Australian Government

Australian Radiation Protection and Nuclear Safety Agency

CODE OF PRACTICE

Safe Transport of Radioactive Material

Radiation Protection Series Publication No. 2

2008 EDITION

Version for public consultation: 21 August 2007

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All submissions will be held in a register of submissions, and unless marked confidential, may be made public.

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

Published by the Chief Executive Officer of ARPANSA in MMM 200Y

Foreword

The regulation of the transport of radioactive material in Australia has, for many years, been based on international requirements published by the International Atomic Energy Agency (IAEA). The regulatory frameworks of the Commonwealth, State and Territory jurisdictions currently apply the *Code of Practice for the Safe Transport of Radioactive Material (2001)* which, in turn, adopts the IAEA's *Regulations for the Safe Transport of Radioactive Material* 1996 Edition (Revised) (No. TS-R-1 (ST-1, Revised)), as published in 2000. The Code establishes requirements for adoption by Commonwealth, State and Territory jurisdictions that will maintain a system for the safe transport of radioactive material by road, rail and waterways (other than those subject to the *Navigation Act 1912)* in Australia.

In 2003 and 2005, the IAEA published revisions of their *Regulations for the Safe Transport of Radioactive Material* and recommended that 'adoption of these revised Regulations occur within a period of five years from their publication to achieve worldwide harmonization of their application.'

The Radiation Health Committee, established under the ARPANS Act 1998, has recommended that the Transport Code be revised to incorporate the 2005 IAEA Regulations and the revised Transport Code be promulgated on 1 January 2008 to cover the transport of radioactive material in Australia by road, rail and waterways (other than those subject to the *Navigation Act 1912).*

This revised Code of Practice has been developed by a working group of the Radiation Health Committee, which has reviewed the IAEA 2005 Regulations and compared the requirements therein with those specified in the 2001 Transport Code.

The main changes from the 2001 Transport Code are machinery, grammatical or clarifying in nature and it is expected that there would little or no cost to industry in revising the Transport Code. Any cost to users would result from familiarising themselves with the new requirements and this is expected to be only minor and only occur in the first year.

It should be noted that transport of radioactive materials by air and international waterways incorporate the IAEA 2005 Regulations under the jurisdiction of *Civil Aviation Act 1988* and the *Navigation Act 1912* respectively. Any company involved with the import or export of radioactive material would therefore already need to be familiar with the requirements of the 2005 IAEA Regulations.

The revised Transport Code was released for a public comment period from 21 August 2007 to 28 September 2007 along with a table outlining the differences between the two Codes and an assessment of the costs to stakeholders. The comments received were reviewed by the working group, and the final document was approved by the Radiation Health Committee on DD-DD MMMM 200Y, and the Radiation Health and Safety Advisory Council at their meeting of DD MMMM 200Y advised the CEO to adopt the Code.

The Code will remain in the Radiation Protection Series as RPS 2, with a change to the date (2008) to reflect the revised version. It is expected that the Code will be further revised and updated from time to time to ensure that it continues to provide the highest standards of protection.

John Loy
CEO of ARPANSA

MMMM 200Y

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1. Introduction

1.1 Citation

This Code of Practice may be cited as the *Code of Practice for the Safe Transport of Radioactive Material (2008).*

1.2 Background

This Code of Practice replaces the *Code of Practice for the Safe Transport of Radioactive Material (2001)* and adopts the *International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material* 2005 Edition (No. TS-R-1).

The transport of radioactive material by any person, organisation or government must comply with the radiation safety legislation of the State, Territory or Commonwealth jurisdiction through which the radioactive material is transported.

1.3 Purpose

This Code of Practice is intended to establish uniform requirements for the transport of radioactive material in Australia.

1.4 Scope

This Code of Practice is intended to apply to the transport of radioactive material by:

(a) road;

(b) rail; and

(c) waterways under the jurisdiction of States and Territories in Australia.

The transport of radioactive material by air is covered by the *Civil Aviation Act 1988*. Similarly, transport of radioactive material by waterways that do not otherwise come under the jurisdiction of States and Territories in Australia is covered by the *Navigation Act 1912*. Details of the relevant Australian competent authorities relating transport of radioactive materials by air or sea can be found in Table 2 of Schedule B.

1.5 Structure

Section 2 includes modifications and clarifications for Australian circumstances to the International Atomic Energy Agency *Regulations for the Safe Transport of Radioactive Material* 2005 Edition (No. TS-R-1).

Schedule A of this Code of Practice incorporates the International Atomic Energy Agency *Regulations for the Safe Transport of Radioactive Material* 2005 Edition (No. TS-R-1) and includes material, written in regulatory format, which forms part of the regulatory guidance of this Code.

Schedule B contains a list of Australian Competent Authorities for the Transport of Radioactive Material.

The terms used in this Code are defined in the Glossary.

Annexes to this Code of Practice include advisory material that provides background to the regulatory guidance.

Annex 1 is a summary of the health effects of ionizing radiation standards for control of exposure. Annex 2 contains a list of ARPANSA Radiation Protection Series Publications.

2. Modifications and Clarifications to International Regulations

2.1 A person must not transport radioactive material by road, rail or waterways (other than those subject to the *Navigation Act 1912*) unless that person does so in accordance with the International Regulations as modified and clarified by Clauses 2.2-2.11 of this Code of Practice.

2.2 Competent Authorities are:

(a) for the purpose of this Code of Practice, those listed in Table 1 of Schedule B, as amended from time to time; or

(b) for the purpose of transport by sea or air, those listed in Table 2 of Schedule B, as amended from time to time.

2.3 The 'relevant transport regulations for dangerous goods' referred to in paragraph 109 of the International Regulations are the regulations of Australian States, Territories and the Commonwealth for the transport of dangerous goods by road and rail which are based upon the Australian Code for the Transport of Dangerous Goods by Road and Rail, Sixth Edition, 1998 (ADG Code).

2.4 In relation to the transport of radioactive material by road and rail, where there is a conflict between the requirements of this Code and the ADG Code, the provisions of this Code prevail.

2.5 Paragraph 308 of the International Regulations is replaced by:

The relevant *competent authority* may impose requirements to ensure that radiation protection measures comply with the recommendations in RPS1.

2.6 In paragraph 563 of the International Regulations, the word 'dose' is taken to mean 'effective dose'.

2.7 The limits in relation to U(nat) and Th(nat) are to be applied in terms of the parent radionuclide i.e. U-238 and Th-232 respectively.

2.8 The paragraphs of the International Regulations to be complied with by consignors are:

109, 306, 309-314, 401-419, 501-511, 514, 515(a)-(c), 516-563, 567-569, 571-572, 575-576, 601-682, 701-737, 801-803, 805(a)-(c), 806-807, 809-810, 812-813, 815-820, 822, 824-825.

2.9 The paragraphs of the International Regulations to be complied with by carriers are:

109, 301-306, 309-314, 503-514, 523, 525-527, 533(c), 541-544, 547-548, 563-579, 583, 625-628.

2.10 The default values given in paragraphs 526(a) and (b) of the International Regulations, where used instead of actual measurements, may require transport under exclusive use according to paragraph 530 of the International Regulations.

2.11 Where the provisions of clause 2.10 of this Code of Practice causes difficulty, the relevant Competent Authority should be contacted.

Schedule A

The International Regulations

The IAEA Regulations for the SAFE TRANSPORT of Radioactive Material 2005 Edition IAEA Safety Standards Series No. TS-R-1

http://www-pub.iaea.org/MTCD/publications/PDF/Pub1225_web.pdf

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Schedule B

Table 1: List of Australian Competent Authorities for the Purpose of this Code

COMMONWEALTH STATE / TERRITORY	CONTACT	COMPETENT AUTHORITY
Commonwealth	Chief Executive Officer ARPANSA PO Box 655 Tel: (02) 9541 8333 Miranda NSW 1490 Fax: (02) 9541 8314 Email: info@arpansa.gov.au	Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
Australian Capital Territory	Manager Radiation Safety Radiation Safety Section ACT Health Locked Bag 5 Tel: (02) 6207 6946 Weston Creek ACT 2611 Fax: (02) 6207 6966 Email: radiation.safety@act.gov.au	Australian Capital Territory Radiation Council
New South Wales	Manager Hazardous Material and Radiation PO Box A290 Tel: (02) 9995 5000 Sydney South NSW 1232 Fax: (02) 9995 6603 Email: radiation@environment.nsw.gov.au	Department of Environment and Climate Change
Northern Territory (i) for radioactive ores and concentrates	Chief Inspector – Radioactive Ores and Concentrates (Packaging and Transport) NT WorkSafe Department of Education, Employment & Training GPO Box 4821 Tel: (08) 8999 5010 Darwin NT 0801 Fax: (08) 8999 5141 Email: neil.watson@nt.gov.au	Work Health Authority
(ii) for all other radioactive substances	Manager – Radiation Health Radiation Health Section Department of Health & Community Services GPO Box 40596 Tel: (08) 8999 2983 Casuarina NT 0811 Fax: (08) 8999 2700 Email: envirohealth@nt.gov.au	Department of Health & Community Services
Queensland	Director, Radiation Health Unit Department of Health 450 Gregory Terrace Tel: (07) 3406 8000 Fortitude Valley QLD 4006 Fax: (07) 3406 8030 Email: radiation_health@health.qld.gov.au	Queensland Department of Health
South Australia	Director, Radiation Protection Division Environment Protection Authority PO Box 721 Tel: (08) 8130 0700 Kent Town SA 5071 Fax: (08) 8130 0777 Email: radiationprotection@epa.sa.gov.au	Minister for Environment & Conservation
Tasmania	Senior Health Physicist, Health Physics Branch Department of Health & Human Services GPO Box 125 Tel: (03) 6222 7256 Hobart TAS 7001 Fax: (03) 6222 7257 Email: health.physics@dhhs.tas.gov.au	Director of Public Health
Victoria	Manager, Radiation Safety Section Department of Human Services GPO Box 4057 Tel: 1300 767 469 Melbourne VIC 3001 Fax: 1300 769 274 Email: radiation.safety@dhs.vic.gov.au	Secretary, Department of Human Services
Western Australia	Secretary Radiological Council Locked Bag 2006 Tel: (08) 9346 2260 Nedlands WA 6009 Fax: (08) 9381 1423 Email: radiation.health@health.wa.gov.au	Radiological Council

Table 2: List of Other Australian Competent Authorities for the Transport of Radioactive Material by Sea or Air

MODE OF TRANSPORT	CONTACT	COMPETENT AUTHORITY
Air Transport	Director, Aviation Safety Civil Aviation Safety Authority GPO Box 2005 Tel: (02) 6217 1154 Canberra ACT 2601 Fax: (02) 6217 1500 Email: paul.steele@casa.gov.au	Civil Aviation Safety Authority
Sea (international and interstate)	Manager, Ship Inspections Maritime Operations Australian Maritime Safety Authority GPO Box 2181 Tel: (02) 6279 5048 Canberra ACT 2601 Fax: (02) 6279 5058 Email: MOCBRSHIPMAN@amsa.gov.au	Australian Maritime Safety Authority

Tables 1 and 2 were correct at the time of printing but are subject to change from time to time. For the most up-to-date list, the reader is advised to consult the ARPANSA web site.

Glossary

Effective Dose

The quantity *E*, defined as a summation of the tissue equivalent doses, each multiplied by the appropriate tissue weighting factor:

$$E = \sum_{T} w_T \cdot H_T$$

where H_T is the equivalent dose in tissue T and
w_T is the tissue weighting factor for tissue T.

From the definition of equivalent dose, it follows that:

$$E = \sum_{T} w_T \cdot \sum_{R} w_R \cdot D_{T,R}$$

where w_R is the radiation weighting factor for radiation R and
$D_{T,R}$ is the average absorbed dose in the organ or tissue T.

The unit of effective dose is J kg^{-1}, termed the sievert (Sv)

International Regulations, the

means the International Atomic Energy Agency 2000, *Regulations for the Safe Transport of Radioactive Material 2005 Edition (No. TS-R-1)* as reproduced in Schedule A.

RPS1

the *Recommendations for limiting exposure to ionizing radiation (1995) (NOHSC guidance note)* and the *National standard for limiting occupational exposure to ionizing radiation.* Radiation Protection Series No. 1.

Other meanings in this Code are those defined in the International Regulations.

Annex 1

Health effects of ionizing radiation and standards for control of exposure

It is well known that high doses of ionizing radiation can cause harm, but there is continuing scientific uncertainty about effects at low doses. At levels of dose routinely encountered by members of the public and occupationally exposed persons, there is little or no epidemiological evidence of health effects. Radiation protection standards recognise that it is not possible to eliminate all radiation exposure, but they do provide for a system of control to avoid unnecessary exposure and to keep doses in the low dose range.

Extreme doses of radiation to the whole body (around 10 sievert* and above), received in a short period, cause so much damage to internal organs and tissues of the body that vital systems cease to function and death may result within days or weeks. Very high doses (between about 1 sievert and 10 sievert), received in a short period, kill large numbers of cells, which can impair the function of vital organs and systems. Acute health effects, such as nausea, vomiting, skin and deep tissue burns, and impairment of the body's ability to fight infection may result within hours, days or weeks. The extent of the damage increases with dose. However, 'deterministic' effects such as these are not observed at doses below certain thresholds. By limiting doses to levels below the thresholds, deterministic effects can be prevented entirely.

Doses below the thresholds for deterministic effects may cause cellular damage, but this does not necessarily lead to harm to the individual: the effects are probabilistic or 'stochastic' in nature. It is known that doses above about 100 millisievert, received in a short period, lead to an increased risk of developing cancer later in life. There is good epidemiological evidence – especially from studies of the survivors of the atomic bombings – that, for several types of cancer, the risk increases roughly linearly with dose, and that the risk factor averaged over all ages and cancer types is about 1 in 100 for every 100 millisievert of dose (i.e. 1 in 10 000 per millisievert).

At doses below about 100 millisievert, the evidence of harm is not clear-cut. While some studies indicate evidence of radiation-induced effects, epidemiological research has been unable to establish unequivocally that there are effects of statistical significance at doses below a few tens of millisieverts. Nevertheless, given that no threshold for stochastic effects has been demonstrated, and in order to be cautious in establishing health standards, the proportionality between risk and dose observed at higher doses is presumed to continue through all lower levels of dose to zero. This is called the linear, no-threshold (LNT) hypothesis and it is made for radiation protection purposes only.

There is evidence that a dose accumulated over a long period carries less risk than the same dose received over a short period. Except for accidents and medical exposures, doses are not normally received over short periods, so that it is appropriate in determining standards for the control of exposure to use a risk factor that takes this into account. While not well quantified, a reduction of the high-dose risk factor by a factor of two has been adopted internationally, so that for radiation protection purposes the risk of radiation-induced fatal cancer (the risk factor) is taken to be about 1 in 20 000 per millisievert of dose for the population as a whole.

* The sievert (Sv) is a unit of measurement of radiation dose (see ARPANSA's *Recommendations for limiting exposure to ionizing radiation (2002)*).

If the LNT hypothesis is correct, any dose carries some risk. Therefore, measures for control of exposure for stochastic effects seek to avoid all reasonably avoidable risk. This is called optimising protection. However, risk in this sense may often be assessed in terms of risk to a population, and may not ensure sufficient protection of the individual. Consequently, the optimisation approach is underpinned by applying dose limits that restrict the risk to individuals to an acceptable level. The fundamental regulatory philosophy is expressed in three principles, based on the recommendations of the International Commission on Radiological Protection (ICRP), which may be summarised as follows:

Justification: human activities that cause exposure to radiation may be permitted only if they do more good than harm;

Optimisation of protection: exposure to radiation from justified activities should be kept as low as reasonably achievable, social and economic factors being taken into account; and

Limitation of individual dose: doses must not exceed the prescribed dose limits.

Determining what is an acceptable risk for regulatory purposes is a complex value judgement. The ICRP reviewed a number of factors in developing its recommendations, which have in general been internationally endorsed, including by the World Health Organization, the International Labour Organisation and the International Atomic Energy Agency. Australia's Radiation Health Committee, now established under the ARPANS Act[†], has recommended that the international standards be adopted in Australia. The recommended dose limits are summarised as follows:

Limit on effective dose*

	For occupational exposure	For members of the public
To limit individual risk	20 mSv per year, averaged over 5 years*	1 mSv in a year*

*for details, see *ARPANSA's Recommendations for limiting exposure to ionizing radiation* (2002)

In most situations, the requirements for limiting individual risk ensure that doses are below deterministic thresholds, but for cases where this does not apply, the recommended limits are as follows:

[†] The *Australian Radiation Protection and Nuclear Safety Act (1998)*

Annual limit on equivalent dose*

	For occupational exposure	For members of the public
To prevent deterministic effects		
in the lens of the eye	150 mSv	15 mSv
in the skin	500 mSv	50 mSv
in the hands and feet	500 mSv	–

*for details, see *ARPANSA's Recommendations for limiting exposure to ionizing radiation* (2002)

In the case of occupational exposure during pregnancy, the general principle is that the embryo or fetus should be afforded the same level of protection as is required for a member of the public. For medical workers, the ICRP recommends that there should be a reasonable assurance that fetal dose can be kept below 1 mGy‡ during the course of the pregnancy. This guidance may be generalised to cover all occupationally exposed pregnant workers by keeping the fetal dose below 1 mSv. A full explanation of radiation protection principles and of the recommended standards for Australia is given in ARPANSA/NOHSC Radiation Protection Series No. 1: *Recommendations for limiting exposure to ionizing radiation (1995)* and *National standard for limiting occupational exposure to ionizing radiation (both republished 2002).*

‡ The gray (Gy) is a unit of radiation dose. For X-rays and gamma radiation, it is essentially equivalent to the sievert.

Annex 2

ARPANSA Radiation Protection Series Publications

ARPANSA has taken over responsibility for the administration of the former NHMRC Radiation Health Series of publications and for the codes developed under the *Environment Protection (Nuclear Codes) Act 1978*. The publications are being progressively reviewed and republished as part of the *Radiation Protection Series*. All of the Nuclear Codes have now been republished in the Radiation Protection Series.

All publications listed below are available in electronic format, and can be downloaded free of charge by visiting ARPANSA's website at **www.arpansa.gov.au/Publications/codes/index.cfm**.

Radiation Protection Series publications are available for purchase directly from ARPANSA. Further information can be obtained by telephoning ARPANSA on 1800 022 333 (freecall within Australia) or (03) 9433 2211.

RADIATION PROTECTION SERIES

RPS 1. Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (republished 2002)

RPS 2. Code of Practice for the Safe Transport of Radioactive Material (200Y)

RPS 3. Radiation Protection Standard for Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz (2002)

RPS 4. Recommendations on the Discharge of Patients undergoing Treatment with Radioactive Substances (2002)

RPS 5. Code of Practice and Safety Guide for Portable Density/Moisture Gauges Containing Radioactive Sources (2004)

RPS 6. National Directory for Radiation Protection, Edition 1.0 (2004)

RPS 7. Recommendations for Intervention in Emergency situations Involving Radiation Exposure (2004)

RPS 8. Code of Practice for the Exposure of Humans to Ionizing Radiation for Medical Research Purposes (2005)

RPS 9. Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005)

RPS 10. Code of Practice and Safety Guide for Radiation Protection in Dentistry (2005)

RPS 11. Code of Practice for the Security of Radioactive Sources (2007)

RPS 12. Radiation Protection Standard for Occupational Exposure to Ultraviolet Radiation (2006)

RPS 13. Code of Practice and Safety Guide for Safe Use of Fixed Radiation Gauges (2007)

Those publications from the NHMRC **Radiation Health Series** that are still current are:

RHS 3. Code of practice for the safe use of ionizing radiation in veterinary radiology: Parts 1 and 2 (1982)

RHS 8. Code of nursing practice for staff exposed to ionizing radiation (1984)

RHS 9. Code of practice for protection against ionizing radiation emitted from X-ray analysis equipment (1984)

RHS 10. Code of practice for safe use of ionizing radiation in veterinary radiology: part 3-radiotherapy (1984)

RHS 13. Code of practice for the disposal of radioactive wastes by the user (1985)

RHS 14. Recommendations for minimising radiological hazards to patients (1985)

RHS 15. Code of practice for the safe use of microwave diathermy units (1985)

RHS 16. Code of practice for the safe use of short wave (radiofrequency) diathermy units (1985)

RHS 18. Code of practice for the safe handling of corpses containing radioactive materials (1986)

RHS 19. Code of practice for the safe use of ionizing radiation in secondary schools (1986)

RHS 21. Revised statement on cabinet X-ray equipment for examination of letters, packages, baggage, freight and other articles for security, quality control and other purposes (1987)

RHS 22. Statement on enclosed X-ray equipment for special applications (1987)

RHS 23. Code of practice for the control and safe handling of radioactive sources used for therapeutic purposes (1988)

RHS 24. Code of practice for the design and safe operation of non-medical irradiation facilities (1988)

RHS 25. Recommendations for ionization chamber smoke detectors for commercial and industrial fire protection systems (1988)

RHS 28. Code of practice for the safe use of sealed radioactive sources in borehole logging (1989)

RHS 30. Interim guidelines on limits of exposure to 50/60Hz electric and magnetic fields (1989)

RHS 31. Code of practice for the safe use of industrial radiography equipment (1989)

RHS 34. Safety guidelines for magnetic resonance diagnostic facilities (1991)

RHS 35. Code of practice for the near-surface disposal of radioactive waste in Australia (1992)

RHS 36. Code of practice for the safe use of lasers in schools (1995)

RHS 37. Code of practice for the safe use of lasers in the entertainment industry (1995)

RHS 38. Recommended limits on radioactive contamination on surfaces in laboratories (1995)

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