncertainties and unforeseens.[23] The precautionary principle was not considered applicable to EME in the WHO's view, although considerable support has been expressed for a sensible, precautionary approach.[24] However, WHO did acknowledge that there is a growing movement to adopt precautionary approaches to manage health risks with scientific uncertainty.

6.24 A "precautionary approach" to address public concerns rather than invocation of the "precautionary principle" is the favoured approach. It has been suggested that this can include ongoing research, encouraging manufacturers to keep exposures to the minimum needed for the technology (including SAR testing and disclosure), better risk communication, targeting audiences with honest and accurate information, involving the public in decision making, and siting facilities to minimise public exposure and concerns.

Precautionary approach in ARPANSA draft standard

6.25 The draft Radiation Protection Standard formulated by the ARPANSA working group includes a precautionary statement that:

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22 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 6.

23 Dr Repacholi, WHO, *Proof Committee Hansard*, 31/8/00, p 5.

24 Dr Hocking, *Proof Committee Hansard*, 22/9/00, p 108; EMF South World P/L, *Proof Committee Hansard*, 8/9/00, p 65, 68; Mr Maisch, *Proof Committee Hansard*, 22/9/00, p 96 ("we have to be cautious" due to uncertainty of potential health effects); Prof. Fisher, 22/9/00, pp 181, 183; Mr Fist, *Proof Committee Hansard*, 16/11/00, pp 193, 199 (uses the expression 'precautionary principle' but suggests a cautionary approach/precautionary statement); Ms Corbin, CTN, *Proof Committee Hansard*, 16/11/00, p 218; Dr Haddad, CSIRO, *Proof Committee Hansard*, 16/11/00, pp 221, 235-6 (uses the expression 'precautionary principle' but suggests a precautionary warning "to make the point that this is not absolutely protective" at 236); Mr Lincoln, EMRAA, *Proof Committee Hansard*, 16/11/00, pp 243-4, 247; Prof McKenzie, *Proof Committee Hansard*, 16/11/00, p 272; Mr Dwyer, *Proof Committee Hansard*, 16/11/00, pp 274-5; Mr Doull, *Proof Committee Hansard*, 2/3/01, p 408. Taking different views were Dr Cherry (a precautionary approach is inadequate protection) *Proof Committee Hansard*, 2/3/01, p 339; and MMF (the safety factor in the standards is a sufficient precautionary approach), *Proof Committee Hansard*, 2/3/01, p 371.

> It is generally sensible, in achieving service or process requirements to minimise unnecessary or incidental RF exposure, provided it does not introduce other risks and can be achieved at modest expense.[25]

6.26 The draft standard details risk management processes for the hazards associated with RF exposure. Contrary to criticism that the working group had been directed not to consider precautionary approaches, clearly the draft standard adopts a precautionary approach.

Labor Senators support the inclusion of precautionary measures in the new standard, and consider the approach taken in the draft standard to be sensible.

Labor Senators find no substantial criticism of the transfer of the responsibility for setting a new Australian standard for electromagnetic emissions to the Australian Radiation Protection and Nuclear Safety Agency.

SENATOR MARK BISHOP

A.L.P (W.A.)

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25 Dr Loy, ARPANSA, PCH, 2/3/01, p.344; ARPANSA, "Draft Radiation Protection Standard – Maximum exposure levels to radiofrequency fields – 3kHz to 300GHz", Section 5, p.22, http://www.arpansa.gov.au/pubs/d_rf_prot_stnd.pdf. Also Annex 6.

APPENDIX 1 – CRITIQUE OF CHAIR'S REPORT

1.1 Labor Senators concluded in Chapter 2 of this Report that the Chair's Report is untenable because certain recommendations, conclusions and evidence in the body of the report are erroneous and specious considering the actual evidence. As outlined above (Chapter 2), the basis of this judgment by Labor Senators is that in the Chair's Report:

a) Some recommendations and evidence are outside the terms of reference of the Inquiry, whilst other evidence that was also outside the terms of reference is not in the report.

b) Some recommendations and conclusions are nonsensical and unfounded in the light of the evidence, some contradict the evidence presented to the Committee and some even contradict the Chair's own conclusions on the evidence.

c) Certain evidence has been given undue weight notwithstanding dubious credibility of witnesses or weight of evidence to the contrary.

d) Evidence has been distorted or taken out of context.

e) Other recommendations do not seem to have been clearly thought out, as they lack detail or are imprecise.

1.2 Justification of each of these criticisms follows.

(a) Issues extraneous to terms of reference

1.3 It is important that the Committee confines its deliberations and conclusions to the terms of reference of an Inquiry. Even though considerable evidence was presented to the Committee on matters extraneous to the terms of reference of this Inquiry, the Committee had requested that comments to the Inquiry be confined to the specific terms of reference. As such, any evidence outside the terms of reference cannot be considered to represent the range of opinions on a particular issue, as there has been no proper opportunity for comment. It is inappropriate for the Committee to make recommendations and conclusions on issues outside the terms of reference when it has not properly or fully inquired on those matters.[1]

1.4 Additionally recommendations made by the Chair were not raised in evidence received by the Committee.[2] Other recommendations made by the Chair were strongly criticised in evidence to the Committee from witnesses.[3]

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1 Recommendations 2.1, 2.2

2 Recommendations 2.8 – that the Government sponsor conferences (the Chair has not justified this recommendation or demonstrated a need for it, nor was it recommended or even mooted by witnesses).

1.5 Other evidence that was also outside the terms of reference of the Inquiry is not in the report, suggesting apparent selection of material to be included based on its utility in supporting the Chair's argument or conclusions.[4]

(b) Chair's recommendations/conclusions inconsistent with evidence

1.6 The Chair has reached a number of conclusions in the body of the report that contradict, or are simply very different from, the recommendations in the report.

1.7 For example, Recommendation 2.9 in the Chair's report contradicts the Chair's conclusion that it is not for the Committee to determine/direct how research funding should be allocated. The Chair's conclusion was correct, it is neither within the Committee's competence nor is it the Committee's role to direct experts as to how funding should properly be allocated. As such, the Chair's recommendation is inappropriate and improper.

1.8 Recommendation 4.1, that the Committee recommends that the radiofrequency standard be defined and administered by a process similar to that used by Standards Australia is nonsensical. If the process envisaged by the Chair resembles that which occurred previously and failed, it is likely that a similar outcome would eventuate. As a consequence Australia would remain with an unsatisfactory Standard, contributing to the confusion of the general public as well as to those who are supposed to comply with the Standard.

1.9 The merits or otherwise of the Chair's recommendation 2.8 (that the Commonwealth Government consider sponsoring conferences on the health effects of radiofrequency radiation along similar lines to that conducted on gene technology) were not discussed in evidence before the Committee. In fact, the issue was not raised at all.

1.10 The NHMRC advised the Committee that it went to some lengths to prevent the perception of conflict of interest in their procedures for allocating funds. For example, Dr Ken Joyner is only a non-voting member of the NHMRC Expert Committee. Despite the comment made at paragraph 3.79 of the Chair's report, it is difficult to see how the NHMRC could make greater efforts to ensure it is perceived to

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3 Recommendation 2.7, criticised by Dr Swicord and Dr Joyner, MMF, PCH, 2/3/01, p.372-5; Dr Black, OCH, 8/9/00, p.64.

Recommendation 3.1 $5 annual charge on mobile phone users – notwithstanding considerable support for more research, the $5 charge was questioned by NHMRC and MMF because it is doubtful whether there is sufficient expertise in Australia to achieve quality results from that considerable quantum of research funding; whether the amount is justified by the amount of uncertainty; whether this action is premature considering the WHO EMF Project is yet to report on the outcomes of many international and Australian studies (in 2005). It is also important that the need for more EMR research in Australia is balanced against other health research requirements.

4 For example, the dangers associated with mobile phones and driving; the health effects that may be associated with stress arising from concerns about potential health risks from exposure to EMR.

be at arms-length from the telecommunications industry, short of excluding experts in the field from the Committee.

1.11 The inclusion in the Chair's report of material from scientists who applied for funds, but were not awarded grants (paragraphs 3.89-3.91), belies the comment at 3.100 that it is not the role of the Committee to advocate which projects should have been funded.

(c) Relative credibility of witnesses – distorted in Chair's report

1.12 It seems that certain witnesses have been afforded undue weight in the Chair's deliberations, notwithstanding questionable credibility of witnesses or weight of evidence to the contrary.

1.13 The evidence of Dr Cherry has been given an inordinate amount of attention in the Chair's report. This is the case in spite of the fact that much of Dr Cherry's evidence has been criticised by scientific experts who gave evidence before the Committee. Dr Cherry himself stated in evidence before the Committee that "I come to totally different conclusions than Dr Moulder, Dr Black, Dr Elwood and Dr Repacholi",[5] all experts in this field. Clearly, balancing the opinions of these experts against those of Dr Cherry calls into question the relative weight that should be accorded the evidence of Dr Cherry.

1.14 Dr Cherry works in the area of agricultural meteorology[6] and appeared as "an independent academic scientist and senior academic at Lincoln University who has researched these effects, … [who] appeared in the first base station court case in New Zealand in 1995 [and who has] been researching the issue to try to see whether there are public health effects and biological effects".[7]

1.15 Yet Dr Cherry conceded to the Committee that:

> I am involved in direct research into natural electromagnetic radiation and the effects on public health and relating those studies, but it is correct that I am largely quoting other peer review published literature and looking carefully at that literature and applying scientific techniques to it. …

1.16 In public hearings Senator Bishop commented:

> You do not engage in original research in this particular narrow field as a number of other witnesses have, but you have done extensive analysis and

5 PCH, 2/3/01, p.330.

6 PCH, 2/3/01, p.333.

7 PCH, 2/3/01, p.328.

> evaluation of the work carried out by others. I just wanted to establish that…[8]

1.17 Dr Cherry responded:

> That is generally true, but I have also taken the opportunity to meet with the others where possible and to check my analysis to make sure that it is correct.[9]

1.18 A review carried out by the Institute of Environmental Science and Research commissioned by the New Zealand Ministry of Health in June of last year concluded (at pages 30, 31, 32 and 33):[10]

> Overall, one is left with the impression that Cherry either has not had the skills to properly evaluate and extend the published cancer epidemiological analyses, or has not applied an objective approach, or possibly both. This review engendered no confidence that Cherry has the expertise or the objectivity to evaluate the other areas of radio frequency epidemiology covered in his critique. ... in conclusion, based on the assessment set out above, this reviewer could not recommend that Dr Cherry's critique of the ICNIRP Guidelines be accorded weight in determining the final shape of the New Zealand guidelines for the siting of radio frequency transmission sites.
>
> However, he [Dr Cherry] shows only limited awareness of the potential for bias (confounding, selection bias, and information bias), not only in his assessment of the published results of studies, but also in his own re-analyses of the data of others. That, in this reviewer's opinion, is the most fundamental problem with Dr Cherry's analysis of the epidemiological literature. It is a pervasive issue that renders most of his re-analyses and reinterpretations invalid, or, at least, highly suspect.

1.19 Dr Cherry responded that the reviewer's conclusions have "so little substance that it looks like a predetermined view right from the start. I am not surprised at that, because Dr Bates, who wrote that report, told me his opinion before he wrote it. I reject his criticism as being unjustified, and it is certainly not justified by his report".[11]

1.20 The Chair's report affords greater weight to the evidence of Dr Cherry than appears to be warranted, particularly where his views contradict the conclusions of expert review panels such as the recent respected and comprehensive UK Stewart Report.

1.21 Dr Repacholi made the following comments in response to the statements about him in Dr Cherry's submission:

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8 PCH, 2/3/01, p.333.

9 Ibid.

10 PCH, 2/3/01, pp.334-5.

11 PCH, 2/3/01, p.335.

> …Dr Cherry has no credibility to make any meaningful accusations of scientific professionals who have worked in the EMF field for over 30 years. What Dr Cherry does not mention in his resume is that he was elected to local government using the EMF issue and has been [a] crusader ever since, ensuring that his misinterpretation of the facts will keep the issue alive along with electoral success. …
>
> Dr Cherry has no credible scientific publications in this field, lacking even one peer reviewed publication, and has done no research related to biological effects of EMF. He goes from conference to conference giving abstracts that are never submitted to scientific peer review for publication. Conference abstracts have no value in science until all information is provided in a full scientific paper. The most reliable scientific papers should be published in peer-reviewed scientific journals.
>
> No one denies the right of Dr Cherry to make valid criticisms about the science … this is part of the scientific process. However, such criticisms must be submitted to peer scrutiny to determine their worth…something that occurs in blue-ribbon review panels.
>
> The sum total of Dr Cherry's knowledge comes from his "selective reviews" that he publishes himself. Not only does Dr Cherry only present studies that support his own case, he mostly fails [to] cite studies that do not support his views…this is something that is not done by any credible scientist or organization with which WHO is associated. Further, his reviews cover studies that need specialist interpretation; for example by biologists, epidemiologists, clinical specialists and physical scientists. To conduct the reviews that Dr Cherry claims to do, WHO would bring together specialists from all these disciplines to obtain their expert assessments of all the studies, giving evidence both for and against there being an effect, and then reach consensus conclusions and recommendations through the standard "weight of evidence" approach. An Agricultural Meteorologist does not appear to fit this requirement.
>
> Without exception all national or international scientific review panels have reviewed all the same studies as Dr Cherry and reached the same conclusions at the WHO and ICNIRP.[12]

1.22 Dr Black, in his submission, also refers to concerns arising "when people take scientific information out of context, or, more commonly, are led to do so by a minority of scientists and others who make incorrect interpretations of the scientific literature".[13]

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12 Rebuttal to accusations made by Dr Neil Cherry to Australian Senate Committee on Health Effects of Electromagnetic Radiation, Dr Repacholi, World Health Organization, Geneva, 5 October 2000, p 1.

13 Submission 93, p.3.

1.23 Furthermore, in the Chair's report, there appears to be an implied adverse reflection on the professionalism/integrity of Dr Repacholi in referring to his 'industry' links.[14] There are vested interests other than industry involved in this debate and, while the industry interests have been criticised,[15] other vested interests have not been acknowledged in the Chair's report.[16] Additionally, Dr Repacholi suggested that Dr Cherry may have a vested interest in promoting a particular viewpoint on this issue by virtue of his role in local government, a perspective not presented in the Chair's report.[17]

1.24 Other opinions afforded undue attention include Dr Sykes who is mentioned in Paragraph 3.89 even though she was not a witness or submitter to the Inquiry.

1.25 Curiously, the expert evidence of ARPANSA, in general, seems to have been ignored by the Chair's report - especially in relation to the conclusion that ARPANSA should not have responsibility for the new Standard.

(d) Evidence taken out of context/distorted

1.26 There are examples in the Chair's report which Labor Senators perceived as misinterpretation or distortion of the evidence presented to the Committee.

1.27 For example, in the Report, paragraph 3.95 implies that the CSIRO criticised the RF EME Research Program, but the quotation appears to have been taken out of context. The context of the quote was in relation to the research situation at the time the CSIRO wrote its report (ie pre-1994). Dr Barnett does say that the situation has probably not changed since then, but that comment is not so strong as the way it has appeared in the Chair's report. The full quote is:[18]

> The government at that time appreciated that there was reasonable cause for concern to undertake some sensible structured program of research, which up until then did not really exist and probably still does not.
>
> Research has been sporadic. The results have been controversial and contradictory. It is not really surprising. Unless you have a properly structured and directed system of research, you will not overcome the initial problem of the undirected sporadic bits of research that are carried on, sometimes not particularly well.

1.28 Peer review is an important element of scientific research despite shortcomings identified in the Chair's report.[19] However, the Chair seems to place

14 Chair's Report at paragraph 2.218.

15 Chair's Report at paragraphs 2.217, 2.223.

16 For example those of researchers involved in the manufacture of shielding devices.

17 Footnote 12.

18 *Official Committee Hansard*, 16/11/00, pp 223-224.

19 Peer review is discussed at paragraphs 2.46 – 2.53 of the Chair's Report.

insufficient emphasis on the importance of peer-review in scientific research. This is particularly so given the references to Dr Cherry's analysis, which has not been peer-reviewed.

1.29 There is a comment at paragraph 3.129 about the level of uncertainty about the safety of cellphones identified in so many scientific studies which seems to overemphasise the case.

1.30 Furthermore, the Chair seems to, inappropriately, give equal weighting to the views of those who are not directly involved in research in this area.[20]

(e) Recommendations imprecise

1.31 An example of the Chair's recommendations being imprecise, and consequently problematic, is the Chair's recommendation 4.2, that the level of 200 microwatts per square centimetre in the expired Interim Standard (AS/NZS 2772.1(Int):1998) be retained in the Australian Standard.

1.32 A specific recommendation about a measurement of power flux density (ie 200 microwatts per square centimetre) should specify whether it applies to all people or whether it maintains the differences between the occupationally-exposed and non-occupationally-exposed population, in the expired Standard.

1.33 The recommendation requires some comment about whether this would be an instantaneous measurement (which may not be possible), whether it be averaged over some time period, or over some amount of tissue. 200 $\mu W/cm^2$ would provide a lower level of exposure than exists at present but at frequencies below 10 MHz, power flux density is not the appropriate measurement to use, according to ARPANSA.

1.34 The expired Interim Standard adopted this exposure level for the non-occupationally exposed population for frequencies above 10 MHz. The draft ARPANSA Standard adopts this exposure level for general public exposures between 10 MHz and 400 MHz, but then allows increasing levels with increasing frequencies.

1.35 In addition, that recommendation of the Chair's report comments that Australia should not adopt the ICNIRP Guidelines, but it implies support for the expired Interim Standard which was based in some part on the International Radiation Protection Association (IRPA) Guidelines and IRPA became ICNIRP. This is not a logical argument.

1.36 As concluded above (Chapter 2), the pervasive flaws, errors and misinterpretations in the Chair's report necessitate this Minority Report which represents Labor Senators conclusions based on evidence to the Inquiry.

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20 For example, evidence of EMRAA at paragraph 2.45 of the Chair's Report.

APPENDIX 2 - GLOSSARY

Acronym	
AMTA	Australian Mobile Telecommunications Association
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CSIRO	Commonwealth scientific and industrial research organisation
ELF	Extremely low frequency
EME	Electromagnetic energy
EMF	Electromagnetic field
EMR	Electromagnetic radiation
EMRAA	Electromagnetic Radiation Alliance of Australia
ICNIRP	International Commission on Non-Ionising Radiation Protection
NHMRC	National Health and Medical Research Council
PCH	Proof Committee Hansard
RF	Radiofrequency
SAR	Specific absorption rate
WHO	World Health Organisation

APPENDIX 1

LIST OF SUBMISSIONS

Sub No	Name	Organisation	State
1	Ms Marie Kougellis		NSW
2	Mr Walter Kosterke		NSW
3	Mr John C. Bedford		NSW
4	Mr A. W. Bewley	Warrimoo Citizens Association	NSW
5	Mr Michael Rolfe	The Vaucluse Progress Association	NSW
6	Mr Stephen O'Rourke		QLD
7	Mr Les Lucas		NSW
8	Mr David Lucas		NSW
9	Ms Sarah Noakes		NSW
10	Ms Michelle Cossey		NSW
11	Professor Mark Elwood		VIC
12	Ms Sarah Newsome		NSW
13	Mr Ray Winter		NSW
14	Mr Greg Eggert		NSW
15	Ms Annie Carn		NSW
16	Chris & Marie Kougellis		NSW
17	Mr Joe Friend		NSW
18	Mr Leigh Tanner		NSW
19 19(a)	Mr Peter Russell	Australian Mobile Telecommunications Association (AMTA)	ACT

Sub No	Name	Organisation	State
20	Mr Don Maisch		TAS
20(a); 20(b); 20(c); 20(d); 20(e)			
21	Dr Bruce Hocking		VIC
21(a); 21(b); 21(c)			
22	Ms Dalana MCaren		Canada
23	Mr Evan Bzun		NSW
24	Mr Noah Yamore		NSW
25	Ms Suzanne Neffeler		NSW
26	Ms Sandy Carr		NSW
27	Mr Armand Dupont		NSW
28	Mr Donald Adams		TAS
29	Mr Andrew Tink, MP		NSW
30 30(a)	Mr Stewart Fist		NSW
31	Ms Sarah Wallace		NSW
32	Ms Elisabeth Newman	National Council of Women of Australia (NCWA)	VIC
33	Ms Lyn Ward & Mr Mark Lamb		NSW
34	Ms Gail Darby		NSW
35	Ms Helen Joyce		NSW
36	Mr Stan Stanfield		NSW
37	Dr Peter French		NSW
38	Ms Sylvia Douglas		NSW
39	Ms Stephanie Evans		QLD
40 40(a)	Mr Les K Dalton		VIC

Sub No	Name	Organisation	State
41	Professor Barry Boettcher AM		NSW
42	Mr John McNally	City of Melville	WA
43	Dr John Yesberg		QLD
44	Mr D Trezise	Holroyd City Council	NSW
45	Mr Keith Orchison	Electricity Supply Association of Australia Limited (ESAA)	NSW
46	JW & JB Purchase		NSW
47	Mr William Lowe & Ms Iris Detenhoff		NSW
48	Mr and Mrs Emanuel Vassallo		NSW
49	Mrs P R Richards		QLD
50	Mr Gary Schroder		QLD
51	Dr David Mercer		NSW
52	Mr D Arthur		NSW
53	Mr Frank Edwards	Town of Kwinana	WA
54	Confidential		
55	Ms Barbara Schwabe	Sunshine Coast Environment Council Inc.	QLD
56	Dr Michael H Repacholi	World Health Organization (WHO)	Switzerland
57	Confidential		
58	Name Withheld		
59	Mr Clifford Maurer		NSW
60 60(a)	Dr John Moulder		USA
61	Mr Bo Soderbarg	FEB Sweden	Sweden

Sub No	Name	Organisation	State
62	Ms Gillian Summerbell		NSW
63	Mr Nick McKillop		VIC
64	Dr Graeme Stringer		QLD
65	Mr John Allen		QLD
66 66(a)	Mr Dan Dwyer	Telecommunications Officers Association Branch of CEPU	NSW
67	Ms Helen McKillop		VIC
68	Mr Tyler McGee	Nokia Mobile Phones, Australia	NSW
69	Mr Robert Wells	National Health Medical Research Council (NHMRC)	ACT
70	Mr C S Newton		ACT
71	Confidential		
72	Mr Frank Panter	Castlemaine Optus Antennas Relocation Group (COARG)	VIC
73	Mr David Havyatt	AAPT Limited	NSW
74	Mr Harold Hird MLA		ACT
75	Mr Michael Milligan	Mobile Manufacturers Forum (MMF)	Belgium
76	Ms Sonia Venditti		QLD
77	Mr Paul Greatrex	OneSteel Market Mills (formerly BHP Structural & Pipeline Products)	NSW
78	Mr Michael Filipovic	Motorola Australia	VIC
79	Confidential		
80 80(a)	Ms Lyn McLean	Electromagnetic Radiation Alliance of Australia (EMRAA)	NSW
81	Ms Yvonne Jayawardena		NSW

Sub No	Name	Organisation	State
82	Ms Gwenda Spencer & Mr Tom Spencer		QLD
83	Mr Chris Deason		QLD
84	Mr Paul Hunt		NSW
85	Mr Roger M Lilley		VIC
86	Mr Bob Fontijne	Maleny Residents' Action Group	QLD
87 87(a)	Ms Betty Shelley & Mr Trevor Shelley	Betty and Trevor Shelley	QLD
88 88(a)	Mr David Shires	Telstra	ACT
89	Ms Sue Pennicuik	Australian Council of Trade Unions (ACTU)	VIC
90	Mr Bruce Dunn	The Maple Street Cooperative Society Ltd	QLD
91	Mr Brian Currie	Hutchison Telecommunications	NSW
92	Mr Yoke Berry	Dapto Residents Against Tower Health Risks	NSW
93 93(a)	Dr David R Black		New Zealand
94	Ms Ruth Parnell		QLD
95	Dr G.N. Haddad	CSIRO Telecommunications & Industrial Physics	NSW
96	Mr Paul Fletcher	Cable and Wireless Optus	NSW
97	Mr & Mrs Garry Davies		SA
98 98(a)	Mr Chris Zombolas	Electrical Compliance Testing Association (ECTA)	VIC
99	Mr Andrew Bissex	Vodafone Network Pty Ltd	NSW

Sub No	Name	Organisation	State
100	Mr Max Schneider	Australian Communications Authority	ACT
101	Ms Helen Campbell	Consumers' Telecommunications Network (CTN)	NSW
102	Mr John Allen	Greenbank Area Powerline Group (GAP)	QLD
103	Associate Professor Olle Johansson		Sweden
104	Ms Sandra Jordan		VIC
105	Mr & Mrs Tony Reeves		QLD
106	Professor Brian Tress	Department of Human Services	VIC
107	Mr Pranay Bhattacharya		NSW
108	Mr Greg Hutchison		ACT
109	Ms Bonny Bauer	Power to the People Action Group	QLD
110	Mr David McKenna	Community and Public Sector Union (CPSU)	VIC
111 111(a)	Ms Betty Venables	The EMR Safety Network International	NSW
112	Mr Richard Giles		QLD
113	Mr Alexander H. Doull		VIC
114	Mr Ross Kelso	Centre for International Research on Communication and Information Technologies (CIRCIT)	VIC
115	Mr John Higginbottom	ntl	NSW
116	Mr Darryll Davies		QLD
117	Mr Geoff Benson	Coomera Valley Progress Association	QLD

Sub No	Name	Organisation	State
118 118(a)	Mr Neil J. Boucher		QLD
119	Mr Simon Fielding OBE		UK
120	Mr Chris Ashton		QLD
121	Ms Janette Wright		VIC
122	Professor Philip Jennings		WA
123	Ms Heather Anne Meyer		QLD
124	Ms Jane Cajdler	Karawatha Forest Protection Society Inc	QLD
125	Associate Professor Frank G. Fisher		VIC
126	Dr J Phua		NSW
127	Dr Colin Roy	Electromagnetic Energy Public Health Issues Committee (CEMEPHI)	VIC
128	Dr John Loy	Australian Radiation Protection & Nuclear Safety Agency (ARPANSA)	NSW
129 129(a); 129(b)	Mr Terry Butler	EMF South World Pty Ltd	ACT
130	Dr Garry J Smith	Sutherland Shire Council	NSW
131	Ms Maria Selva		NSW
132	Mrs Karen Banks	One-Tel Tower Committee	VIC
133	Mr Roger Lyle	Standards Australia	NSW
134	Mr Robert C Green		NSW
135	Ms Nikki Carabetta		SA
136	Mrs M.S. Allen		NSW
137	Mr John Hyde		WA

Sub No	Name	Organisation	State
138	Ms Diane Beaumont		Withheld
139 139(a)	Mr Alan K. Tunnah		NSW
140	Ms Janina Paletemps	Sunshine Heights Kindergarten	VIC
141	Mrs H. Adamidis	Sunshine Action Group	VIC
142	Ms Sarah Benson	Electromagnetic Awareness Network	VIC
143	Dr John A.G. Holt		WA
144	Mrs Leanne Noakes		WA
145	Mrs Beryl Humphries		VIC
146 146(a)	Dr Neil Cherry		New Zealand
147	Dr Henry Lai & Dr Narendra Singh		USA
148	Mr David Rae	Municipal Association of Victoria	VIC
149	Mr Peter Kerley	Deafness Council of NSW Inc	NSW

APPENDIX 2

WITNESSES AT HEARINGS

Canberra - Thursday, 31 August 2000

World Health Organization

- Dr Michael Repacholi, Coordinator, Occupational Health & Environmental Health

Canberra – Friday, 8 September 2000

Australian Mobile Telcommunications Association

- Mr Alex Gosman, Chairman, Electromagnetic Energy Committee
- Mr Peter Russell, Chief Executive Officer
- Mr David Havyatt, Member
- Ms Roslyn Young, Member

National Health and Medical Research Council

- Mr David Clarkson, Director, Research Development Section

Enviromedix

- Dr David Black, Independent Consultant, and Senior Lecturer, University of Auckland Medical School

EMF South World Pty Ltd

- Mr Terry Butler, Chief Executive Officer
- Mr John Cooper, General Manager

DNA Communications

- Mr Neil Boucher, Consulting Engineer and Managing Director

Microwave Therapy Centre

- Dr John Holt, Medical Director

Melbourne – Friday, 22 September 2000

Mr Don Maisch (private capacity)

Municipal Association of Victoria

- Mr David Rae, Consultant
- Ms Natasha Latham, Policy Officer

Dr Bruce Hocking (private capacity)

Professor Mark Elwood (private capacity)

EMF South World Pty Ltd/ EMX Corporation

- Mr Terry Butler, CEO, EMF
- Dr Thomas Magnussen, CEO, EMX
- Dr Theodore Litovitz, Professor Emeritus of Physics, Catholic University of America

Electrical Compliance Testing Association

- Mr Chris Zombolas, Vice-President
- Mr Malcolm Mulcare, Member

Mr Les Dalton (private capacity)

Monash University, Graduate School of Environmental Science

- Associate Professor Frank Fisher, Director

Canberra – Tuesday, 7 November 2000

The Experimental Dermatology Unit, Department of Neuroscience, Karolinka Institutet

- Associate Professor Olle Johansson

Sydney - Thursday, 16 November 2000

Mr Stewart Fist (private capacity)

BHP Structural & Pipeline Products (OneSteel Market Mills)

- Dr Trevor Height, Manager, Technology

- Dr Peter Hart, Consultant
- Mr Ian Waters, Technical Superintendent

Consumers' Telecommunciations Network (CTN)

- Ms Teresa Corbin, Policy Adviser

CSIRO Telecommunications & Industrial Physics

- Dr Gerry Haddad, Chief
- Dr Stan Barnett, Project Leader

Electromagnetic Radiation Alliance of Australia

- Mr John Lincoln, Convenor
- Mrs Lyn McLean, Secretary

EMR Safety Network International

- Mr Richard Watkins, Member

Dr Peter French (private capacity)

Professor David McKenzie (private capacity)

Telecommunications Officers Association Branch of Communications, Electrical and Plumbing Union

- Mr Dan Dwyer, Vice-President and Branch Secretary

Standards Australia

- Mr Colin Blair, General Manager, Standards and Technical Writing Division
- Mr Roger Lyle, Director, Communications, IT and e-Commerce Standards

Australian Communications Authority

- Dr Robert Horton, Deputy Chair
- Mr Ian McAlister, Manager, Radiocommunications Standards Team

Canberra - Friday, 2 March 2001

Dr John Moulder (private capacity)

Dr Neil Cherry (private capacity)

Australian Radiation Protection & Nuclear Safety Agency and Electromagnetic Energy Public Health Issues Committee

- Dr John Loy, Chief Executive Officer
- Mr Wayne Cornelius, Manager, EMR & Laser Optical Radiation Branch

Mobile Manufacturers Forum

- Mr Peter Harrison, Immediate Past Chairman
- Dr Mays Swicord, Research Coordinator
- Dr Ken Joyner, Member, Regulatory Working Group
- Mr Michael Milligan, Secretary General

Telstra

- Mr Tony Bundrock, National General Manager, On Air Convergence
- Dr Hugh Bradlow, Chief Technology Officer

ntl Australia

- Mr Clive Morton, Braodcast Services Director
- Mr John Higginbottom, Technical Services Director

National Health and Medical Research Council

- Mr David Clarkson, Director, Research Development Section
- Ms Liz Cotton, EME Project Officer

Mr Alexander Doull (private capacity)

APPENDIX 3

ADDITIONAL INFORMATION

Tabled Documents

Canberra – Friday, 8 September 2000

Mr Peter Russell, AMTA

- EME Senate Inquiry, copy of Power Point Presentation Slides

Mr David Clarkson, NHMRC

- NHMRC Application Process, copy of Power Point Presentation Slides

Mr Terry Butler, EMF South World Pty Ltd

- Senate Inquiry into EMR, Copy of Power Point Presentation Slides
- Documentation on the effectiveness of the EMF Bioprotection™ technology, dated 7 August 2000 by Dr Magnussen

Dr John Holt

- Submission to the Senate Inquiry into Electromagnetic Radiation (undated)

Melbourne – Friday, 22 September 2000

Dr Bruce Hocking

- Paper titled 'Decreased survival for childhood leukaemia in proximity to TV Towers' by Dr Hocking
- Article entitled 'Cancer incidence and mortality and proximity to TV Towers' from *Medical Journal of Australia*, Vol 165, 2/16 December 1996 by B Hocking, I R Gordon, H L Grain & G E Hatfield
- Letters to the Editor entitled 'TV Towers and childhood leukaemia' from *Australian and New Zealand Journal of Public Health*, 2000 Vol 24 No 2 by B Hocking, I Gordon & G Hatfield
- Case Report titled 'Neurological abnormalities associated with mobile phone use' from *Occupational Medicine* Vol 50 No 5 by B Hocking and R Westerman
- Article titled 'Preliminary report: Symptoms associated with mobile phone use' from *Occupational Medicine* Vol 48 No 6 by B Hocking

Professor Mark Elwood

- Overhead Transparencies

Dr Thomas Magnussen

- Copy of Power Point Presentation Slides

Mr Chris Zombolas, Electrical Compliance Testing Association

- ECTA Submission to Senate Inquiry into EMR

Professor Frank Fisher

- Paper containing three quotes
- Copy of an Email from Frank Fisher to a number of people concerning the Renewable Energy (Electricity) Bill 2000, dated 28 August 2000
- Pamphlet called *Australian Health Consumer*, dated September 2000

Sydney - Thursday, 16 November 2000

Mr Stewart Fist

- Folder entitled *Additional Material*, dated 16 November 2000

Dr Trevor Height, OneSteel Market Mills

- Copy of Power Point Presentation Slides

Dr Gerry Haddad, CSIRO

- Graph showing magnetic field strength limits for public exposure

Ms Lyn McLean, EMRAA

- Copies of Abstracts

Mr Richard Watkins, EMR Safety Network International

- Book titled ElectroMagnetic Radiation and your health by Betty Venables

Dr Peter French

- Curriculum Vitae of Peter French
- Review titled 'Role of the Heat Shock Response and Molecular Chaperones in Oncogensis and Cell Death' from *Journal of the National Cancer Institute,* Vol 92, No 19, October 4 2000

Mr Dan Dwyer, CEPU

- Reprint Brochure titled Evaluation of Antenna Configurations fro Reduced Power Absorption in the Head by Rodney Baughan & Neil Scott (originally published in IEEE Transactions on Vehicular Technology, Vol 48, No 5, September 1999)

Dr Bob Horton, ACA

- Copy of Power Point Presentation Slides

Canberra - Friday, 2 March 2001

Dr Neil Cherry

- Summary table on epidemiological studies

Dr Loy, ARPANSA

- Draft Radiation Protection Standard – Maximum exposure levels to radiofrequency fields – 3kHz to 300GHz
- Opening Statement
- Copy of Power Point Presentation

Mr Michael Milligan, MMF

- 3 Brochures titled Mobile phones: health and safety issues; Mobile phones: base stations; and Understanding SAR
- Cellular Telephones and Cancer: How Should Science Respond? and Cellular Telephones and Cancer – a Nationwide Cohort Study in Denmark from *Journal of the National Cancer Institute*, Vol 93, No 3, 7 February 2001
- Radiofrequency Exposure and Mortality from Cancer of the Brain and Lymphatic/Hamatopoietic Systems from *Epidemiology*, Vol 11, No 2, March 2000
- Cellular Telephone Use & Brain Tumours from NEJM website, 19 December 2000
- Handheld Cellular Telephone Use & Risk of Brain Cancer, *Journal of the American Medical Association*, Vol 284, No 23, 20 December 2000

Mr Tony Bundrock, Telstra

- Copy of Power Point Presentation

Mr David Clarkson, NHMRC

- Status Report to Senate Inquiry, NHMRC Electromagnetic Energy Research Program
- Copy of Power Point Presentation

Answers to Questions on Notice

Letter from Mr Zombolas, Technical Director, EMC Technologies, dated 19 January 2001

Letter from Mr Black, Deputy Executive Officer, AMTA, dated 31 January 2001

Answers to written questions from CEMEPHI, dated March 2001

Email from Ms Cotton, EME Project Officer, NHMRC, dated March 2001

Letter from Dr Bradlow, Chief Technology Officer, Telstra, dated 21 March 2001

Email from Ms Beverley Neill, ARPANSA attaching answers, dated 22 March 2001

Facsimile letter from Mr Milligan, Secretary General, MMF, dated 23 March 2001

Additional Correspondence

Letter from Ms Tarnawski, Assistant Manager (EMR), ACA, dated 14 September 2000

Letter from Dr Schaap, Assistant Director – Environment and Sustainable Energy, ESAA, dated 15 March 2001

Letter from Dr Hocking, dated 22 March 2001

Responses to Adverse Comments made in Written Submissions

Letter from Professor Vernon-Roberts, Director, Institute of Medical & Veterinary Science, dated 9 August 2000

Letter from Mr Wells, Chief Executive Officer, NHMRC, dated 14 August 2000

Rebuttal from Dr Repacholi, WHO, dated 5 October 2000