Australian Government

Radiation Health and Safety Advisory Council

BACKGROUND PAPER

TRANSPORT OF RADIOACTIVE MATERIAL IN AUSTRALIA – DISCUSSION OF THE RISKS

1. INTRODUCTION

This background paper provides an overview of the way in which the safe and secure transport of radioactive materials is currently managed in Australia. It includes a description of the different types of radioactive materials that are transported, how they are transported, information on the number and severity of incidents and accidents involving radioactive materials transport nationally and a brief outline of the safety and security regulations that are in place. The paper concludes by identifying the key risk, safety and security management and communication issues that arise for consideration.

2. INTERNATIONAL TRANSPORT BACKGROUND

The transport of radioactive material is a mature process that has a proven safety record. Worldwide, about 20 million packages containing radioactive materials are transported each year on public roads, by rail and by sea.[1] Most of these materials are for medical or general industrial use. While many packages are manually handled, some require the use of lifting equipment because of their weight, usually due to their in-built radiation shielding material. Packages are often transported by road and rail through urban areas and the public may at times be in close proximity to the packages.

Incidents and accidents have occurred during transport and the United Nations Scientific Committee on the Effects of Atomic Radiation (**UNSCEAR**) has summarised data on transport accidents involving radioactive materials. Where incidents and accidents have occurred, the consequences have been limited by built-in safety features of the packages/containers and by adherence to regulatory controls, including emergency response procedures.[2] In the event of an accident, the packages are designed to prevent or mitigate any release of their contents, thereby significantly limiting any health or environmental related consequences.

3. AUSTRALIAN TRANSPORT EXPERIENCE

Transport of radioactive materials is a small but important part of the radiation related business and activities in Australia. Radioactive materials are classified as 'Class 7 Dangerous Goods' and even very small quantities of radioactive materials are subject to stringent transport requirements. The transport of radioactive materials is only a small component in Australia's system for managing the risks in the transport of dangerous goods. The part of the system relating to the transport of radioactive materials is fully developed and fully consistent with international standards and arrangements.

While radioactive materials transport incidents and accidents are relatively infrequent, some have occurred. Consistent with the practices overseas, Australia has a register – the Australian Radiation Protection and Nuclear Safety Agency (**ARPANSA**) *Australian Radiation Incident Register* (**ARIR**), in which such incidents and accidents are recorded.

The ARIR is a database that includes radiation transport incident reports provided by Commonwealth, state and territory radiation protection authorities. The goal of collecting this data is that it be analysed

1 See: UK Nuclear Decommissioning Authority. *Managing Radioactive Waste Safely*.

2 Extract from Scientific Annex C, *Sources and Effects of Ionizing Radiation* UNSCEAR 2008 (A: Transport accidents).

from time to time to reveal the evidence basis for making improvements in safety and security. The annual summary reports from 2004 to 2012 provide a total of 12 reported transport incidents in 9 years.[3] A précis of these incidents and accidents is provided in **Attachment 1**. The ARPANSA Radiation Health and Safety Advisory Council (**Council**) is aware that the Radiation Health Committee (**RHC**) is currently undertaking a review of the ARIR with a view to its improvement. Nevertheless, the ARIR does provide some relevant statistics in relation to the transport of radioactive materials in Australia.

Australia's domestic nuclear industry is small and therefore the majority of non-medical radioactive materials are received from overseas suppliers. At the end of their useful lives they are returned to overseas recipients as used radioactive materials for recycling or disposal. Sources manufactured by the Australian Nuclear Science and Technology Organisation (**ANSTO**) or its predecessor the Australian Atomic Energy Commission are returned to ANSTO for further management. See **Attachment 2** for detailed statistics on imports and exports of non-medical radioactive material. Australia's domestic nuclear industry does produce some radioactive materials, which also require transport. The size of the transport industry relating to domestically produced radioactive materials is indicated by the following statistics:

- The average annual volume of uranium oxide concentrate (**UOC**) exported from Australia in the last three years was approximately 7,000 tonnes.
- In 2012, ANSTO shipped 8,844 orders of medical radioisotopes domestically and 247 orders internationally.

In addition to these statistics, Council notes that radioactive sources, e.g. radiation gauges, borehole logging sources and industrial radiography sources are routinely transported on roads throughout Australia on a daily basis.

Based on information provided to the relevant regulatory authorities, no significant incidents have occurred in Australia and there is no recorded incidence of any injuries or fatalities involving transport of radioactive material. While incidents have been listed in the ARIR, the radiological consequences of such incidents have been consistently negligible or minor. The incidents described in the ARIR illustrate an understanding that the transport of radioactive material in Australia and the emergency services response to accidents involving these materials is well understood. Through the adherence to international standards and arrangements the risks continue to be well managed.

4. TRANSPORTATION REGULATION

Australia's legislative framework relating to the safe and secure transport of radioactive material is based on international best practice. The transport of radioactive material by any person, organisation or government agency by land (road/rail), water and air must comply with the radiation safety legislation of the Commonwealth, state, territory or international jurisdiction through which the radioactive material is transported. **Attachment 3** provides a summary of the legislation applying to the transport of radioactive material by land.

(a) Safety Regulation

Australia has recognised for many years that from a radiological perspective it operates in a world-wide context. As a result, the transport of radioactive materials into, within and out of Australia has to be able to occur seamlessly. Consequently for many years, the transport of radioactive material in Australia has been based on international requirements published by the International Atomic Energy Agency (**IAEA**).

Regulatory frameworks of the Commonwealth, state and territory jurisdictions currently apply the *Code of Practice for the Safe Transport of Radioactive Material* 2008 (RPS2)[4], which is based on the IAEA's

3 http://www.arpansa.gov.au/RadiationProtection/arir/arir_reports.cfm as at 7 October 2013.

4 http://www.arpansa.gov.au/pubs/rps/rps2.pdf

Regulations for the Safe Transport of Radioactive Material (TS-R-1) 2005 edition (**IAEA Regulations**)[5]. The IAEA published a new edition of its Transport Regulations in October 2012, now called *SSR-6*[6]. To ensure Australia is aligned with international practice in transport of radioactive material, ARPANSA is undertaking a revision of RPS2 which will adopt the IAEA 2012 document.

The IAEA Regulations address all classes of radioactive material ranging from very low activity material, including such materials as ores and concentrates of ores, to very high activity material such as spent fuel and high-level waste. The material to be transported is categorised on the basis of its activity concentration, total activity, fissile characteristics (if any) and other relevant subsidiary characteristics. Packaging and package requirements are then specified on the basis of the hazard of the contents and range from normal commercial packaging (for low hazard contents) to strict design and performance requirements (for higher hazard contents). Specific requirements are also established for marking, labelling, placarding of conveyances, documentation, external radiation limits, operational controls, quality assurance and notification and approval of certain shipments and package types.[7]

The transport safety requirements of RPS2 and the transport security requirements of ARPANSA's *Code of Practice for the Security of Radioactive Sources 2007*[8] (RPS11) are applied consistently across all jurisdictions in Australia, however there are variations in authorisation requirements between jurisdictions. For example, some jurisdictions require transport providers to be registered or licensed whereas other jurisdictions do not have these requirements. This can lead to misunderstanding, particularly for interstate transporters, and could result in inadvertent breaches of jurisdictional arrangements. Despite these differences in jurisdictional requirements within Australia, the consistent application of RPS2 and RPS11 ensures the safe and secure transport of radioactive material.

The transport of radioactive material by air and waterways that do not otherwise come under the jurisdiction of the Australian states and territories is covered by the Commonwealth *Civil Aviation Act* 1988 and the Commonwealth *Navigation Act* 2012 respectively.

The *International Maritime Dangerous Goods Code* (**IMDG Code**) requirements are based on, and mandate the use of the TS-R-1. The Australian Maritime Safety Authority (**AMSA**) is responsible for regulating the IMDG Code.

For air transport, the *Civil Aviation Regulations 1998* adopt the International Civil Aviation Organization (**ICAO**) *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (DOC 9284 AN/905) and these Technical Instructions also adopt TS-R-1.[9]. The Civil Aviation Safety Authority (**CASA**) is responsible for regulating the Technical Instructions.

(b) Security Regulation

As a responsible contributor to global security, Australia takes the security of radioactive material seriously. To this end, Australia has adopted the IAEA *Code of Conduct on the Security of Radioactive Sources*[10], and the supplementary *IAEA Guidance on Imports and Exports of Radioactive Material*[11]. RPS11 links directly with these international instruments to ensure that the transportation of security-enhanced radioactive sources is appropriately protected within Australia and in line with our international obligations and commitments.

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5 http://www-pub.iaea.org/mtcd/publications/pdf/pub1225_web.pdf

6 http://www-pub.iaea.org/books/IAEABooks/8851/Regulations-for-the-Safe-Transport-of-Radioactive-Material-2012-Edition-Specific-Safety-Requirements

7 http://www-pub.iaea.org/MTCD/publications/PDF/Pub1109_scr.pdf

8 http://www.arpansa.gov.au/pubs/rps/rps11.pdf

9 IATA Dangerous Goods Regulations

10 http://www-ns.iaea.org/tech-areas/radiation-safety/code-of-conduct.asp

11 http://www-pub.iaea.org/books/IAEABooks/8901/Guidance-on-the-Import-and-Export-of-Radioactive-Sources

A small number of transport-related incidents have occurred in Australia during the past few years. These incidents involved the inadvertent import and export of contaminated semi-finished products by land and by sea. At the time of writing no information has been published in relation to transport incidents involving radioactive material that have occurred within Australia as a result of a security related malicious act.

Australia's legislative framework relating to the safe and secure transport of radioactive material is based on international best practice. Any arrangements prohibiting the transport of radioactive material along certain routes need to be considered carefully and based on facts relating to all transport risks rather than perceptions of risk focussed solely on the presence of radioactive materials in the goods being transported. It is important that these perceptions are addressed so that they do not compromise radiation protection and nuclear safety and security.

5. THE AUSTRALIAN INVENTORY

The regulatory infrastructure in place in Australia provides the background context for management of transport risks. In managing the risks it is important to consider the quantity and nature of radioactive material being transported. Five main categories of materials can be identified:

- Radioactive materials required for medical purposes and scientific research,
- Research reactor fuel,
- Uranium, and other naturally occurring radioactive materials (**NORM**),
- Sealed sources used in the mining and manufacturing industries, and
- Radioactive waste materials.

(a) Radioactive Materials Required for Medical Purposes and Scientific Research

The most frequently transported radioactive materials throughout Australia are those used for medical purposes and scientific research. Although there are numerous items involved, each contains only small quantities of radioactive materials. The most important considerations in the transport of these items are the proper packaging, handling, recording, tracking and auditing of the transports to ensure that all radioactive materials are properly accounted for.

These systems work well in Australia but while few accidents have happened, there is no room for complacency. Although transport of this type of material is common and has been shown to be safe, public confidence in the safety procedures could be undermined by anything other than a minor incident or minor non-compliance.

(b) Research Reactor Fuel

ANSTO research activities use uranium based fuel to generate neutrons by fission reaction. ANSTO's work includes radioisotope production, neutron experiments and research and development. ANSTO's Lucas Heights campus south of Sydney includes infrastructure such as the research reactor and other equipment used in nuclear research, as well as areas where radioactive materials are safely used or stored. All access to the campus is subject to strict security measures for the safety of visitors as well as the protection of the public.

When necessary the irradiated fuels are unloaded from the reactor and stored on-site in designated facilities. This 'spent fuel' is periodically shipped overseas for reprocessing or permanent disposal. Both the (incoming) fresh and (outgoing) spent fuels are transported in robust packages which through rigorous testing and analysis, have been verified as being able to withstand accident conditions. The design standards for these packages are those accepted internationally. The packages are validated for use in Australia by ARPANSA, and by CASA or the AMSA depending on the intended mode of transport.

Approval for undertaking the transport of fresh and spent fuel is required from ARPANSA for ensuring the safety aspects and by both ARPANSA and the Australian Safeguards and Non-Proliferation Office (**ASNO**) for the source security aspects. Further approvals are also required by AMSA or CASA depending on the mode of transport. Every shipment plan is assessed by ARPANSA, ASNO and the other relevant competent authorities (AMSA or CASA) to assure safe and secure transport of the nuclear fuel.

All the spent fuels generated from the historic operation of now decommissioned reactors at Lucas Heights have been safely and securely transported overseas. No spent fuel from the currently operating Open Pool Australian Lightwater (**OPAL**) research reactor has yet been transported off site.

(c) Uranium, and other Naturally Occurring Radioactive Materials (NORM)

A wide range of natural materials, both raw and processed, contain some radioactive material. The most commonly acknowledged NORM is that associated with uranium mining and, to a lesser degree, mineral sands. However, there is a range of materials which have sufficient natural radioactivity to be classified as 'radioactive' for transport purposes. These include a variety of metal concentrates, some ash products, ceramic materials and process materials such as precious metal concentrates. In terms of total volume, NORM represents the largest quantity of radioactive material but it is generally at the lower end of the radioactive concentrations.

Radioactive minerals are transported in different ways. For example uranium is transported differently from mineral sands and metal concentrates. As a consequence, risk assessments identify different transport safety requirements for the different types of mineral.

Radioactive minerals may need to be transported over long routes due to local policies preventing their export from more convenient Australian ports. Council's opinion is that these policies need to be informed by an holistic assessment of transport safety.

UOC currently has the most stringent controls of any of the NORM materials.[12] UOC transport is regulated by the Commonwealth *Nuclear Non-Proliferation Safeguards Act 1987* which establishes a regulatory system for the possession and transport of nuclear material. Further, state and territory radiation protection and transport laws require compliance with RPS2. The laws and regulations that establish the design, operation and governance arrangements for the transport of radioactive materials assure the safety of workers and the public. The transport of UOC is regulated and monitored by:

- ASNO which manages adherence to safeguards and related protocols.
- The Australian Government Department of Industry (**DI**) which manages and monitors export controls.
- AMSA which oversees packaging, stowage, segregation etc.
- The Australian Customs and Border Protection Service (**ACBPS**) because UOC is a restricted export under the *Customs (Prohibited Exports) Regulations 1958*.

Commonwealth, state or territory approved transport plans are required for all domestic movements of UOC from mine site to load port. The safety and security arrangements for transporting UOC mean that there is an even lower probability of an accident occurring than would otherwise be the case. In the unlikely event of an accident involving UOC, the environmental or health issues would be negligible. UOC is chemically unreactive and therefore does not pose a fire or explosion hazard – it remains stable under all conditions of storage, handling and transport.

12 *Guide to Safe Transport of Uranium Oxide Concentrate* Commonwealth of Australia. ISBN 978-1-922106-12-4 (print)].and 978-1-922106-11-7 (online) at http://www.ret.gov.au/resources/Documents/Mining/uranium/Guide-to-Safe-Transport-of-UOC.pdf

In relation to emergency response, radioactive materials are no different from the other classes of dangerous goods. A spill of UOC should be treated similarly to an incident involving any other dangerous good or heavy metal concentrate. Procedures used in standard emergency response should be sufficient to protect health and the environment in the event of an incident or accident.[13]

(d) Sealed Sources Used in the Mining and Manufacturing Industries

There are many industrial, medical and research uses for sealed radiation sources and these are transported relatively frequently. It is noted that the sterilisation of medical products, some foods, and other goods by ionising radiation requires high activity radioactive sources. This is a well-established industrial process in Australia as it is in a number of technologically advanced countries.

The most common of the sealed source transports are those associated with portable density and moisture gauges, borehole logging and industrial radiography sources. These sources are transported in specially made containers which have integral radiation shielding and are designed to withstand accident conditions to prevent damage to the radiation sources during transport, and to protect people and the environment from exposure to radiation. Many are designed to be portable to allow them to be carried safely from place to place. These sources are the most commonly observed by the public, as the transporting vehicles must bear radiation signage.

These sealed sources are generally robust and designed to withstand day-to-day minor accidents and routine use. When more significant accidents involving these sources have occurred, correct handling and response has resulted in maintenance of the high level of safety associated with sealed sources.

(e) Radioactive Waste Materials

Radioactive waste materials are generated as part of a range of processes and arise from current and historical operations. The majority of historic waste is associated with remediation of sites which utilised radioactive materials or with the operations of ANSTO at Lucas Heights. There is however a large diversity in radioactive waste in Australia that includes disused radiation gauges, medical and research material, NORM residues and commercial and domestic sources (e.g. old tritium exit signs and disused smoke detectors). The largest proportion of this waste is owned and managed by the Commonwealth. The remainder is controlled by individual states and territories.

Commonwealth owned and managed radioactive waste is currently located in several temporary stores. It comprises both low-level and intermediate level wastes, each requiring management solutions that reflect their degree of risk to people and the environment.

The Commonwealth's bulk waste comprises most of the 'legacy' inventory in Australia and includes:

- Soils contaminated with radioactive elements
- Plastic, paper and glass used in the preparation of radiopharmaceuticals, and
- Residues left from research into mineral processing.

This waste is currently stored in steel drums in several locations, principally at Lucas Heights and at Woomera where contaminated soils were taken for temporary storage. Lesser amounts (by volume) are located at several Commonwealth Scientific and Industrial Research Organisation (**CSIRO**) premises and Department of Defence sites.

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13 *Guide to Safe Transport of Uranium Oxide Concentrate* Commonwealth of Australia. ISBN 978-1-922106-12-4 (print)].and 978-1-922106-11-7 (online) at http://www.ret.gov.au/resources/Documents/Mining/uranium/Guide-to-Safe-Transport-of-UOC.pdf

Small quantities of additional wastes, principally encapsulated sources used in instruments or laboratories, are located in numerous facilities in many areas. These wastes can be consolidated and placed in steel drums for transport and storage. Some will require conditioning to be undertaken before transport to a disposal facility such as the proposed Commonwealth radioactive waste management facility. It is anticipated that the bulk waste will be conditioned, enclosed in steel drums, palletised and loaded into shipping containers for transport by road or rail to the waste facility.[14]

6. MAIN RISK MANAGEMENT ISSUES

Having considered regulatory arrangements currently in place relating to the transport of radioactive and also the inventory of radioactive material that will at some time be transported, it is possible to consider the main risk management issues.

Managing the risks of radioactive materials transport requires two main elements:

- To minimise the (already low) likelihood of occurrence of accidents:
  This can be achieved by consideration of all risks associated with the transport of these materials. Of particular concern is what could be a disproportionately higher risk associated with any unnecessarily long transport routes when alternatives with lower overall risks may be available.
- To reduce the consequences of an incident or accident:
  This can be achieved by appropriate packaging and handling, ensuring appropriate emergency preparedness, and addressing public concerns.

Risk management associated with the transport of radioactive material should be considered in the context of conventional risks and transport concerns. As a general rule other dangerous goods (e.g. petrol, LPG, explosives, acids, caustic substances, etc.) are transported far more frequently than radioactive materials. Radioactivity is also relatively easy to detect in an accident situation with appropriate instrumentation. This is at variance with some other dangerous goods that require specialised laboratory analysis or specialised instrumentation to detect the presence of chemicals such as organics, pesticides, gaseous material etc. Consequences of accidents involving dangerous goods have included significant property damage and fatalities. The perception of risk associated with the transport of radioactive material has as a result the potential to be disproportionate to the actual risk.

Key risk perception issues such as perceived health and safety risks in radioactive material transport, relative risks in transport versus storage at an existing site and the perception of communities along transport routes all need to be addressed. A modern approach to risk management requires fully open engagement and communication between all concerned to ensure public confidence, in this case in the safe transport of radioactive material and in the radiation protection arrangements in general. This means not only safety *assurance* but rather safety *reassurance*. The public expects risk informed decision making in this area to be fully transparent, fully accountable, and reflective of international best practice.

7. DISCUSSION

From this review, the following key observations should be noted:

1. The probability and consequence of incidents and accidents in Australia associated with the transport of radioactive material are demonstrably low.
2. The main hazards associated with and the potential causes of accidents in road, rail, sea and air transport of radioactive materials are well understood by scientists, engineers and regulators. Consequently well designed risk-based requirements have been developed by the IAEA and adopted within Australian legislation for all transport of radioactive material.

14 Source: Department of Resources, Energy and Tourism (DRET) Proposed Commonwealth Radioactive Waste Management Facility, Northern Territory. *Transport Assessment Report* (2009).

3. The direct radiological consequences of a transportation incident involving radioactive materials are generally low.

4. The perceptions of the consequences (i.e. secondary or indirect) of transport incidents and accidents are of concern. These perceptions could arise from a general lack of effective communication and information around the safety of transport of radioactive material and this could have an influence on risk management decisions.

5. Unnecessary restrictions on transport routing are radiologically unsound from a risk-informed radiation protection and nuclear safety perspective. Effective communication with, and provision of information to the media and the public will assist in the elimination of unnecessary restrictions on transport routing.

8. SUMMARY OF KEY POINTS

Overall, there is a low probability of an incident or accident occurring and a low potential for any consequential harm. The level of risk associated with the transport of radioactive material in Australia is therefore considered to be low. Having reviewed the current evidence, Council would like to draw attention to the following key points:

1. Australian data should continue to be used to better inform the public and to put the risks associated with the safety of radioactive materials transport into context.

2. Communication with the public should be enhanced through credible, clear, unbiased, easily accessible material on radioactive material transportation and risk management (for example, an ARPANSA Radiation Transport fact sheet on the ARPANSA website).

3. Confidence building activities such as local seminars, presentations, and accessible web material are essential to bridge the gap between actual and perceived risks in radioactive materials transport. Simple ‘what is’ and ‘what to do if’ communication materials/messages should be encouraged.

4. Continued collaboration between Australia’s radiation regulators, producers, transporters, handlers and end users of radioactive materials, will help to better communicate the safety of transport arrangements.

5. All transporters should be encouraged to continue to apply risk reduction methods including mitigation strategies such as a robust programme of quality assurance and controls for all transport activities.

6. The development of the proposed Commonwealth radioactive waste facility is an opportunity to engage with the host community and all stakeholders to discuss and explore issues around the implications of radioactive waste transport. For example, safety and security, the amount and frequency of traffic, and the impact of transport routes on specific communities.

7. The transport of radioactive minerals over unnecessarily long routes, due to local policies rather than legislation preventing export of radioactive material from certain Australian ports cannot be supported from a risk management perspective. While community values need to be considered, they should be in the context of overall transport risk. A review of local policies should be encouraged to ensure they are informed by an holistic assessment of all the risks associated with the transport of radioactive material.

DECEMBER 2013

ATTACHMENT 1

ARIR Summary of Transport Radiation Incidents

Year	Transport incident details
2012	The single transport incident concerned the shipment of five sealed sources in a single package using a commercial flight from Australia to Germany. On arrival in Germany the package was found to have been incorrectly fitted and the contents partially dislodged and outside of its shielded position. Conservative estimates suggest that the effective dose to a person handling the package based on 10 minutes exposure to be 6.6 mSv. The conservative estimate of effective dose to a passenger seated directly above the cargo bay storage location during both legs of the flight is 4.6 mSv. The cause of this incident was human error. Training will be provided to workers to prevent recurrence. This incident was reported to the International Atomic Energy Agency as a level 2 incident on the International Nuclear Event Scale (INES).
2011	During transportation of four caesium-137 sources from Adelaide to Melbourne, one of the Cs-137 sources in the disposal package became detached from the base plate. The source was subsequently found undamaged in the void fill used during the transportation. The Cs-137 source was awaiting disposal. Following thus event, an accident investigation was undertaken detailing that higher than expected dose rates were detected from the steel drum in which the sources were transported. Subsequent gamma spectrometer of the sealed sources revealed that one of the sources was cobalt 60 and not Cs-137 as stated and that one source was in fact americium-241/beryllium plus a Cs-137 source and not just a Cs-137 source as stated.
2010	An incident involving a motor vehicle crash resulted in the release of radioactive material (technetium-99m) that was to be used for nuclear medicine. It was apparent that the vehicle had been hit in the rear by a truck, after which the container carrying the lead pot had flown out through the rear window of the vehicle onto the road. The lead pot appeared to have been run over by the truck. The vial containing Tc-99m was completely smashed and fragments of glass, the label from the vial, and the radioactive material was spread over the road. The site was cordoned off and radiation safety staff attended. Post-incident, staff were monitored for contamination and the area cleaned up. Debris and contamination was removed and placed in bags and containers and disposed or stored appropriately. Due to the small area of contamination and the short-half-life of radioactive substance there was no risk to persons or the environment.
2009	None reported
2008	None reported
2007	2 incidents involved damage to a package containing radiopharmaceuticals/radiation source during transport. In the first case a package fell from a trolley, became wedged under the trolley and was dragged along the bitumen for several hundred metres. The box was torn and dented, and an edge of the plastic bucket inside the package had a hole in it, though the lead pots containing four thallium-201 sources (each of 1000 MBq) and two gallium-67 sources (800 MBq and 200 MBq) were undamaged. No persons were exposed to radiation. In the second case a package containing a sealed cobalt-57 (9.25 MBq) pen marker was discovered on the ground next to a pallet with damage to the packaging. The source was not damaged, and there were no personal exposures or contamination from this incident.
2007	2 incidents involved motor vehicle accidents involving vehicles transporting radiation gauges. In the first case a motor vehicle crash involved two cars, one of which was carrying a portable density moisture gauge (one americium-241/beryllium source and a caesium-137 source) in its container. The container was undamaged and there was no contamination. In the second incident, a vehicle transporting a portable moisture density gauge rolled over. The gauge was undamaged apart from a cracked case. Both the americium-241/beryllium and the caesium-137 sources were undamaged and remained contained in the shielded enclosures. No persons received radiation doses.
2007	1 incident involved a source lost during transport (found later). A 37 MBq consignment of phosphorus-33 was lost while in transit to an airport. The source was shipped as an excepted package and therefore had no radioactive labelling on the outside of the packaging. The outer packaging was damaged when found by a passing motorist however the integrity of the source was not compromised. There was no contamination of the scene and no persons received a radiation dose.
2006	A borehole logging source containing americium-241/beryllium of approximately 592 GBq was temporarily lost during transport. The source was found 10 m from the highway in a rural location. It was determined that the source was not strongly secured resulting in it becoming lost. Wipe tests showed no external contamination of the container.
2005	A source caesium-137 of 74 GBq was inadequately secured in vehicle. Damage to the container resulted in the radioactive source being released. Remediation occurred at the destination although the driver, passenger and person who picked up the source received doses up to 50 μSv (whole body) and 200 mSv (extremity).
2004	*1 incident involved a vehicle accident during transport.* A borehole logging company driver transporting two sources [cobalt-60, 2.2 GBq and americium-241, 37 GBq] lost control of the vehicle, causing it to roll several times. The driver had only minor injuries and the sources and shielded containers were in place and undamaged.

Year	Transport incident details
2004	*1 incident involved a radiation source that was temporarily lost during transport*. A radiation source [caesium-137, 8.3 mCi], used in a density meter associated with well–logging was lost from a truck during transport to a well site in a remote area. The source was later recovered and found to have broken away from its holder, but the encapsulation remained intact.
	Total number of transport incidents = 12

Source: Australian Radiation Risk Register

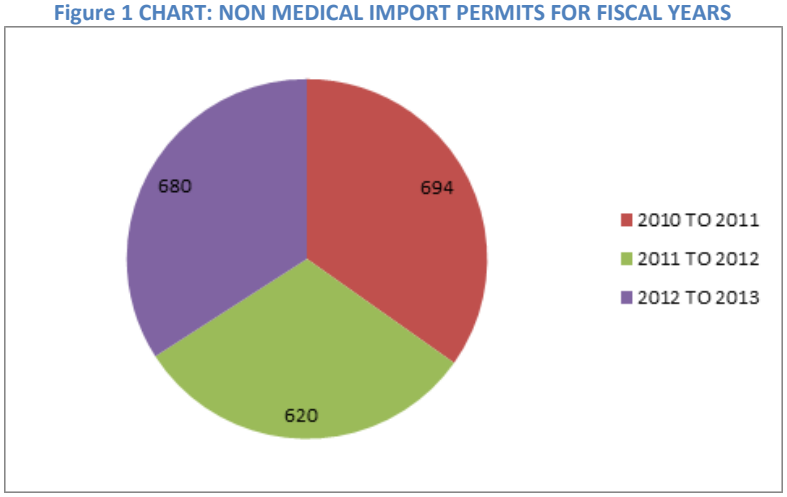
ATTACHMENT 2

Non-Medical Import Permits Issued[15]

FISCAL YEARS:

DATE FROM:	DATE TO:	TOTAL NUMBER OF IMPORT PERMITS:
1/7/10	30/6/11	694
1/7/11	30/6/12	620
1/7/12	30/6/13	680

Figure 1 CHART: NON MEDICAL IMPORT PERMITS FOR FISCAL YEARS

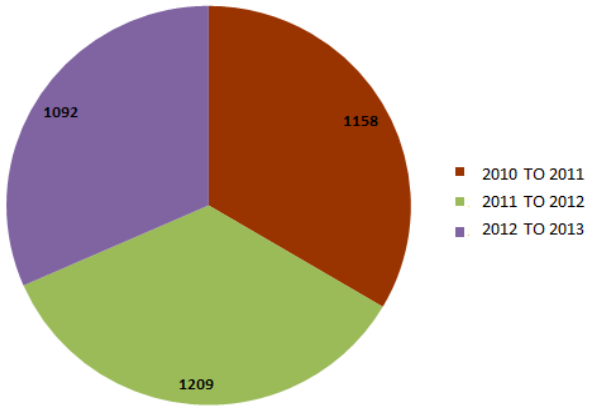


Medical Import Permits Issued[16]

FISCAL YEARS:

DATE FROM:	DATE TO:	TOTAL NUMBER OF IMPORT PERMITS:
1/7/10	30/6/11	1158
1/7/11	30/6/12	1209
1/7/12	30/6/13	1092

Figure 2 CHART: MEDICAL IMPORT PERMITS FOR FISCAL YEARS



15 Source: ARPANSA, Security and Community Safety Section

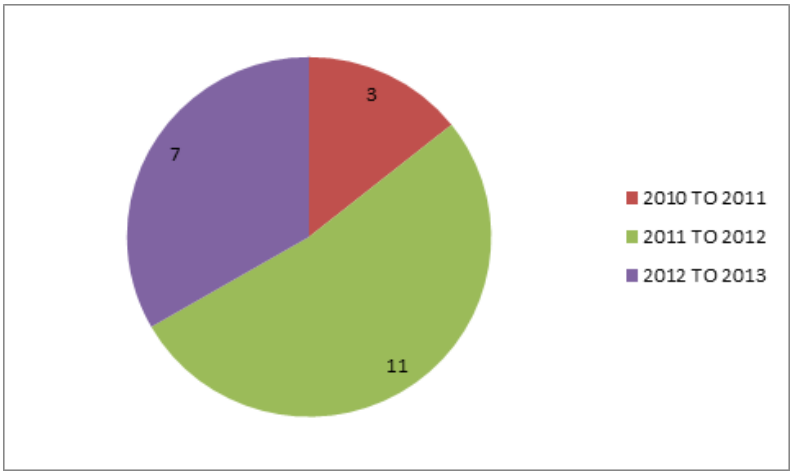
16 Source: ARPANSA, Medical Services Section

Export Permits Issued for Category 1 and 2 High Activity Sources – Non -Medical and Medical Sources[17]

FISCAL YEARS:

DATE FROM:	DATE TO:	TOTAL NUMBER OF EXPORT PERMITS:
1/7/10	30/6/11	3
1/7/11	30/6/12	11
1/7/12	30/6/13	7

Figure 3 EXPORT PERMITS – CAT 1 AND 2 – NON-MEDICAL AND MEDICAL



17 Source: ARPANSA, Security and Community Safety Section

ATTACHMENT 3

Summary of Australian legislation related to the transport of radioactive material by road

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
Queensland	*Radiation Safety Act 1999* *Radiation Safety Regulation 2010*	Radioactive substances (Radioactive material that exceeds a prescribed activity and activity concentration. Does not include a mineral on a mining lease.)	Act - Section 14 & 15 A person must not transport a radioactive substance unless the person is the holder of a transport licence to transport the substance.	**Type of licence required:** For transport by road, only an individual may hold a transport licence. **Transport Code**: [19] Licence conditions stated in the *Regulation* require compliance with the 2008 version of the code. The *Regulation* provides for a transport licence exemption for excepted packages, and for some types of practices (industrial radiography, borehole logging, geotechnical measurements), but transport must still be in compliance with the Transport Code. **Transport Security[20]:** The *Act* requires that a security enhanced source (including by aggregation) must only be transported if there is a Transport Security Plan for the transport of the source. The Plan may be held by a possession licensee or a transport licensee.

[18] Note that an Act or Regulation may provide for exemptions from certain transport related requirements based on the activity of radioactive material, the type of radiation source, the source being packaged as an excepted package, or the type of radiation practice carried out.

[19] Code of Practice for the Safe Transport of Radioactive Material, published by ARPANSA

[20] References to "Transport Security Plan", "Security Enhanced Source" are as described in the Code of Practice for the Security of Radioactive Sources (the Security Code), published by ARPANSA

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
New South Wales	*Radiation Control Regulation 2013* *Radiation Control Act 1990*	Radioactive substances (Radioactive material that exceeds a prescribed activity.)	Regulation - Section 36 A person must not cause any radioactive substance to be transported otherwise than in accordance with the requirements of the Transport Code, as in force from time to time.	**Type of licence required:** No specific transport licence required. The *Radiation Control Act 1990* requires that person responsible for regulated material (the owner or the person in possession of the material) has a radiation management licence for the material. This does not apply to a person who is in possession only for the purposes of transporting the material. **Transport Code**: The *Regulation* requires compliance with the current version of the code. **Transport Security:** The *Act* requires that each person responsible for a security enhanced source (the holder of the radiation management licence) must ensure there is Transport Security Plan for the transport of the source, and must ensure the Plan is complied with.
Victoria	*Radiation Act 2005* *Radiation Regulations 2007*	Radioactive material (Material that emits ionising radiation exceeding a prescribed activity or activity concentration. Does not include raw material with unmodified concentrations of radionuclides.)	Act - Section 12 A person must not conduct a radiation practice unless the person holds a management licence that allows the person to conduct that radiation practice (transporting radioactive material is a radiation practice).	**Type of licence required:** Management licences are held by companies. An individual is allowed to transport radioactive material under a company's management licence. A distinction is made between 'contract carriers', 'consignors' and 'private carriers'. **Transport Code**: Compliance with the 2008 version of the code is required. **Transport Security:** Neither the *Act* or *Radiation Regulations 2007* refer to security of radiation sources. However the Department of Health has advised that they have varied the management licences held by those organisations that possess a Security Enhanced Source to require compliance with the Security Code (which requires a Transport Security Plan).

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
Tasmania	*Radiation Protection Act 2005* *Radiation Protection Regulations 2006*	Radioactive material (Material that emits ionising radiation as a consequence of nuclear transformations.)	Act - Section 13 A person must not transport a radiation source other than in accordance with a licence.	**Type of licence required:** Companies and individuals may hold a transport licence. An individual may transport radioactive material under a company's licence. **Transport Code**: *Regulations* require compliance with the current version of the code. **Transport Security:** No reference to transport security found in legislation or the Department of Health and Human Services website. The Act allows The Director of Public Health to approve a code of practice that relates to the transport of a radiation source. The *Regulations* provide for a transport licence exemption for radiation apparatus, excepted packages, some other radiation sources, and certain quantities and activities of radioactive material.
South Australia	*Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003* *Radiation Protection and Control Act 1982* *Radiation Protection and Control (Ionising Radiation) Regulations 2000*	Radioactive material (Radioactive material as defined in the Transport Code.)	Regulations - Sections 5, 6 & 7 Regulations divide the responsibilities for safe transport between 'carriers', 'consignors' and 'drivers'. The specific responsibilities of these groups are set out in the Transport Code and the Regulations	**Type of licence required:** No licence required under the *RPC(TRS) Regulations* but as described below there may be a requirement for a licence to possess a Security Enhanced Source during its transport. **Transport Code**: *Regulations* require compliance with the 2001 version with modification as described in regulations. **Transport Security:** Section 180E of the *RPC(IR) Regulations* indicate that a licence is required for the possession, during transport, of a Security Enhanced Source. A transport Security Plan is listed in the *RPC(IR) Regulations* as a "Supporting Document" for an application for certain licences. It is assumed that compliance with the Transport Security Plan would be a condition of the licence. The *Radiation Protection and Control Act 1982* does not mention 'transport'.

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
Western Australia	*Radiation Safety Act 1975* *Radiation Safety (Transport of Radioactive Substances) Regulations 2002* *Radiation Safety (General) Regulations 1983*	Radioactive substances (Substance that contains more than a prescribed activity of a radioactive element.)	Act - Section 25 Unless done so under, and in accordance with any conditions, restrictions or limitations imposed in relation to a licence a person who transports any radioactive substance commits an offence.	**Type of licence required:** Only individuals may hold a transport licence. An unlicensed individual may transport radioactive material under a licensed person's licence. **Transport Code**: *Radiation Safety (Transport of Radioactive Substances) Regulations 2002* require compliance with the 2008 version of the code as modified by the *Regulation*. **Transport Security:** No reference to transport security found in legislation or the Radiological Council website.
Northern Territory	*Radiation Protection Act* *Radiation Protection Regulations*	Radiation source (Radioactive material that exceeds a prescribed activity and activity concentration.)	RP Act - Section 12 A person must not transport a radiation source other than in accordance with a licence authorising the person to do so.	Transport is regulated under two Acts. The *Radiation Protection Act* does not apply to transport of uranium ores, concentrates or uranium oxide (U_3O_8) which are regulated under the *Radioactive Ores and Concentrates (Packaging and Transport) Act*. **Type of licence required:** A company or individual may hold a transport licence under the RP Act. For transport of uranium ore concentrate under the *ROC(PT) Act*, the owner of the ore must hold a licence, and an individual can transport under the owner's licence **Transport Code**: *ROC(PT) Act* requires transport to be in compliance with an adopted code of practice (which the Minister may gazette). Under the RP Act the Chief Health Officer may, by notice in the Gazette, approve an instrument as in force at a particular time or from time to time as a code of practice relating to transporting a radiation source. The Northern Territory has adopted the 2008 version of the Transport Code. **Transport Security:** No reference to transport security found in legislation or the Department of Health website.
	Radioactive Ores and Concentrates (Packaging and Transport) Act	Radioactive material (Uranium ores and concentrates, uranium oxide with a specific activity greater than a 0.002µC/g.)	ROC(PT) Act - Sections 12 & 13 Owner of radioactive material must hold a licence authorizing the transport of radioactive material	

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
Australian Capital Territory	*Radiation Protection Act 2006* *Radiation Protection Regulation 2007*	Radioactive material (Material that spontaneously emits ionising radiation as a consequence of nuclear transformations.)	Act - Sections 16 &17 A person who transports a radioactive material is required to hold a licence.	**Type of licence required:** Individuals may hold a licence for transport by public road. **Transport Code**: Compliance with the Transport Code may be a condition of licence imposed by the Radiation Council. Advice received is that the 2008 version of the Code has been adopted. **Transport Security:** In deciding whether to issue a licence, the Radiation Council may consider whether the applicant can satisfy the security criteria in Schedule 8 of the National Directory for Radiation Protection (currently no criteria). The Radiation Council may impose particular security measures as a condition on a licence. No advice received about whether compliance with the Security Code is being made a licence condition
Commonwealth	*Australian Radiation Protection and Nuclear Safety Regulations 1999* Applies only to Commonwealth entities.	Controlled material (Material which emits ionising radiation spontaneously.)	Regulations - Section 48 The holder of a source licence (for controlled material) must ensure that dealings are compliant with the Transport Code	**Type of licence required:** No specific transport licence - transport is a type of dealing allowed under a source licence. **Transport Code**: The *Regulations* require the source licence holder to comply with the 2008 version of the Transport Code. **Transport Security**: The *Regulations* require the source licence holder to comply with the Security Code. The *Australian Radiation Protection and Nuclear Safety Act 1998* does not mention 'transport'.

Jurisdiction	Legislation	Material regulated 18	Relevant section of Act or Regulation	Notes
	Nuclear Non-Proliferation (Safeguards) Act 1987 Applies to all persons.	Nuclear material (Material as defined in the Agreement between Australia and the IAEA - Natural uranium, depleted uranium, enriched uranium, thorium, plutonium-239, uranium-233. Does not include uranium ore.)	Act - Section 13, 16, & 23 It is an offence for a person to possess nuclear material without a Permit.	**Type of licence required:** No specific transport licence - nuclear material may be transported under a Permit to Possess Nuclear Material or a special Permit to Possess Nuclear Material for the purpose of transport. **Transport Code**: Neither the *Act* or the *Nuclear Non-Proliferation (Safeguards) Regulations 1987* contain a specific requirement for compliance with the Transport Code. **Transport Security**: Neither the *Act* or the *Nuclear Non-Proliferation (Safeguards) Regulations 1987* contain a specific requirement for compliance with the Security Code. However, a permit may be issued with conditions related to measures to be taken to ensure the physical security of nuclear material.