YELLOWCAKE ROAD: THE LEGAL REGIME FOR THE ROAD TRANSPORT OF URANIUM OXIDE IN WESTERN AUSTRALIA

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This thesis is presented for the Honours degree of Bachelor of Laws of Murdoch University, 2017.

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(Excluding footnotes, bibliography and appendices)
DECLARATION

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Author: Emily Bell

Year: 2017
ABSTRACT

Uranium is a contentious and emotive commodity. Attitudes towards uranium and the nuclear fuel cycle have, overall, been negative. Distrust of the nuclear industry and misunderstandings about the level of risk posed by the transport of uranium oxide (also known as yellowcake) has influenced a policy ban prohibiting uranium exports from Western Australian ports. Western Australia has a nascent uranium industry, with four major projects at various stages of government approval. When these mines commence production, producers will be forced to truck the uranium oxide by road to either Port Adelaide or Port Darwin for export.

This thesis analyses the issues facing Western Australian producers as a consequence of the export ban. The current regulatory regime exposes Western Australian producers to three governments, five regulatory agencies, and at least seven different approvals and permits. The radiation protection schemes in each jurisdiction varies, so a consignment of uranium oxide is subject to different requirements between the Northern Territory, South Australia and Western Australia. Further, different versions of the *Code for the Safe Transport of Radioactive Material* operate around Australia, compounding legislative discrepancies.

This thesis considers that the current regime is overly complex, overlapping and out-of-date with international best practice, and considers broad reforms to harmonise the legislation governing the transport of uranium oxide. It argues that multiple regulators and different legislative requirements impose significant financial burdens and compliance costs on Western Australian producers. These differences also threaten the integrity of the overall goal of radiation protection to protect the health and safety of people from the harmful effects of ionising radiation. Further, Australia’s inability to remain up-to-date with international developments affects contractual relationships with overseas uranium consumers and may induce shipment denials.
GENERAL ACKNOWLEDGEMENTS

I wish to thank my supervisor, Professor Kate Lewins, for her guidance, insightful comments, and support throughout the course of this thesis.

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<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADG Code</td>
<td>Australian Code for the Transport of Dangerous Goods by Road and Rail</td>
</tr>
<tr>
<td>Advisory Material</td>
<td>Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material</td>
</tr>
<tr>
<td>ANSO</td>
<td>Australian Non-Proliferation and Safeguards Office</td>
</tr>
<tr>
<td>ARIR</td>
<td>Australian Radiation Incident Register</td>
</tr>
<tr>
<td>ARMA</td>
<td>Australian Radiation Management Authority</td>
</tr>
<tr>
<td>ARPANSA</td>
<td>Australian Radiation Protection and Nuclear Safety Agency</td>
</tr>
<tr>
<td>ARPANS Act</td>
<td>Australian Radiation Protection and Nuclear Safety Act 1998 (Cth)</td>
</tr>
<tr>
<td>AS 3846</td>
<td>Australian Standard AS 3846 – Handling and Transport of Dangerous Cargoes in Port Areas</td>
</tr>
<tr>
<td>Bq</td>
<td>Becquerel</td>
</tr>
<tr>
<td>COAG</td>
<td>Council of Australian Governments</td>
</tr>
<tr>
<td>DG Model Law</td>
<td>United Nation’s Recommendations on the Transport of Dangerous Goods</td>
</tr>
<tr>
<td>DIIS</td>
<td>Department of Industry, Innovation and Science</td>
</tr>
<tr>
<td>DGS Act</td>
<td>Dangerous Goods Safety Act 2004 (WA)</td>
</tr>
<tr>
<td>DG Transport Regulations</td>
<td>Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 (WA)</td>
</tr>
<tr>
<td>DMP</td>
<td>Department of Mines and Petroleum</td>
</tr>
<tr>
<td>EMP</td>
<td>Emergency Response Plan</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Authority (WA)</td>
</tr>
<tr>
<td>EP Act</td>
<td>Environmental Protection Act 1986 (WA)</td>
</tr>
<tr>
<td>EPBC Act</td>
<td>Environment Protection and Biodiversity Conservation Act 1999 (Cth)</td>
</tr>
<tr>
<td>FESA</td>
<td>Fire and Emergency Services</td>
</tr>
<tr>
<td>Fremantle Standard</td>
<td>Fremantle Port, Dangerous Cargoes Standard (2017)</td>
</tr>
<tr>
<td>Gy</td>
<td>Gray</td>
</tr>
<tr>
<td>IAEA</td>
<td>International Atomic Energy Agency</td>
</tr>
<tr>
<td>IAEA Statute</td>
<td>Statute of the International Atomic Energy Agency</td>
</tr>
<tr>
<td>ICRP</td>
<td>International Commission on Radiological Protection</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>ICRU</td>
<td>International Commission on Radiation Units and Measurements</td>
</tr>
<tr>
<td>IMDG Code</td>
<td><em>International Maritime Dangerous Goods Code</em></td>
</tr>
<tr>
<td>International Regulations</td>
<td>IAEA’s <em>Regulations for the Safe Transport of Radioactive Material</em></td>
</tr>
<tr>
<td>LSA</td>
<td>Low specific activity</td>
</tr>
<tr>
<td>MLUOT</td>
<td>Model Law for Uranium Oxide Transport</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
</tr>
<tr>
<td>MRA</td>
<td><em>Mutual Recognition Act 1992 (Cth)</em></td>
</tr>
<tr>
<td>NDRP</td>
<td>National Directory for Radiation Protection</td>
</tr>
<tr>
<td>NEA</td>
<td>Nuclear Energy Agency (USA)</td>
</tr>
<tr>
<td>NFC</td>
<td>Nuclear fuel cycle</td>
</tr>
<tr>
<td>NPS Act</td>
<td><em>Non-Proliferation (Safeguards) Act 1987 (Cth)</em></td>
</tr>
<tr>
<td>NRSR</td>
<td>National Rail Safety Regulator</td>
</tr>
<tr>
<td>NSC</td>
<td>Nuclear Safety Committee</td>
</tr>
<tr>
<td>NT</td>
<td>Northern Territory</td>
</tr>
<tr>
<td>NT Act</td>
<td><em>Radioactive Ores and Concentrates (Packaging and Transport) Act 1980 (NT)</em></td>
</tr>
<tr>
<td>NTC</td>
<td>National Transport Commission</td>
</tr>
<tr>
<td>NT Regulations</td>
<td><em>Radioactive Ores and Concentrates (Packaging and Transport) Regulations 1980 (NT)</em></td>
</tr>
<tr>
<td>PER</td>
<td>Public environmental review</td>
</tr>
<tr>
<td>RAR</td>
<td>Reasonably assured resources</td>
</tr>
<tr>
<td>RHC</td>
<td>Radiation Health Committee</td>
</tr>
<tr>
<td>RHSAC</td>
<td>Radiation Health and Safety Advisory Council</td>
</tr>
<tr>
<td>RIS</td>
<td>Regulatory Impact Statement</td>
</tr>
<tr>
<td>RPP</td>
<td>Radiation Protection Programme</td>
</tr>
<tr>
<td>RSA</td>
<td><em>Radiation Safety Act 1975 (WA)</em></td>
</tr>
<tr>
<td>SA</td>
<td>South Australia</td>
</tr>
<tr>
<td>SA Act</td>
<td><em>Radiation Protection and Control Act 1982 (SA)</em></td>
</tr>
<tr>
<td><strong>SA General Regulations</strong></td>
<td><em>Radiation Protection and Control (Ionising Radiation) Regulations 2000 (SA)</em></td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>SA Transport Regulations</strong></td>
<td><em>Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003 (SA)</em></td>
</tr>
<tr>
<td><strong>SI</strong></td>
<td>International System of Units</td>
</tr>
<tr>
<td><strong>Sv</strong></td>
<td>Sievert</td>
</tr>
<tr>
<td><strong>TI</strong></td>
<td>Transport index</td>
</tr>
<tr>
<td><strong>TMP</strong></td>
<td>Transport Management Plan</td>
</tr>
<tr>
<td><strong>Transport Code</strong></td>
<td><em>Code for the Safe Transport of Radioactive Materials</em> (ARPANSA)</td>
</tr>
<tr>
<td><strong>Transport Council</strong></td>
<td>COAG Transport and Infrastructure Council</td>
</tr>
<tr>
<td><strong>UN</strong></td>
<td>United Nations</td>
</tr>
<tr>
<td><strong>UN2912</strong></td>
<td>UN2912 Radioactive Material Low Specific Activity (LSA–I), Non-Fissile or Fissile Excepted</td>
</tr>
<tr>
<td><strong>UNSCAR</strong></td>
<td>United Nations Scientific Committee on the Effects of Atomic Radiation</td>
</tr>
<tr>
<td><strong>WA</strong></td>
<td>Western Australia</td>
</tr>
<tr>
<td><strong>WA General Regulations</strong></td>
<td><em>Radiation Safety (General) Regulations 1983 (WA)</em></td>
</tr>
<tr>
<td><strong>WA Transport Regulations</strong></td>
<td><em>Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA)</em></td>
</tr>
<tr>
<td><strong>WNA</strong></td>
<td>World Nuclear Association</td>
</tr>
<tr>
<td><strong>WNTI</strong></td>
<td>World Nuclear Transport Institute</td>
</tr>
</tbody>
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I INTRODUCTION

Every year, 20 million consignments of radioactive materials are transported globally by road, rail, air and sea. The vast majority of radioactive materials are transported for use in medicine, agriculture, research and mineral exploration. Approximately five per cent of these consignments are related to the nuclear fuel cycle (NFC). The NFC encompasses a series of processes where fissionable material is transformed into fuel to create nuclear energy.

Uranium is indispensable to the NFC – natural uranium, once enriched, generates 20,000 times more energy than black coal. Importantly, Australia is a uranium producer and only participates in the first two stages of the NFC – the mining of uranium ore and the milling of uranium oxide. Consequently, all Australian uranium is exported overseas to ‘consumer nations’ for nuclear energy. In the 2010–11 financial year, Australia exported 6,950 tonnes of uranium oxide worth AU$610 million.

---

5 Natural uranium is 99.3% U–238, a mildly radioactive but not fissile isotope. The remaining 0.7% is the fissile U–235. U–235’s natural concentration is increased via ‘enrichment’ (a NFC process): Paul Harding, ‘Uranium Enrichment’ in Ian Hore-Lacy (ed), Uranium for Nuclear Power: Resources, Mining and Transformation to Fuel (Elsevier, 2016) 321, 321.
7 Uranium oxide is also known as uranium oxide concentrate, yellowcake or U₃O₈. Australia has yet to expand its NFC operations to conversion, enrichment, energy generation and spent fuel management. However, SA recently completed a Royal Commission, examining the State’s potential to expand its NFC operations. It concluded expansion could safely occur, including the disposal of used nuclear fuel and waste: South Australia, Nuclear Fuel Cycle Royal Commission, Report (2016).
8 Australia only exports uranium to countries with which it has a nuclear cooperation (safeguards) agreement. Australia has 23 nuclear safeguard agreements covering 41 countries (including the European Union): Department of Foreign Affairs and Trade, Australia’s Network of Nuclear Cooperation Agreements (2017) <http://dfat.gov.au/international-relations/security/non-proliferation-disarmament-arms-control/policies-agreements-treaties/nuclear-cooperation-agreements/Pages/australias-network-of-nuclear-cooperation-agreements.aspx>. See Appendix A for a list of the agreements and Chapter III generally for an explanation of Australia’s nuclear non-proliferation regime.
Australia is a major player in the provision of uranium to the world energy market. We are the world’s third biggest uranium producer, behind Canada and Kazakhstan. Australia is home to the largest percentage of the world’s reasonably assured uranium resources (RAR), representing 29 per cent of the global total. These resources are concentrated in South Australia (SA), the Northern Territory (NT), Western Australia (WA) and Queensland.

The NT and SA have a long history of uranium mining, and are the only Australian jurisdictions currently producing and exporting uranium. The NT’s Ranger mine commenced operations in 1980. Actual mining of uranium ore ceased in November 2012, but Ranger continues to process ore from stockpiles and is expected to close completely by 2020. In the 2015–16 financial year, Ranger processed 2,208 tonnes of uranium oxide. SA’s Olympic Dam mine commenced operations in 1988 and is one of the world’s largest mineral resources, also producing copper, gold and silver. Olympic Dam continues to operate and produced 4,363 tonnes of uranium oxide in the 2015–16 financial year.

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12 RAR are resources ‘thought to exist with sufficient confidence that mining operations can proceed’. The resource estimate is broken down by cost because lower grade uranium ore is more expensive to produce (eg RAR at US$260 per kg): Dave Elliott, Bob Everett and Janet Ramage, ‘The Future of Nuclear Power’ in Bob Everett et al (eds), *Energy Systems and Sustainability: Power for a Sustainable Future* (Oxford University Press, 2nd ed, 2012) 427, 433; ibid 9.
14 SA holds 80% of Australia’s RAR, representing 23% of the global total. Of the remaining Australian RAR, the NT holds 10%, WA holds 6% and Queensland holds 4%: Department of Resources, Energy and Tourism, above n 9.
19 Kay, above n 15.
WA has a nascent uranium industry. A ban on uranium exploration was lifted in 2008, and at present, there are four major uranium projects at various stages of approval and development (see Table 1). Due to the current low price of uranium, it is uncertain when these projects will be completed and when production will begin.

Table 1: Major Uranium Projects in WA

<table>
<thead>
<tr>
<th>Project</th>
<th>Operator</th>
<th>WA Environmental Approval</th>
<th>Federal Environmental Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kintyre</td>
<td>Cameco Australia</td>
<td>Yes(^{23})</td>
<td>Yes(^{24})</td>
</tr>
<tr>
<td>Mulga Rock</td>
<td>Vimy Resources Ltd</td>
<td>Yes(^{25})</td>
<td>Yes(^{26})</td>
</tr>
<tr>
<td>Wiluna</td>
<td>Toro Energy Ltd</td>
<td>Yes(^{27})</td>
<td>Yes: Centipede and Lake Way Deposits(^{28}) Pending: Lake Maitland and Millipede Deposits(^{29})</td>
</tr>
<tr>
<td>Yeelirrie</td>
<td>Cameco Australia</td>
<td>Yes(^{30})</td>
<td>Pending(^{31})</td>
</tr>
</tbody>
</table>

25 Albert Jacob, ‘Statement that a Proposal May be Implemented (Environmental Protection Act 1986): Mulga Rock Uranium Project’ (Ministerial Statement, Statement No 1046, 16 December 2016).
27 Bill Marmion, ‘Statement that a Proposal may be Implemented (Pursuant to the Provisions of the Environmental Protection Act 1986): Wiluna Uranium Mine, 30 km South and 15 km South-East of Wiluna, Shire of Wiluna’ (Ministerial Statement, Statement No 913, 10 October 2012); Albert Jacob, ‘Statement that a Revised Proposal may be Implemented (Environmental Protection Act 1986): Revised Wiluna Uranium Proposal’ (Ministerial Statement, Statement No 1051, 9 January 2017).
30 Albert Jacob, ‘Statement that a Proposal may be Implemented (Environmental Protection Act 1986): Yeelirrie Uranium Project’ (Ministerial Statement, Statement No 1053, 20 January 2017).
31 See Bruce Edwards, ‘Notification of Extension of Time in Which to Make a Decision Whether to Approve a Controlled Action, Yeelirrie Uranium Mine, Shire of Wiluna, WA (Departmental Decision, EPBC 2009/4906, 2 September 2016).
NT and SA mines export uranium from their local ports in Darwin and Adelaide respectively. However, when uranium production commences in WA, it will be transported interstate by road to either Port Adelaide or Port Darwin for export. This is because State Government policy prohibits the export of uranium oxide from local ports. As a result, WA producers are exposed to an additional layer of regulation.

The purpose of this thesis is to analyse elements of the regime governing the road transport of WA uranium oxide and highlight its deficiencies and subsequent impact on WA producers. In doing so, it becomes clear that while WA producers are at a disadvantage to their NT and SA counterparts, the whole regime is overly complex, repetitious, and incapable of responding to international developments concerning radioactive materials transport.

A A Complicated Regime
The current regime for the transport of uranium oxide is outdated, overlapping and complex, even for a producer exporting from their home State. This is compounded for WA producers because they cannot use local ports for export. Instead, the uranium oxide must travel by road to Darwin or Adelaide. To do so, they must obtain at least seven approvals from five agencies operating under three different governments (see Table 2).

Table 2: Overview of the transport permits required by NT, SA and WA producers

<table>
<thead>
<tr>
<th>Approval/Permit</th>
<th>Agency</th>
<th>NT</th>
<th>SA</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA Environmental Approval</td>
<td>EPA</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>WA Transport Licence</td>
<td>Radiological Council</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SA Environmental Approval</td>
<td>EPA</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>SA Transport Licence</td>
<td>NT WorkSafe</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>NT Environmental Approval</td>
<td>EPA</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>NT Transport Licence</td>
<td></td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Cth Transport Permit</td>
<td>ASNO</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cth Possession Permit</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cth Mineral Export Permit</td>
<td>DIIS</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Cth Individual Consignment Approval</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

In WA, before a uranium mine is constructed, the proponent must obtain environmental approval for all aspects of production (including transport) from the Environmental Protection Authority (EPA). Once production starts and a consignment is ready for export, the producer and transporter individually obtain licences from the
WA Radiological Council. They must also gain possession and transport permits from the Australian Non-Proliferation Office (ASNO) and individual consignment approval and a Mineral Export Permit from the Department of Industry, Innovation and Science (DIIS). Further, transport licences from the NT Work Health Authority or SA Environment Protection Authority are also required for interstate transport.

The law governing uranium can be broadly broken into three categories: security, safeguards, and safety.\(^{32}\) Nuclear security focuses on preventing the intentional misuse of nuclear materials by terrorists and other non-state actors.\(^{33}\) Nuclear safeguards prevent new States gaining nuclear weapons,\(^{34}\) and is achieved primarily through the nuclear non-proliferation agreement framework.\(^{35}\) These areas are regulated by the Commonwealth through non-proliferation and export controls.\(^{36}\)

Nuclear safety encompasses radiation protection measures that protect human health and the environment from the effects of ionising radiation.\(^{37}\) Historically, the States and Territories are responsible for mining, public health, environment protection and transport.\(^{38}\) The radiation protection legislation is intertwined with each of these areas. In WA, the Radiation Safety Act 1975 (WA) (RSA) mandates licensing requirements, dose limits,\(^{39}\) reporting obligations and training requirements.

The Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) (WA Transport Regulations) implements the Code for the Safe Transport of Radioactive Material (Transport Code). This Code is published by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) and mirrors the Regulations for the Safe Transport of Radioactive Material (International


\(^{34}\) Stoiber, above n 32, 3.

\(^{35}\) Ibid.

\(^{36}\) The Australian non-proliferation safeguards regime is explained in Chapter III at page 32. See also Appendix A for a list of Australia’s bilateral agreements.

\(^{37}\) The Commonwealth’s non-proliferation safeguards and export regime is explained in Chapter III at pages 32.

\(^{38}\) The constitutional basis for uranium regulation is explored in Chapter III at page 27.

\(^{39}\) A dose limit is the value of an effective or equivalent dose (see 13–4 nn 86–7) to individuals from planned exposure situations that shall not be exceeded: J Valentin (ed), Annals of the ICRP: The 2007 Recommendations of the International Committee on Radiological Protection (Publication 103, Elsevier, 2007) 22.
Regulations) developed by the International Atomic Energy Agency (IAEA). It is implemented in the radiation protection legislation of each Australian jurisdiction. The International Regulations represent world’s best practice for the regulation of the transport of radioactive materials. They are reviewed biannually, with the last substantive revision occurring in 2012. This revision is reflected in the 2014 Transport Code. However, this is not uniformly implemented across Australia. In fact, three different editions of the Transport Code operate across State borders.

B The Problem

Each jurisdiction has its own radiation protection regime governing the transport of radioactive materials, and consequently, the transport of uranium oxide. Further, other permits are required at the Commonwealth level to regulate nuclear security and safeguards. There is no mechanism in place (such as a mutual recognition scheme) to reduce the number of permits required by a producer to transport uranium oxide. This is compounded for producers in WA because the product must travel interstate due to the policy ban.

This entails significant economic consequences for WA producers. The variety of regulators and approvals increase costs and draws out the time required for approval. This in turn can delay shipments of uranium oxide, with contractual consequences for producers and the overseas consumer. There are also major discrepancies between the requirements of the radiation protection legislation in the NT, SA and WA. This increases compliance costs for WA producers as they attempt to abide by the disjunctive licensing, reporting and other requirements imposed. Further, the different operational versions of the Transport Code in force across Australia has safety implications, as requirements are not consistent with international requirements, and


may induce a shipment denial\textsuperscript{42} where a consignment does not meet the version of the International Regulations enforced overseas.

\subsection*{C The Solution?}
The science is clear that the physical dangers presented by uranium oxide are low compared to other radioactive materials and heavy metals regularly transported in WA.\textsuperscript{43} The policy ban then, is likely the culmination of negative public attitudes towards uranium.\textsuperscript{44} These attitudes are influenced by negative associations with uranium mining,\textsuperscript{45} distrust of the industry,\textsuperscript{46} and recent nuclear incidents (such as the Fukushima-Daiichi disaster in 2011).\textsuperscript{47} Further, WA has a new Labor Government ideologically opposed to uranium mining.\textsuperscript{48} In these circumstances, it is unlikely that the policy ban will be lifted in the near future.

As a result, a solution must be reached between the States, Territories and Commonwealth to simplify the regime for the transport of uranium oxide. A solution not straightforward – as indicated above, the regime for uranium oxide transport canvasses multiple legal areas and levels of government. Reform to uranium oxide transport must consider its impact on areas such as general transport, radiation protection, uranium mining, and the Australian NFC. Further, reform can impact non-NFC industries – for instance, reform to radiation protection legislation may also affect medicine and radiology.

\subsection*{D Structure of this Thesis}
This thesis examines the current regime for the transport of uranium oxide in WA and highlights the difficulties and costs faced by producers and transporters trucking the

\textsuperscript{42} A denial of shipment is the ‘explicit or implicit refusal to carry a shipment of radioactive material though it conforms to all the applicable Regulations’: International Atomic Energy Agency, \textit{Handbook for Addressing Instances of Denials/Delays of Shipment of Radioactive Material} (2010) (\textit{Shipment Denial Handbook}) cl 2. Shipment denials are discussed further in Chapter V.

\textsuperscript{43} Chapter V explains that uranium oxide is classed as ‘LSA-I’ material, which is characterised by a low level of radioactivity. Compare this to radioisotopes (used in medicine, industry and research) which are commonly transported in ‘Type A’ packages (and are therefore more radioactive, and more dangerous).

\textsuperscript{44} The factors influencing the policy ban are analysed in Chapter II.


\textsuperscript{47} See Lei Huang et al, ‘Effect of the Fukushima Nuclear Accident on the Risk Perception of Residents near a Nuclear Power Plant in China’ (2013) 110(49) \textit{Proceedings of the National Academy of Sciences of the United States of America} 19742.

\textsuperscript{48} See Chapter II at page 16.
material interstate. Chapter II explains the WA policy ban, its influencing factors and the capacity of WA ports to handle and export uranium oxide. Chapter III introduces the legislative scheme governing the transport of uranium oxide at the Commonwealth and WA levels. It explains the practical effect of the current scheme on producers and transporters. Chapter IV analyses the radiation protection legislation in the NT, SA and WA and highlights the major discrepancies between the three regimes. It argues that these differences impose greater obligations on WA producers compared to their interstate counterparts. Chapter V introduces the International Regulations and Transport Code and explains their application throughout Australia. It analyses the different versions of the Transport Code in force and explains the importance of it staying up to date with Australian and international developments. Finally, Chapter VI proposes three reforms to modify and harmonise the existing regime to improve the outcomes for WA uranium producers.
II THE PORT PROBLEM

A Introduction

In the NT and SA, uranium producers have two regulatory regimes governing shipment: their own and the Commonwealth. This is because uranium oxide can be exported from local ports. WA producers face a very different situation. A policy ban prevents uranium oxide being exported from WA ports. Consequently, WA producers must transport uranium oxide interstate to either Port Adelaide or Port Darwin for export. This policy decision exposes producers to three regulatory schemes and in turn, increases business and compliance costs.\(^{49}\)

The public perception of uranium influences such policy decisions.\(^{50}\) The regulator is tasked not only with protecting the public from the actual hazards of uranium oxide, but also managing negative perceptions.\(^{51}\) This Chapter begins by outlining the policy ban itself. It then explains the actual hazards posed by uranium oxide and the local influences on its perception. Finally, this Chapter explores Fremantle Port’s capacity to export uranium oxide if the ban was lifted.

B The Policy Ban

There is no legislative impediment prohibiting uranium oxide export from WA ports – the ban is pure policy. When the uranium mining ban was lifted in 2008,\(^ {52}\) WA industrial port facilities were considered as potential export hubs.\(^{53}\) Soon after, the Minister for Mines and Petroleum stated that ‘in the early stages … any material will be exported through ports in the Northern Territory or South Australia. Uranium will not be exported through residentially bound ports’.\(^ {54}\) By 2012, the State Government did not consider any WA ports suitable because they were ‘either surrounded by residential areas or [did] not have container facilities’.\(^ {55}\)

\(^{49}\) These costs are explained further in Chapters III and IV.

\(^{50}\) See generally Paul Slovic, ‘Public Perception of Risk’ (1997) 59(9) *Journal of Environmental Health* 22, 22.


\(^{52}\) Department of Premier and Cabinet, above n 21.


The lack of port container facilities is a legitimate barrier to uranium oxide export. This is because uranium oxide is sealed in 200-litre steel drums, which are then stowed in shipping containers for transport.\textsuperscript{56} In WA, Fremantle Port handles the majority of containerised trade.\textsuperscript{57} The Port of Esperance also has facilities for containerised cargo.\textsuperscript{58} Both ports are excluded as potential uranium export ports because they are surrounded by residential areas.\textsuperscript{59} However, it is argued that this reason is not sufficient by itself to exclude uranium oxide export. This is because the hazards posed by uranium oxide are low and can be safely managed.

C Hazards of Uranium Oxide

The hazards posed by uranium oxide can be understood from three perspectives: (1) transport risks; (2) radiological risks; and (3) chemical risks.

1 Transport Risks

The risk in transporting uranium oxide is derived from the material itself and the mode of transport selected. The shipping container stowing the uranium oxide is transported by articulated trucks. Heavy vehicle transport has baseline risks. Heavy vehicles are disproportionately involved in casualty crashes, representing 16 per cent of road crash fatalities.\textsuperscript{60} Risk factors associated with heavy vehicle accidents include speed,\textsuperscript{61} road and vehicle design,\textsuperscript{62} and fatigue.\textsuperscript{63}


\textsuperscript{58} Ibid 25.

\textsuperscript{59} Taylor, above n 55.


\textsuperscript{61} Jane Elkington and Mark Stevenson, \textit{The Heavy Vehicle Study – Final Report} (Curtin Monash Accident Research Centre, 2013) 36.

\textsuperscript{62} SJ Raftery, JAL Grigo and JE Woolley, \textit{Heavy Vehicle Road Safety: Research Scan} (Centre for Automotive Safety Research, 2011) 21.

Fatigue is a particularly important issue for the transport of WA uranium oxide and a compelling reason to review the policy ban. This is because consignments must travel long distances from the uranium mine in WA to either Port Adelaide or Darwin. The journey between Port Adelaide and Kalgoorlie is over 2,100 kilometres and approximately 22 hours of driving time. Similarly, the distance between Port Adelaide and Wiluna is 2,600 kilometres and 27 hours of driving time (see Figure 1). In contrast, Olympic Dam is 570 kilometres and six hours from Port Adelaide and Ranger is 260 kilometres and three hours from Port Darwin. Some SA uranium mines are also supported by rail infrastructure to Port Adelaide.

*Figure 1: WA uranium mines and relevant ports and townsites*

The transport risk can also be assessed by examining historical accident data. Millions of shipments of radioactive materials occur around the world each year. Since 1961, there is no record of any accident involving the transport of radioactive materials (either by road, rail, air or sea) causing significant radiological damage to human


64 Radiation Health and Safety Advisory Council, above n 40.
65 Kalgoorlie is the closest town to the Mulga Rock development.
66 Wiluna is the closest town to the Wiluna and Yeelirrie developments.
68 World Nuclear Association, above n 1.
health or the environment.\(^{69}\) This is likely the consequence of the robust packaging and control system developed by the IAEA.\(^{70}\)

The IAEA’s records for radioactive waste dumping and radiological losses at sea demonstrates the danger posed by historical accidents.\(^{71}\) Only two major incidents involving the sea transport of NFC materials have ever been recorded. The first was the Mont Luis sinking in 1984, carrying low-level enriched uranium hexafluoride. The second was the MSC Carla hull failure, carrying caesium-137 sealed sources. No releases of radioactivity were reported in either case.\(^{72}\)

Cook et al have also predicted the risk of death from an accident involving the transport of radioactive waste, describing that risk as ‘vanishingly small’.\(^{73}\) Common hazards like smoking, traffic accidents, surgical anaesthesia and air travel present a greater risk of death than an accident involving the rail or sea journey of radioactive waste (see Table 3).\(^{74}\)

### Table 3: Risk of death from common and radiological hazards

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Annual risk of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>1 in 100</td>
</tr>
<tr>
<td>Traffic accident</td>
<td>1 in 8,000</td>
</tr>
<tr>
<td>Surgical anaesthesia</td>
<td>1 in 185,000</td>
</tr>
<tr>
<td>Air travel</td>
<td>1 in 12.5 million</td>
</tr>
<tr>
<td>1,000 km rail journey of radioactive waste</td>
<td>1 in 4 billion</td>
</tr>
<tr>
<td>20,000 km sea journey of radioactive waste</td>
<td>1 in 1,000 trillion</td>
</tr>
</tbody>
</table>

Australian radiation incidents are recorded in the Australian Radiation Incident Register (ARIR). The ARIR records incidents in 31 categories, including transport.\(^{75}\) Very few transport incidents have been recorded and the radiological consequences of these have been negligible or minor.\(^{76}\) In 2015, 95 per cent of reported radiation

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\(^{69}\) The International Atomic Energy Agency’s *Regulations for the Safe Transport of Radioactive Material* were first published in 1961.


\(^{72}\) Ibid 23.

\(^{73}\) Darron Cook et al, *Safety and Risks in the Transportation of Radioactive Materials to and in Australia: Transport Safety and Risks Overview and Assessment* (Jacobs Group (Australia) Pty Ltd, 2016) 49.

\(^{74}\) Ibid.

\(^{75}\) These categories also include nuclear medicine, radiology, dental, mining and lasers.

\(^{76}\) Radiation Health and Safety Advisory Council, above n 40, 2.
incidents were medically related.\textsuperscript{77} Between 2004 and 2015, 1717 incidents were reported to the ARIR – only 17 were transport incidents.\textsuperscript{78}

Transport data indicates the risk of a serious incident involving radioactive materials is low. However, the risk may be exacerbated by transport conditions specific to WA – that is, the transport of uranium oxide over long distances between the mine and port.

2 \textit{Radiological Risks}

Uranium oxide emits ionising radiation.\textsuperscript{79} Ionisation occurs when an unstable atom (with an excess of protons and neutrons) attempts to stabilise itself by discharging excess particles.\textsuperscript{80} The atom disintegrates and transforms into a different nuclide through radioactive decay.\textsuperscript{81} Radiation is the energy released during radioactive decay; radioactivity is the rate of radiation emission.\textsuperscript{82} Ionising radiation discharges a lot of energy which can cause chemical change and damage in living tissue.\textsuperscript{83}

Radioactivity is measured by the Becqueral (Bq).\textsuperscript{84} Radiation exposure is measured by the Gray (Gy).\textsuperscript{85} The Sievert (Sv) measures biological exposure to radiation.\textsuperscript{86} These units are usually accompanied by a prefix denoting a fraction (eg milli, micro) (see Appendix B).


\textsuperscript{78} This represents less than 1\% of all Australian radiation incidents reported in the RAR: see ARIR Website, above n 77.


\textsuperscript{81} Obodovskiy, above n 80, 5; Martin et al, above n 80, 8; Burchfield, above n 80, 38–40.

\textsuperscript{82} Obodovskiy, above n 80, 5; Martin et al, above n 80, 8; Burchfield, above n 80, 38–40.

\textsuperscript{83} Obodovskiy, above n 80, 20; Martin et al, above n 80, 27; Burchfield, above n 80, 39–40.

\textsuperscript{84} Bureau International des Poids et Mesures, \textit{The International System of Units} (Organisation Intergouvernementale de la Convention du Mètre, 8th ed, 2006) 120. Australia has adopted the International System of Units (SI) under the \textit{National Measurement Act 1960} (Cth) (see also the \textit{National Measurement Regulations 1999} (Cth) sch 1 pt 2).

\textsuperscript{85} Radiation exposure is called the ‘absorbed dose’ and measures the energy deposited into a material or substance: Bureau International des Poids et Mesures, above n 84, 120.

\textsuperscript{86} Biological exposure is called the equivalent dose. ‘Effective dose’ also measures the biological exposure of organs in the human body. Some organs are more sensitive to radiation. These include the bone marrow, lungs and breasts: Australian Radiation Protection and Nuclear Safety Agency, \textit{Fundamentals: Protection Against Ionising Radiation} (Radiation Protection Series F-1, 2014) 7–9; Bureau International des Poids et Mesures, above n 84, 120.
Uranium emits ionising radiation in the form of alpha ($\alpha$) particles. Alpha particles are only a health concern if they enter the body, but cannot travel far – they cannot penetrate a sheet of paper and travel only a few centimetres in the air. Uranium is also a weak gamma ($\gamma$) emitter. Gamma rays have the highest level of energy in the electromagnetic spectrum and can pass through most materials. During transport, the gamma dose rate from uranium oxide increases because of the close proximity of the drums and as the material decays.

Uranium oxide’s radioactivity is explained by comparing its dose to other common doses of ionising radiation. We are constantly exposed to natural background radiation emanating from the environment (eg in rocks and soil). In Australia, the annual dose from background radiation is approximately 1.5 mSv. Other sources of radiation are CT scans (5–10 mSv), chest x-rays (0.06 mSv) and international travel (return flight between Melbourne and London, 0.11 mSv). Uranium mine workers and radioactive transport workers receive an annual dose below 1 mSv in the course of their employment (see also Table 4). There is no evidence that ionising radiation affects human health for doses up to 10 mSv, although any event, the occupational limit set by the ICRP is 20 mSv per year. A person would need to stand within one metre of a drum containing uranium oxide for 1,000 hours to reach the occupational limit.

95 The occupational limit is averaged over 5 years and no single year can exceed 50 mSv: Valentin, above n 39, Table 6.
96 Uranium Council Transport Working Group, above n 90, 14.
Table 4: Typical radiation doses for uranium oxide

<table>
<thead>
<tr>
<th></th>
<th>Contained activity of U-238 (GBq)</th>
<th>γ dose at 1m (mSv/h)</th>
<th>γ dose at 2m (mSv/h)</th>
<th>Max γ dose at surface (mSv/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum</td>
<td>10</td>
<td>0.004</td>
<td>-</td>
<td>0.02</td>
</tr>
<tr>
<td>Container</td>
<td>440</td>
<td>0.02</td>
<td>0.01</td>
<td>0.06</td>
</tr>
</tbody>
</table>

3 Chemical Risks

Uranium oxide’s chemical characteristics are a greater threat to human health than its radiological characteristics. Uranium oxide is not easily absorbed into the human body because it is insoluble, but can enter the bloodstream if ingested or inhaled. If absorbed, uranium targets kidney tissue and renal processes. However, the average adult can tolerate an intake of up to 11 mg per year, and in low doses (between 25–40 mg), the kidney repairs itself.

This toxicity is not unique – other heavy metals, including lead, nickel and copper, also threaten human health at certain doses. In Australia, toxic heavy metals (such as lead sulphite concentrate) are transported daily as ‘environmental hazardous substances’ under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). Further, uranium oxide is stable and does not pose an explosion hazard.

4 Concluding Remarks

Transporting uranium oxide will always have risks, but this is no different to the transport of other radioactive substances, toxic metals or dangerous goods routinely transported in Australia. The chemical and radiological risks of uranium oxide are

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97 Ibid.
99 Between 0.76–5% of inhaled uranium and 0.1–6% of ingested uranium will enter the bloodstream. Uranium is very unlikely to enter the human body through the skin: Keith, above n 98, 41.
100 Ibid 4.
102 Department of Protection of the Human Environment, Depleted Uranium: Sources, Exposures and Health Effects (World Health Organization, 2011) 146.
105 Uranium Council Transport Working Group, above n 90, 11.
well-managed through IAEA controls, demonstrated by the low number of transport incidents in both the Australian and international context. The main risk is the driving conditions associated with articulated vehicles. This is a specific problem for WA producers because of the distance between the uranium mine and export ports, especially the fatigue associated with long-distance haulage. Ironically, the policy ban is more likely to increase, not decrease, this risk. The next section will examine the factors that influence the policy.

D Factors Influencing the Policy Ban

Various factors influence the policy ban. These reflect negative public perceptions about the NFC and misconceptions about uranium oxide not necessarily based in fact. These factors are roughly characterised as: (1) political factors; (2) social factors; and (3) economic considerations.

1 Political Factors

There is no bipartisan approach to uranium mining in WA. WA Labor traditionally opposes uranium mining and exports, while the WA Liberals support it. The newly-elected Labor Government in WA has vowed no new uranium mines will be permitted, but existing approved projects will be allowed to continue. In contrast, both sides of politics in SA and the NT support uranium mining. Further, the Greens

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106 These controls, implemented through the International Atomic Energy Agency’s Regulations for the Safe Transport of Radioactive Material, are explained in detail in Chapter V.
and several unions (eg the Australian Manufacturing Workers’ Union) are strongly anti-uranium.\textsuperscript{111}

The most suitable ports for uranium export in WA are Fremantle and Esperance. Unsurprisingly, concerns about exporting uranium oxide through local ports has been voiced by Fremantle and Esperance politicians. Fremantle Port operates in a safe Labor seat\textsuperscript{112} and a Greens-led local government.\textsuperscript{113} The Greens’ spokesman against uranium mining has said that uranium is ‘harmful in ways more far reaching than asbestos. [It] brings nothing but contamination and misery’.\textsuperscript{114} The Fremantle Mayor has observed that the government is ‘keenly aware of the power of community backlash [regarding uranium oxide export] after 2009 concerns about potential lead pollution’ following State Government approval for lead carbonate exports through Fremantle.\textsuperscript{115}

In 2015, Cameco proffered Esperance as a potential export port for WA uranium.\textsuperscript{116} This was rejected. Esperance was regarded as unsuitable because it was surrounded by built-up areas.\textsuperscript{117} Further, public opposition was reported against this ‘emotive commodity’,\textsuperscript{118} with safety concerns following the extensive lead pollution of Esperance between 2005 and 2007.\textsuperscript{119}


\textsuperscript{115} Taylor, above n 55.


Local government opposition also contributes to policy difficulties.\textsuperscript{120} Many local councils, including the City of Fremantle, have established ‘nuclear free zones’ in their municipalities.\textsuperscript{121} For instance, the City of Fremantle’s \textit{Nuclear Free Fremantle Policy} declares that no uranium may be stored or transported in the municipality.\textsuperscript{122} These policies are a statement of opposition to the transport of radioactive materials through the local government area, but have no legal force.\textsuperscript{123} The Joint Standing Committee on Delegated Legislation will not approve local laws that attempt to make internal policies enforceable.\textsuperscript{124} In any event, the State Government may override local government laws where they are inconsistent with other written laws.\textsuperscript{125} However, the policies reflect communities attitudes and demonstrate the negative perception of uranium.

2  \textbf{Social Factors}

Public opposition to uranium mining has been widely reported.\textsuperscript{126} More specifically, the Australian public has voiced concerns that the transport of uranium oxide along populated routes poses a threat to human health and the environment.\textsuperscript{127} For instance, \textit{The Australian} reported that Toro’s Energy’s plan to transport uranium oxide through Kalgoorlie-Boulder was ‘causing angst’ because houses were only 10 metres away from the Goldfields Highway.\textsuperscript{128} In 2008, the WA Opposition Leader stated there were ‘many issues’ with the routes, including the safety of those living alongside them.\textsuperscript{129}

\begin{itemize}
\item \textsuperscript{120} See, eg, Uranium Mining, Processing and Nuclear Energy Review, \textit{Uranium Mining, Processing and Nuclear Energy – Opportunities for Australia?} (Department of the Prime Minister and Cabinet, 2006) 29.
\item \textsuperscript{121} See, for example, City of Vincent, \textit{Nuclear Free Zone} (Policy No 4.1.8, City of Vincent Policy Manual, 1995); City of Kwinana, \textit{Policy: Nuclear Free Zones} (Policy No 561, 2015) (\textit{Kwinana Policy}).
\item \textsuperscript{122} City of Fremantle, \textit{Policy: Nuclear Free Fremantle} (No SG20, 2000) cls 1, 3.
\item \textsuperscript{123} This is expressly recognised in the City of Kwinana’s Nuclear Free Zone Policy: Kwinana Policy, above n 121, cl 1.
\item \textsuperscript{124} This does not extend to policies made under the \textit{Planning and Development Act 2005} (WA). See also Department of Local Government and Communities, \textit{Local Government Operational Guidelines: Local Laws} (No 16, November 2011) 10–1; \textit{Interpretation Act 1984} (WA) s 42.
\item \textsuperscript{125} \textit{Local Government Act 1995} (WA) s 3.7.
\item \textsuperscript{128} Taylor, above n 55.
\item \textsuperscript{129} Clarke, above n 53.
\end{itemize}
However, these concerns do not align with the actual radiological risk posed by uranium oxide. A car passing a truck carrying uranium oxide would be exposed to, at most, 0.004 mSv.\textsuperscript{130} Shipments stopped directly next to a building would emit an annual dose equal to 0.2 mSv.\textsuperscript{131} These doses are well under the annual public limit of 1 mSv. The dust hazard is also low. Uranium oxide is sealed in drums during transport and placed inside a shipping container. If material does escape during an accident, it is covered and treated like any other heavy metal concentrate. Only those within 10 metres of a spill are required to wear personal protective equipment.\textsuperscript{132}

So why then is there such a discrepancy between the public perception of uranium oxide and its actual risk? The disparity can be explained by: (a) risk perception; and (b) the influence of recent nuclear incidents.

\textit{(a) Risk Perception}

‘Risk’ refers to the chance a hazard will occur, mitigated by any safeguards.\textsuperscript{133} Risk depends on the identification of what can happen, the probability that it will happen, and the consequences should it happen.\textsuperscript{134} However, risk is perceived differently by different people and always involves a subjective assessment.\textsuperscript{135} Risk can be quantifiably measured by the ‘psychometric paradigm’.\textsuperscript{136} For example, a person can rate the riskiness of an activity from one to ten (with ten being the most risky).

Risk perception varies between lay people and experts.\textsuperscript{137} Experts judge risk according to technical estimates, whereas lay people judge risk according to other ‘hazard


\textsuperscript{132} Personal protective equipment includes equipment such as dust mask: Uranium Council Transport Working Group, above n 90, 35.

\textsuperscript{133} Stanley Kaplan and B John Garrick, ‘On the Quantitative Definition of Risk’ (1981) 1(1) Risk Analysis 11, 12.

\textsuperscript{134} Ibid 12–3.


\textsuperscript{137} Experts are persons with special skill or knowledge in a particular field: Tanja Perko, ‘Radiation Risk Perception: A Discrepancy Between the Experts and the General Population’ (2014) 133 \textit{Journal of Environmental Radioactivity} 86, 91; Slovic, above n 50, 165; \textit{Macquarie Dictionary Online} (Macquarie Dictionary Publishers, 2016) (definition of ‘expert’).
characteristics’ (see Table 5). Hendee suggests that nuclear energy satisfies all the hazard characteristics for increased public concern: nuclear energy is unfamiliar to many people and not well understood, has received plenty of negative media attention, and has the ability to impact future generations (eg fallout from Chernobyl in 1986). Similarly, uranium oxide transport is unfamiliar, not well-understood by the public and has received negative media attention.

**Table 5: Hazard characteristics involved in public risk perception**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Increased public concern</th>
<th>Decreased public concern</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Catastrophic potential</strong></td>
<td>Fatalities/injuries grouped in space and time</td>
<td>Fatalities/injuries scattered and random</td>
</tr>
<tr>
<td><strong>Familiarity</strong></td>
<td>Unfamiliar</td>
<td>Familiar</td>
</tr>
<tr>
<td><strong>Understanding</strong></td>
<td>Mechanisms/process not understood</td>
<td>Mechanisms/process understood</td>
</tr>
<tr>
<td><strong>Personal controllability</strong></td>
<td>Uncontrollable</td>
<td>Controllable</td>
</tr>
<tr>
<td><strong>Effects on future generations</strong></td>
<td>Risk to future generations</td>
<td>No risk to future generations</td>
</tr>
<tr>
<td><strong>Media attention</strong></td>
<td>Much media attention</td>
<td>Little media attention</td>
</tr>
<tr>
<td><strong>Accident history</strong></td>
<td>Major and sometimes minor accidents</td>
<td>No major or minor accidents</td>
</tr>
<tr>
<td><strong>Origin</strong></td>
<td>Caused by human actions or failures</td>
<td>Caused by acts of nature or God</td>
</tr>
</tbody>
</table>

Multiple studies demonstrate that experts have lower risk perceptions of radiation than the public. In one study, experts employed at the Belgium Nuclear Research Centre and members of the public were asked to evaluate the risks of nuclear waste,

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142 Perko, above n 137.

143 The experts, on average, had worked in nuclear applications for 15 years, were regularly exposed to regulation, and 70 per cent had higher degrees.
an accident at a nuclear installation, natural radiation and medical x-rays on a scale of one (very low risk) to five (very high risk). The general population rated nuclear waste and a nuclear accident as riskier than natural radiation and x-rays – for the experts, the opposite was found.  Another study measured the risk perception of nuclear testing of scientists, doctors and villages in Kazakhstan.  The participants were asked questions related to the health effects of radiation exposure and nuclear testing in Kazakhstan. The villagers exhibited the highest risk response, followed by the doctors and then the scientists.

(b) Nuclear incidents

Nuclear disasters in recent memory also contribute to public fear and distrust of the NFC. In 2011, the Fukushima Dai-ichi Nuclear Power Plant (Fukushima) experienced a meltdown following a 9.0 magnitude earthquake and tsunami.  This was the largest civilian nuclear accident since the Chernobyl disaster in 1986.  No radiation-related deaths or acute diseases among the public or radiation workers are reported by UNSCEAR, but the fear of future health impact remain.

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144 Factors that contributed to a lower risk perception included professional experience (ie the more experienced a radiation expert was, the less risky radiation was), a feeling of protection from radiation risks in nuclear installations, and a higher perceived control of radiation by authorities.

145 Purvis-Roberts, Werner and Frank, above n 141.


Fukushima has also impacted the public perception of nuclear energy. Bird et al assessed Australian opinions of nuclear power in 2010 and again in 2012 following Fukushima.\textsuperscript{150} They found that following Fukushima, less Australians were willing to accept nuclear power as a form of energy and saw nuclear power as having more risks than benefits.

3 Economic Considerations

Economic factors also influence the ban. It can be argued that it makes economic sense to only export uranium oxide from the existing ports in Adelaide and Darwin. This is for two main reasons: (a) the availability of willing carriers; and (b) the nature of uranium as a low-volume export.

(a) Carriers

A major problem for the NFC is the availability of sea carriers willing to accept radioactive consignments.\textsuperscript{151} The World Nuclear Transport Institute (WNTI) explains:

Ocean carriers may reject carriage of radioactive materials outright, claiming that their hull insurance, or owner(s) prohibit such transport service. In cases where ocean carriers are willing to accept the cargo, there may be ports on the vessel rotation which refuse to accept such freight, or will only do so following time consuming permit procedures, virtually ensuring that the necessary authorisation will not be available by the time the shipment is scheduled to take place.\textsuperscript{152}

(b) Low-volume export

The use of Adelaide and Darwin ‘largely reflects the availability of commercially viable shipping lines for uranium given its low volume/high value nature and the relevant safety and security aspects of uranium transport’.\textsuperscript{153} In Queensland, it was recommended that if uranium mining commenced again in that State, that uranium should be exported through either Darwin or Adelaide because the amount of uranium that would be produced made it unlikely a new shipping route would be established

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\textsuperscript{151} World Nuclear Association, above n 1.


from a Queensland port.\textsuperscript{154} Queensland’s RAR is 40,000 tonnes,\textsuperscript{155} which represents about 4 per cent of Australia’s total RAR.\textsuperscript{156} This is a comparable volume to WA’s RAR representing 6 per cent of Australia’s RAR overall,\textsuperscript{157} and suggests that similar logic may be applied to WA ports.

\textit{(c) The future?}

These economic practicalities could easily shift. The Port of Darwin only services chartered shipments to China,\textsuperscript{158} and there have been difficulties since 2000 shipping uranium oxide from Adelaide because of cancellations in shipping services, extra charges, and competition for shipping services from other commodities.\textsuperscript{159} If Queensland also commences uranium oxide production, then there will be additional pressure on the existing ports. This may make a WA uranium export port viable.

E \textit{The Way Forward?}

The above factors indicate it is unlikely that uranium oxide will be exported from WA in the near future. However, if the ban were lifted, this thesis contends that Fremantle Port is well-placed to service uranium oxide exports under its current operating procedures. This is for three reasons.

First, Fremantle Port regularly handles tantalum glass.\textsuperscript{160} Tantalum glass is an LSA-I material under the International Regulations and Transport Code,\textsuperscript{161} the same classification as uranium oxide. It is also transported in the same manner, inside drums stowed in shipping containers.\textsuperscript{162}

\textsuperscript{154} Uranium Mining Implementation Committee, above n 153, 1–4, 4–19.
\textsuperscript{155} At less than US$130 per kilogram: ibid 2–3.
\textsuperscript{157} Ibid.
\textsuperscript{158} Uranium Mining Implementation Committee, above n 153, 3–19. Australia also supplies the USA, Japan, the Republic of Korea (South Korea), Taiwan, Canada, France, Germany, Sweden and Belgium: Vanessa Guthrie, Australian Uranium Industry (Presented at 7th Australia-China Bilateral Dialogue on Resource and Energy Cooperation, Perth, 6 February 2015) 8.
\textsuperscript{160} Fremantle Ports, Dangerous Cargoes Standard (February 2017) 37.
\textsuperscript{161} LSA stands for ‘low specific activity’. LSA-I is the least radioactive material regulated by the Regulations for the Safe Transport of Radioactive Material. See Chapter V.
Secondly, uranium oxide is regulated under the existing procedural framework. Owners of ‘dangerous things’ within Fremantle Port must comply with Australian Standard AS 3846 (AS 3846). AS 3846 outlines minimum safety requirements and technical guidance for the transport and handling of dangerous goods in port facilities. It applies to ‘dangerous cargoes’ which include those dangerous goods within the scope of the International Maritime Dangerous Goods Code (IMDG Code). The IMDG Code expressly regulates radioactive materials, with specific provisions based on the International Regulations.

Under AS 3846, freight containers brought into the port area must conform to the International Regulations’ requirements. Radioactive consignments will not be received into the port area more than 24 hours prior to shipment although LSA materials (including uranium oxide) can be held in the port’s restricted area for up to five days if permission is granted by the Fremantle Port Authority.

AS 3846 is implemented by Fremantle Port’s Dangerous Cargoes Standard (Fremantle Standard). In addition to the AS 3846 requirements, the Fremantle Standard requires advance notice of at least 48 hours before any dangerous cargoes are brought onto a berth. ‘High hazard dangerous cargoes’ (including radioactive materials) need permission to enter the port and must be obtained well in advance of this 48 hours.

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163 In general, dangerous goods in ports are regulated under Pt 8A of the Dangerous Goods Safety (Storage & Handling of Non-explosives) Regulations 2007 (WA). This replaced the Dangerous Goods Safety (Goods in Ports) Regulations 2007 (WA) which were repealed in 2014. These Regulations do not apply to Class 7 radioactive materials: see reg 8(5)(c). Consequently, Class 7 radioactive materials in WA ports are regulated under the Radiation Safety Act 1975 (WA) and any directions made by harbourmasters under s 105 of the Port Authorities Act 1999 (WA). Note that a port needs to be licensed to store radioactive materials under the Radiation Safety Act 1975 (WA).
165 Standards Australia, above n 164, cl 1.1. AS 3846 operates in conjunction with existing regulatory requirements: Standards Australia, above n 164, cl 1.2.
166 Ibid cl 1.4.20(d).
168 This is the 2009 version of the Regulations for the Safe Transport of Radioactive Material: ibid cl 1.5.1.1.
169 This is the 1996 version of the Regulations for the Safe Transport of Radioactive Material: Standards Australia, above n 164, cl 7.2. In any event, the 2005 International Regulations for the Safe Transport of Radioactive Material are enforced in WA through the Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA). See Chapters IV and V.
170 Standards Australia, above n 164, cl 7.4.1.
171 Fremantle Ports, above n 160, cl 2.1; Standards Australia, above n 164, s 5.
172 Fremantle Ports, above n 160, cl 2.2.
Finally, WA has existing emergency response arrangements in the case of a radiological emergency. The producer and transporter must have an Emergency Response Plan (EMP).¹⁷³ This is usually submitted to the Radiological Council as part of the Transport Management Plan.¹⁷⁴ The EMP outlines the procedures to manage any transport accidents involving uranium oxide – this generally includes a requirement that the driver will undertake appropriate training and will carry an emergency response kit to clean-up any spills.¹⁷⁵ Further, Fire and Emergency Services (FESA) will respond to an incident involving uranium oxide as they would for any other incident involving hazardous materials. These procedures are outlined in the *State Hazard Plan for Hazardous Materials Emergencies*.¹⁷⁶

The combination of these three factors demonstrates that Fremantle Port is well-situated to become a port of export for uranium oxide if the policy ban is lifted. AS 3846 and the Fremantle Standard are a complete procedural approach to the handling of uranium oxide in port areas. As AS 3846 is based on international best practice,¹⁷⁷ it is not recommended that these procedures be modified in any way.

F Concluding Remarks

Uranium oxide, like other radioactive materials and heavy metals, has risks associated with its transport which are well-managed under the International Regulations.¹⁷⁸ Despite this, negative public perceptions persist, influenced by misunderstandings of the actual risk posed by uranium oxide, negative media coverage, and nuclear disasters in recent memory.

In the short and medium term, it is unlikely that the policy will change. This is, in part, due to practical factors (eg the availability of carriers) and political factors (ie the new Labor government). While the ban remains in place, WA uranium oxide must be transported interstate for export. This has two main consequences. First, and ironically,
interstate transport increases the risk of a transport accident. Secondly, interstate transport exposes WA uranium producers to multiple regulatory regimes. This increases regulatory burden, time delays, and compliance costs. This is discussed in the next Chapter.
III AN OVERVIEW OF THE LEGISLATIVE SCHEME

A Introduction

Unlike other producing nations, there is no single national regulator to control all aspects of the NFC in Australia. As a result, the transport of uranium oxide in Australia is regulated by multiple agencies across numerous statutes and policies. WA uranium oxide will be transported across the border to either Port Adelaide or Port Darwin for export. Consequently, WA producers are exposed to more regulators than their NT and SA counterparts.

This chapter provides a broad overview of the legislative scheme applicable to the transport of uranium oxide through WA only. It outlines the division of power between the Commonwealth and WA and then examines the main legal areas of regulation: mining, radiation protection, environmental protection, non-proliferation, and export. Finally, this chapter highlights the practical consequences of this overlapping regime on WA producers. The radiation protection regime in the NT and SA is explored in Chapter IV.

B Division of Regulatory Power

To address why multiple regulators exist over uranium, one must identify who has the capacity to regulate uranium as a mineral. The State of WA owns all uranium deposits within its borders. For this reason, the State has a general power to regulate all aspects of the NFC within its borders under the ‘peace, order and good governance’ provision of the Constitution Act 1889 (WA). This power enables state environmental and radiation protection legislation.

The Commonwealth may only restrict this control through legislation enacted under one of the heads of power in s 51 of the Australian Constitution. There is no specific


180 See Chapter II.

181 Mining Act 1978 (WA) s 9(1)(b): minerals (aside from gold, silver and other precious metals) existing in their natural condition on or below the surface of any land that was not alienated in fee simple from the Crown before 1 January 1899 are the property of the Crown.


head of power under the *Australian Constitution* for mining, energy or transport. Instead, the Commonwealth has historically regulated uranium through the trade and commerce power, and the external affairs power. The trade and commerce power extends to ‘all matters which may affect beneficially or adversely the export trade of Australia in any commodity produced or manufactured in Australia’. Although the power is only used to control the *export* of uranium oxide from Australia, Carney believes the power is wide enough to regulate all aspects of uranium mining and transport because all Australian uranium is exported overseas.

The external affairs power enables the Commonwealth to enact legislation to give effect to any international legal obligation to which the government has agreed to be bound. The most salient example of this in the uranium context is the *Non-Proliferation (Safeguards) Act 1987* (Cth) (*NPS Act*) which gives effect to obligations incurred under the *Treaty on the Non-Proliferation of Nuclear Weapons*. Australia is also a state party to the *Statute of the International Atomic Energy Agency* (*IAEA Statute*). The IAEA is responsible for, among other things, nuclear safety and security, including the transport of radioactive materials. The Commonwealth may have scope to regulate the transport of uranium oxide because of its status as a signatory of the IAEA Statute, but this has yet to occur.

This chapter now turns to examine the main subject areas of regulation for uranium oxide transport. Before doing so, it is useful to address the provisions that govern the mining of uranium ore.

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184 *Australian Constitution* s 51(i).
185 Ibid s 51(xxix). The Commonwealth may also regulate uranium through the corporations power (*Australian Constitution* s 51(xx)) and the defence power (*Australian Constitution* s 51(vi) – see, eg, *Atomic Energy Act 1953* (Cth)). See also Carney, above n 182, 40.
187 The export of uranium is controlled under the *Customs Act 1901* (Cth) and *Customs (Prohibited Exports Regulations 1958* (Cth). This legislation is explained later in this Chapter.
188 Carney, above n 182, 239.
189 *Commonwealth v Tasmania* (‘Tasmanian Dam Case’) (1983) 158 CLR 1, 170–8 (Murphy J), 222 (Brennan J).
192 The role of the IAEA is discussed further in Chapter V.
193 See Carney, above n 182, 340.
194 The extension of the use of these heads of power may be a solution to the existing regulatory overlap. This is not discussed in this thesis. Instead, Chapter VI looks to cooperative solutions for reform.
Uranium mining is governed by the *Mining Act 1978* (WA), but there are no special provisions targeting uranium.\(^{195}\) However, Hunt observes that it is more difficult to obtain the approvals for uranium mining as opposed to other minerals because of the number of agencies involved in the process. He estimates that 38 separate approvals across 12 separate pieces of legislation and 11 agencies are required before mine construction can commence.\(^{196}\) These include the approvals discussed later in this chapter, as well as native title agreements, water use agreements, and the mining lease itself. The most important approvals for transport obtained at the mine development stage are for radiation protection and environmental protection.\(^{197}\)

### C Applicable Laws for the Transport of Uranium Oxide

The regulation of uranium oxide transport falls under five broad legal areas. These are:
1. radiation protection;
2. environmental protection;
3. dangerous goods;
4. non-proliferation; and
5. exports.

Each of these is now discussed.

#### 1 Radiation Protection

The main act governing radiation safety in WA is the *Radiation Safety Act 1975* (WA) (RSA). Regulations made under the RSA include the *Radiation Safety (General) Regulations 1983* (WA) (*WA General Regulations*) and the *Radiation Safety (Transport of Radioactive Substances) Regulations 2002* (WA) (*WA Transport Regulations*).\(^{198}\)

The RSA establishes the Radiological Council.\(^{199}\) The Radiological Council is responsible for the administration of the RSA, including its licensing provisions.\(^{200}\) Briefly, any person who wishes to deal with a radioactive substance must do so under

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\(^{196}\) Ibid.

\(^{197}\) There are also specific radiation protection measures for mines enforced under the *Mines Safety and Inspection Regulations 1995* (WA) pt 16. These are enforced by the Department of Mines and Petroleum, whereas responsibility for the transport of radioactive substances rests with the Radiological Council. See Memorandum of Understanding in Relation to the regulation of Radiation Safety for Mining Operations between the Department of Mines and Petroleum and the Radiological Council in Western Australia (December 2012) cl 1.

\(^{198}\) The other regulations made under the RSA are the *Radiation Safety (Qualifications) Regulations 1980* (WA). This provides that a person may not use, install or repair x-ray or irradiating apparatus without first having passed a radiation safety examination approved by the Radiological Council.

\(^{199}\) *Radiation Safety Act 1975* (WA) pt II.

\(^{200}\) Ibid s 10(2).
a licence.\textsuperscript{201} If a material is a ‘radioactive substance’ within the meaning of the RSA,\textsuperscript{202} then the transport of that material is regulated under the WA Transport Regulations.\textsuperscript{203} The WA Transport Regulations adopt the 2008 version of the Transport Code, based on the 2005 version of the International Regulations. The provisions of the RSA and Transport Code are considered further in Chapters IV and V.

2 Environmental Protection

(a) Western Australia

The transport routes and transport procedures for uranium oxide are relevant to the environmental assessment of a uranium mine. In WA, ‘significant proposals’ are referred to the EPA for assessment under the \textit{Environmental Protection Act 1986} (WA) (\textit{EP Act}). A ‘significant proposal’ is a proposal likely, if implemented, to have a significant impact on the environment.\textsuperscript{204} The EPA decides whether to assess the proposal, and if so, sets a level of assessment as either ‘assessment on proponent information’ or ‘public environmental review’ (\textit{PER}). \textit{PER} is the more stringent standard. The four major uranium projects in WA (see Table 4) were subject to a \textit{PER}.\textsuperscript{205}

The EPA then assesses the proposal and reports on key environmental factors to the Minister.\textsuperscript{206} Relevantly, under the WA Transport Regulations, a carrier must prepare a Radiation Protection Programme (\textit{RPP}) which is assessed by the Radiological Council and ASNO.\textsuperscript{207} The RPP is considered by the \textit{PER} because it addresses two key environmental factors: air quality and human health.\textsuperscript{208}

\textsuperscript{201} A person who operates, uses, manufactures, stores, transports, sells, possesses, installs, services, maintains, repairs or otherwise deals with any radioactive substance, irradiating apparatus or electronic product must hold a licence: ibid s 25(1).
\textsuperscript{202} ‘Radioactive substance’ is defined widely: \textit{Radiation Safety Act 1975} (WA) s 4 (definition of ‘radioactive substance’). The definition is provided in full and explained in Chapter IV.
\textsuperscript{203} \textit{Radiation Safety (Transport of Radioactive Substances) Regulations 2002} (WA) reg 3.
\textsuperscript{204} \textit{Environmental Protection Act 1986} (WA) s 38(1). The Minister may also refer a proposal to the EPA if it appears that there is public concern about the likely effect of the proposal, if implemented, on the environment: \textit{Environmental Protection Act 1986} (WA) s 37B(1).
\textsuperscript{206} \textit{Environmental Protection Act 1986} (WA) s 44.
\textsuperscript{207} \textit{Radiation Safety (Transport of Radioactive Substances) Regulations 2002} (WA) reg 5(1); Department of Mines and Petroleum, above n 173, 18. The RPP is also called a ‘Transport Management Plan’ (\textit{TMP}). See page 27.
\textsuperscript{208} There are 14 key environmental factors identified by the EPA for consideration. These are listed in Appendix C.
Air quality is addressed because of the risk that uranium dust may be released along transport routes during an accident, whereas human health specifically addresses the impact of radiation. In assessing human health, the EPA defers to the expert advice and technical documents produced by the Radiological Council, ARPANSA, and international organisations such as the ICRP. Consequently, an approved RPP is commonly accepted as evidence that the radiation risk posed by the transport of uranium oxide from a mining project is adequately managed.

(b) Commonwealth

The Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) enables the Commonwealth to regulate the mining, use and disposal of uranium in Australia. The Commonwealth must assess any ‘nuclear action’ that has, will have, or is likely to have a significant impact on the environment. Identified nuclear actions includes the transport of radioactive waste products and the mining and milling of uranium ore. The transport of uranium ore or oxide is not identified as a nuclear action. Consequently, the EPBC Act does not specifically govern the transport of uranium oxide.

3 A Note on Dangerous Goods

Radioactive materials (including uranium oxide) are classified as Class 7 dangerous goods under the international dangerous goods scheme. In WA, the Department of

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209 See, eg, Environ Australia Pty Ltd, above n 205. 48. Note that the risk from uranium dust was considered in Chapter II.
210 Environmental Protection Authority, Environmental Factor Guideline: Human Health (December 2016) 2.
211 Ibid 2.
212 See, eg, Environmental Protection Authority, Report and Recommendations of the Environmental Protection Authority: Mulga Rock Uranium Project (Report No 1576, August 2016) 5.
213 Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 21. Only specific people and agencies must not take these nuclear actions – these include constitutional corporations, the Commonwealth, and Commonwealth agencies: see Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 21(1)–(3).
214 Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 22(1)(b), (d).
215 In any event, because of a bilateral agreement between the Commonwealth and Western Australia, the EPA’s assessment would be considered in the place of a separate federal review. A bilateral agreement between Western Australia and the Commonwealth was made in 2014 pursuant to Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 45. This means the Commonwealth can rely on the EPA’s environmental assessments when made at the Public Environmental Review level for its own approval decisions. See Bilateral Agreement Made Under Section 45 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) Relating to Environmental Assessment (Commonwealth of Australian and Western Australia) executed 3 October 2014.
Mines and Petroleum (DMP) administers the Dangerous Goods Safety Act 2004 (WA) (DGS Act). In particular, the road transport of dangerous goods is regulated by the Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 (WA) (DG Transport Regulations). The DG Transport Regulations implement the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). This is a national code given force by legislation in each State and Territory. The DG Transport Regulations implement mutual recognition provisions that harmonise the licensing requirements under the dangerous goods scheme across Australia.

Oddly, neither the DGS Act nor the ADG Code regulate the transport Class 7 materials unless that material is transported with another dangerous good. Instead, the DGS Act and the ADG Code defer to the Transport Code and International Regulations. In WA, Class 7 materials are regulated generally under the RSA.

4 Non-Proliferation

Once the uranium producer obtains state-based approvals, they must then approach the Commonwealth for separate permits from ASNO and the Department of Industry, Innovation and Science (DIIS).

ASNO administers the NPS Act as well as Australia’s general uranium export policy. Australian uranium may only be exported for ‘peaceful non-explosive purposes under Australia’s network of bilateral nuclear cooperation agreements’. Part II of the NPS Act outlines the different permits in operation to prevent the proliferation of nuclear material. Relevantly for the transport of uranium oxide,

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218 See Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007 (WA) pt 19.
219 Dangerous Goods Safety Act 2004 (WA) s 3(1); Dangerous Goods Safety (General) Regulations 2007 (WA) reg 4(4); National Transport Commission, Australian Code for the Transport of Dangerous Goods by Road and Rail (7.5 ed, 2017) xxv, 41, 43, 139. For a list of the classes and divisions of dangerous goods regulated by the ADG Code, see Appendix E.
222 Non-Proliferation (Safeguards) Act 1987 (Cth) ss 9, 11. The definition of ‘nuclear material’ includes uranium oxide: Non-Proliferation (Safeguards) Act 1987 (Cth) s 4(1), sch 3 art 99; Statute of
these include a permit to possess nuclear material and a permit to possess nuclear material for the purpose of transport. Both permits are issued subject to conditions. The permits may also require the producer to include a clause in commercial contracts that states the contract is subject to the relevant bilateral agreement.

5 Exports

Once the ASNO permits are obtained, a uranium producer will discuss their export proposal with DIIS. Uranium cannot be exported from Australia unless permission in writing has been granted by the relevant Minister. This permit is called a Mineral Export Permit. The Mineral Export Permit is usually granted for 10 years at a time, but additional approval is required for every individual shipment of uranium oxide.

D Practical Effects of the Legislative Scheme

The timeline for obtaining transport permits for uranium can be thought of in terms of the domino effect. The Mineral Export Permit considers the ANSO permits, which considers the other permits granted in WA. The analysis of the human health and air quality factors by the EPA depends on the RPP assessed by the Radiological Council and ASNO.

Practically, the process to obtain permits for transport ceases if the producer falls at any of these approval hurdles. If this occurs, the overall time to complete the approvals process is extended, impacting the time it takes to deliver the uranium oxide to overseas consumers. Table 6 outlines the estimated time taken to process and approve these licenses and permits at the WA and Commonwealth levels (assuming no
additional information is required by the regulator and no appeals are undertaken). WA uranium producers face an initial approval process of approximately 2 ½ years. This does not include the additional permits required by the NT or SA.

Table 6: Estimated approval times for transport-related uranium oxide permit/approvals

<table>
<thead>
<tr>
<th>Approval/permit type</th>
<th>Agency/Department</th>
<th>Estimated time of approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licence to deal with radioactive substances</td>
<td>Radiological Council</td>
<td>21 days</td>
</tr>
<tr>
<td>Radiation Management Plan (or RPP)</td>
<td></td>
<td>30 days</td>
</tr>
<tr>
<td>Environmental approval under EP Act</td>
<td>EPA</td>
<td>Minimum 46–61 weeks – Preparation of the Environmental Review Document for PER by the proponent may take an additional 12 months</td>
</tr>
<tr>
<td>Environmental approval under EPBC Act</td>
<td>Department of the Environment and Energy</td>
<td>20 days (decision to assess) – 30 days (assessment under bilateral agreement after receiving assessment report)</td>
</tr>
<tr>
<td>Permit to possess nuclear material</td>
<td>ASNO</td>
<td>42 days</td>
</tr>
<tr>
<td>Permit to transport nuclear material</td>
<td></td>
<td>14 days</td>
</tr>
<tr>
<td>Mineral Export Permit</td>
<td>DIIS</td>
<td>60 days</td>
</tr>
</tbody>
</table>

These licences and permits are not granted for an indefinite period or even the life of the project. A producer must renew the licence or permit when it expires. If there is a delay in reissuing the approval, the shipment of uranium oxide overseas is also delayed. A licence under the RSA is issued for one to three years. Any amendments to the RPP must also be approved by the Radiological Council and ASNO. Further,

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231 Unless otherwise indicated, this Table’s information is extracted from Department of Mines and Petroleum, Uranium Approvals Spreadsheet (18 February 2016) <http://www.dmp.wa.gov.au/Documents/Community-Education/Uranium-Approvals.xlsx>.
232 Note that the Radiological Council only convenes once every month: Radiological Council, Members of the Radiological Council (23 August 2013) <http://www.radiologicalcouncil.wa.gov.au/Pages/CouncilMembers.html>. See also Radiation Safety Act 1975 (WA) s 16(7): ‘the Council shall hold meetings at such times and places as the Council determines’.
233 Environmental Protection Authority, Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2016 (December 2016, ver 1.1) 46. See Appendix D for a breakdown of the timeline in the EPA’s environmental impact assessment.
234 Department of Mines and Petroleum, Uranium Approvals Spreadsheet, above n 231.
235 Environment Protection and Biodiversity Conservation Act 1999 (Cth) s 75(5).
236 Ibid s 130(1B)(a).
237 Radiation Safety Act 1975 (WA) s 37(1).
238 Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) reg 5(1)(b); Australian Safeguards and Non-Proliferation Office, Form ASO113: Application to Approve a New (or a Variation to a Current) Transport Plan (21 January 2011) (Form ASO113). The Radiological Council and ASNO do not state how long this approval process takes. However, ASNO must receive
DIIS requires approval for every individual shipment of uranium oxide.\textsuperscript{239} Approximately 50 shipments occur each year between the four operating uranium mines in Australia.\textsuperscript{240} On average, this means that each producer obtains 12 individual approvals for shipments from DIIS annually.

Another practical factor to consider is the cost of each permit. Some costs are directly quantifiable. For instance, the annual fee for a licence to deal with radioactive substances is $70 and the triennial fee is $140.\textsuperscript{241} Further, the base cost of environment assessment is estimated at $18,146.\textsuperscript{242} Overall, these costs are huge. For instance, Vimy Resources reported in their 2016 Annual Report that they had drawdown $7.5 million to maintain the progress on the Definitive Feasibility Study on Mulga Rock.\textsuperscript{243} These are examples of recurring and one-off compliance costs.\textsuperscript{244} Other costs to producers may include administrative costs (ie complying with licence conditions), training and education costs to workers and commercial losses (eg if a shipment is delayed because a permit has not been obtained).\textsuperscript{245}

\section*{E Concluding Remarks}

The legislative scheme governing the transport of uranium oxide is complex. An Australian producer must obtain approval from not just one, but at least five separate agencies in relation to transport alone. These agencies may issue multiple permits (as demonstrated by ASNO and DIIS) which are accompanied by additional costs, timeframes and compliance obligations. These factors contribute to the regulatory and cost burden facing uranium producers Australia-wide.

WA producers find themselves in a much more diabolical position than their interstate counterparts. This is because they must also contend with the regulatory regimes of

\begin{thebibliography}{99}
\bibitem{239} Uranium Industry and Nuclear Section, above n 227, 2.
\bibitem{241} \textit{Radiation Safety (General) Regulations 1983} (WA) sch XV pt 1 item 4(1).
\bibitem{243} A Definitive Feasibility Study assesses whether the uranium can be mined economically and is included as part of the environmental impact assessment: Vimy Resources Limited, \textit{Annual Report 2016}, 68.
\bibitem{244} Deloitte, above n 51, 79.
\bibitem{245} Ibid; Uranium Mining, Processing and Nuclear Energy Review, above n 120, 29.
\end{thebibliography}
either SA or the NT to get the uranium oxide to export. The resultant issues facing WA producers are considered in the following chapter.
IV A COMPARISON OF THE RADIATION PROTECTION LEGISLATION OF THE NORTHERN TERRITORY, SOUTH AUSTRALIA AND WESTERN AUSTRALIA

A Introduction

The previous chapter outlined the complex legislative scheme for the transport of uranium oxide at the WA and Commonwealth levels. It introduced the RSA and its subordinate legislation governing radiation protection and radioactive materials transport in WA. WA uranium oxide must travel interstate for export. This means WA producers are also subject to the radiation protection legislation in the NT or SA. This chapter introduces the radiation protection schemes of the NT, SA and WA. It first outlines previous attempts to achieve national uniformity in radiation protection. It then explores inconsistency between the three jurisdictions by exploring definitions, licensing, reporting, carrier and consignor obligations, and penalties.

Several Acts and Regulations are repeatedly referred to in this chapter. These are abbreviated in Table 7 for ease of reference.

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Act/Regulation</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Territory</td>
<td>Radioactive Ores and Concentrates (Packaging and Transport) Act 1980</td>
<td>NT Act</td>
</tr>
<tr>
<td></td>
<td>Radioactive Ores and Concentrates (Packaging and Transport) Regulations 1980</td>
<td>NT Regulations</td>
</tr>
<tr>
<td>South Australia</td>
<td>Radiation Protection and Control Act 1982</td>
<td>SA Act</td>
</tr>
<tr>
<td></td>
<td>Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003</td>
<td>SA Transport Regulations</td>
</tr>
<tr>
<td></td>
<td>Radiation Protection and Control (Ionising Radiation) Regulations 2000</td>
<td>SA General Regulations</td>
</tr>
<tr>
<td>Western Australia</td>
<td>Radiation Safety Act 1975</td>
<td>RSA</td>
</tr>
<tr>
<td></td>
<td>Radiation Safety (Transport of Radioactive Substances) Regulations 2002</td>
<td>WA Transport Regulations</td>
</tr>
<tr>
<td></td>
<td>Radiation Safety (General) Regulations 1983</td>
<td>WA General Regulations</td>
</tr>
</tbody>
</table>

B Australian Attempts to Achieve Uniformity in Radiation Protection Laws

The transport of radioactive materials warrants special regulation because of the risk posed to human health and safety.246 It is regulated under public health law, and more specifically, radiation protection laws, because of that special risk. The States have legislative responsibility for the majority of public health issues including radiation.247

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Consequently, 11 ‘competent authorities’ regulate radiation protection and the transport of radioactive materials across Australia (see Table 8).

Table 8: Australian Competent Authorities for Radioactive Materials Transport

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Competent Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commonwealth</td>
<td>ARPANSA</td>
</tr>
<tr>
<td>Australian Capital</td>
<td>ACT Radiation Council – ACT Health Directorate</td>
</tr>
<tr>
<td>ACT</td>
<td>Environment Protection Authority</td>
</tr>
<tr>
<td>New South Wales</td>
<td>Work Health Authority – Department of Business <em>(for the transport of radioactive ores and concentrates)</em></td>
</tr>
<tr>
<td></td>
<td>Department of Health (other radioactive materials)</td>
</tr>
<tr>
<td>Northern Territory</td>
<td>Work Health Authority – Department of Business (for the transport of radioactive ores and concentrates)</td>
</tr>
<tr>
<td></td>
<td>Department of Health (other radioactive materials)</td>
</tr>
<tr>
<td>Queensland</td>
<td>Department of Health</td>
</tr>
<tr>
<td>South Australia</td>
<td>Minister for Sustainability, Environment and Conservation – Environment Protection Authority</td>
</tr>
<tr>
<td>Tasmania</td>
<td>Director of Public Health – Department of Health and Human Services</td>
</tr>
<tr>
<td>Victoria</td>
<td>Secretary, Department of Health</td>
</tr>
<tr>
<td>Western Australia</td>
<td>Radiological Council</td>
</tr>
<tr>
<td>Air</td>
<td>Civil Aviation Safety Authority <em>(CASA)</em></td>
</tr>
<tr>
<td>Sea</td>
<td>Australian Maritime Safety Authority <em>(AMSA)</em></td>
</tr>
</tbody>
</table>

Various attempts have been made since the 1950s to achieve uniformity in radiation protection laws.248 Two recent important developments are the establishment of the ARPANSA and the development of the *National Directory for Radiation Protection* *(NDRP)*.

1 ARPANSA

ARPANSA was established in 1998 by the *Australian Radiation Protection and Nuclear Safety Act 1998* *(Cth)* *(ARPANS Act)*. Prior to this enactment, the use of ionising radiation in Commonwealth facilities was unregulated.249 The ARPANS Act tasks the ARPANSA CEO with promoting uniformity in radiation protection and nuclear safety policy across Australia.250 It also establishes the Radiation Health and Safety Advisory Council *(RHSAC)*,251 Radiation Health Committee *(RHC)*,252 and Nuclear Safety Committee *(NSC)*.253 In particular, the RHC is responsible for

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248 Bidmeade and Reynolds, above n 247, 64.
251 Ibid ss 19–21.
252 Ibid ss 22–24.
253 Ibid ss 25–27.
developing policies and publications to promote uniform national standards for radiation protection.\textsuperscript{254}

2 \textit{National Directory for Radiation Protection}

The RHC developed the NDRP following endorsement in 1999 by the Australian Health Ministers’ Conference. The NDRP has been amended six times since its initial publication in 2004. The NDRP is a broad document that aims to ‘provide an overall agreed framework for radiation safety … together with clear regulatory statements to be adopted by the Commonwealth, States and Territories’.\textsuperscript{255} It outlines agreed principles for radiation protection,\textsuperscript{256} uniform regulatory elements,\textsuperscript{257} and guidelines for best practice.\textsuperscript{258}

The NDRP is not template or model legislation – this option was rejected by the RHC because there was no evidence that legislative inconsistency negatively affected human health or the environment.\textsuperscript{259} Instead, the NDRP is a \textit{guiding framework}. Consequently, inconsistent legislative provisions for radiation protection have developed in each jurisdiction. It is telling that not even the NDRP’s primary objective is uniformly implemented in each jurisdiction. All radiation protection legislation must promote the protection of the health and safety of people and the environment from the harmful effects of ionising and non-ionising radiation.\textsuperscript{260} But between the NT, SA and WA, this objective is only expressly included in the SA Act.\textsuperscript{261} A consistent objective is important because the ‘effectiveness of all other provisions in the legislation and the feasibility of policy options for radiation safety administration will be judged against [it].’\textsuperscript{262}

\begin{thebibliography}{99}
\item 254 Ibid s 23(1)(b).
\item 256 National Directory for Radiation Protection, above n 255, Part A.
\item 257 Ibid Part B.
\item 258 Ibid Part C.
\item 259 Although it was recognised that the current legislative scheme was administratively inefficient. However, ARPANSA believes the NDRP is a stepping stone to template or mirror legislation and must be given time to develop: ARPANSA Competition Review, above n 246, 38–9.
\item 260 National Directory for Radiation Protection, above n 255, cl 2.1.
\item 261 \textit{Radiation Protection and Control Act 1982} (SA) s 23(1). But see \textit{Radiation Protection Act 2004} (NT) s 3 and \textit{Radiation Safety Act 1975} (WA) s 10(1).
\item 262 ARPANSA Competition Review, above n 246, 18.
\end{thebibliography}
The remainder of this Chapter will compare the main provisions of the radiation protection legislation in the NT, SA and WA.

C Comparing Radiation Protection Legislation

ARPANSA and the NDRP can only promote national uniformity for radiation protection; the actual regulation and enforcement is the responsibility of individual states and territories. The freedom to legislate is broad in the absence of model legislation or binding principles. Consequently, WA producers must comply with different requirements across jurisdictions when transporting uranium oxide for export.

This part examines six major areas encompassed by the radiation protection legislation of the NT, SA and WA. These are: (1) definitions; (2) licensing; (3) dose limits; (4) reporting; (5) carrier and consignor obligations; and (6) criminal penalties. The consistency of the legislation and any problems arising from inconsistency is assessed.

1 Definitions

(a) Legislative Provisions

Varying definitions are confusing and impose additional costs on businesses working across jurisdictions. Before assessing other areas of inconsistency in the legislation, it is helpful to first examine how each jurisdiction defines ‘radioactive material’ or ‘radioactive substance’ (and by extension, uranium oxide). As a baseline, the NDRP defines ‘radioactive material’ as any material that emits ionising radiation spontaneously.

In WA, there is a single broad definition of ‘radioactive substance’:

Radioactive substance means any substances, whether natural or artificial, and whether in the form of a solid, a liquid, a gas, or a vapour, or any compound or mixture, including any article that has been manufactured or subjected to any artificial treatment or process, which consists of or contains more than the maximum

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263 Productivity Commission, Identifying and Evaluating Regulation Reforms (Research Report, December 2011, Commonwealth of Australia) 14, appendix F.

264 The terms ‘radioactive material’ and ‘radioactive substance’ are used interchangeably between the radiation protection legislation of the NT, SA and WA.

265 National Directory for Radiation Protection, above n 255, Glossary. Radioactive material is exempted from this definition where is has an activity concentration less than the prescribed amount or an activity concentration greater than the prescribed amount but causes an annual effective dose to an individual member of the public of less than 10 μSv: NDRP cl 3.2.2. The prescribed activity concentration for natural uranium is one Bq per gram: NDRP sch 4.
prescribed concentration of any radioactive element, whether natural or artificial.\textsuperscript{266}

Relevantly, a natural radioactive substance of an equivalent specific radioactivity not exceeding 0.03 MQB/kg or a quantity of natural uranium not exceeding 4.0 MBq are exempt from the definition.\textsuperscript{267}

In SA, a radioactive substance is:

A substance occurring naturally or artificially produced (whether solid, liquid or gaseous) which consists of or contains any radioactive element or compound whether natural or artificial and includes any device or thing that contains such a substance.\textsuperscript{268}

This definition is similar to WA’s, but does not reference vapours or mixtures. This is significant for the legislation’s scope because vapours are distinct from gases, and mixtures are distinct from compounds.\textsuperscript{269} In any event, ‘radioactive ore’ is defined separately as an ‘ore or mineral containing more than the prescribed concentrations of a radioactive element or compound.’\textsuperscript{270} The prescribed concentration is 35 kBq/kg.\textsuperscript{271}

The NT’s definitions are straightforward. This is because radiation protection laws are separated into two Acts. The NT Act governs the packaging and transport of radioactive ores and concentrates, whereas the Radiation Protection Act 2004 (NT) applies to all other radioactive materials.\textsuperscript{272} The NT Act defines ‘radioactive material’ as ‘uranium ores and concentrates, uranium oxide (U\textsubscript{3}O\textsubscript{8}) and any other prescribed radioactive ore and concentrate with a specific activity greater than 0.002 microcuries per gram’.\textsuperscript{273} The NT Act does not apply to radioactive material with a total measured dose rate less than 0.75 millirem per hour.\textsuperscript{274}

\textsuperscript{266} Radiation Safety Act 1974 (WA) s 4 (emphasis added).
\textsuperscript{267} Radiation Safety (General) Regulations 1983 (WA) reg 5(1)(a), (b).
\textsuperscript{268} Radiation Protection and Control Act 1982 (SA) s 5.
\textsuperscript{269} A mixture refers to two distinct chemical substances, whereas a compound is formed by a chemical reaction and cannot be separated by physical means: John Daintith (ed), \textit{A Dictionary of Chemistry} (Oxford University Press, 6th ed, 2008).
\textsuperscript{270} Radiation Protection and Control Act 1982 (SA) s 5.
\textsuperscript{271} Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA) reg 6. The radioactive ore must also have a total activity more than or equal to one, calculated using a specific formula set out in Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA) reg 6. This total activity is dependent on the unique characteristics of the material being measured at the time.
\textsuperscript{272} Radiation Protection Act 2004 (NT) s 9. The Radiation Protection Act 2004 (NT) s 6(3) defines radioactive material as material that (a) spontaneously emits ionising radiation as a consequence of nuclear transformations; and (b) has or exceeds the activity or activity concentration prescribed by the Regulations.
\textsuperscript{273} Radioactive Ores and Concentrates (Packaging and Transport) Act 1980 (NT) s 3.
\textsuperscript{274} Ibid s 4(2). This is measured at one metre. The radioactive material must also have parent radionuclide activity of less than 2.4 x 10\textsuperscript{-4} curie.
(b) Commentary

There is little consistency between the different Acts. The NT Act is most similar to the NDRP definition because it exempts material based on both activity and exposure rates,\(^{275}\) whereas SA and WA calculate exemptions based solely on activity. The NDRP definition (and therefore the NT Act definition) is preferred because the NDRP was developed by the RHC (comprised of representatives from each jurisdiction) operating under ARPANSA and approved by the Australian Health Ministers.\(^{276}\) It also reflects international best practice.\(^{277}\)

However, the NT Act is not perfect. It uses the outdated measurements of ‘rem’ and ‘curie’ which have been replaced by the Sievert and Becquerel respectively under the International System of Units (SI).\(^{278}\) Australia has adopted the SI measurements as legal units of measurement,\(^{279}\) consistently with international organisations the IAEA, ICRP and the International Commission on Radiation Units and Measurements (ICRU)\(^{280}\) In fact, the ICRU recommended that the rem and curie be abandoned in 1975 in favour of the SI system.\(^{281}\) In practice, SI units must be converted into rem and curie for the NT Act to make sense. Conversion is not ideal because calculation mistakes can occur, especially when each container and drum will have its own unique level of activity. Further, the SI units are used by the International Regulations and Transport Code.

In any event, there is no consistency between converted exemption levels in each jurisdiction (see Table 9). Consequently, a material may be regulated in one jurisdiction, but excluded in another. Despite this, it is unlikely that a uranium oxide consignment will ever be exempt under these definitions, as a single drum has a contained activity of 10,000 MBq.\(^{282}\) However, a uranium producer is still required to

\(^{275}\) See 44 n 266.
\(^{277}\) See, eg, Valentin, above n 39.
\(^{279}\) See National Measurement Act 1960 (Cth) and National Measurement Regulations 1999 (Cth) sch 1 pt 4.
\(^{282}\) Ibid; Uranium Council, Guide to Safe Transport of Uranium Oxide Concentrate (Department of Resources, Energy and Tourism, 2012) 14. See Table 3 in Chapter II.
calculate the maximum activity of the radioactive material (eg for transport documentation),\textsuperscript{283} and if crossing into NT, convert that into rem and curie. These inconsistencies demonstrate, at a threshold level, the hurdles facing WA producers.

*Table 9: Exemption levels based on activity rates*\textsuperscript{284}

<table>
<thead>
<tr>
<th>Activity</th>
<th>Northern Territory</th>
<th>South Australia</th>
<th>Western Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion to MBq</td>
<td>0.888 MBq</td>
<td>0.035 MBq</td>
<td>0.03 MBq</td>
</tr>
</tbody>
</table>

2. **Licensing**

A licence must be obtained for ‘radioactive material’ caught by the radiation protection legislation in each jurisdiction.\textsuperscript{285} The NDRP requires that a responsible person who seeks to possess or be in control of a radiation source must hold an authorisation to possess issued by the competent authority.\textsuperscript{286} This is the extent of the requirement – the States and Territories otherwise have complete freedom to legislate the licence process and licence conditions.

(a) **Western Australia**

The scope for licensing in WA is very broad:

Unless he does so under, and in accordance with any conditions, restrictions or limitations imposed in relation to, a licence under this Act of which he is the holder or by virtue of which he is acting under the direction and supervision of the holder, and which authorises him so to do, a person who operates or uses, or manufactures, stores, transports, sells, possesses, installs, services, maintains, repairs, or otherwise deals with any radioactive substance, irradiating apparatus or electronic product where no exemption granted pursuant to this Act applies, commits an offence.\textsuperscript{287}

Two types of licenses are issued under the RSA. The first are licenses authorising people to operate or use radioactive substances, irradiating apparatus or electronic products for a specified purpose (such as medical diagnosis).\textsuperscript{288} The second are


\textsuperscript{284} Uranium Council Transport Working Group, above n 90, 14.

\textsuperscript{285} The producer should also have permits to possess and transport nuclear material from ASNO and a Mineral Export Permit from DIIS: see Chapter III.

\textsuperscript{286} National Directory for Radiation Protection, above n 255, cl 4.1.

\textsuperscript{287} Radiation Safety Act 1975 (WA) s 25(1) (emphasis added).

\textsuperscript{288} Ibid s 26(1)(a).
licences authorising people to deal with radioactive substances in other ways, including transport.\footnote{289}{Ibid s 26(1)(b).} The licence is issued to a natural person because the proposed licensee must undertake and pass a recognised training course and examination in radioactive materials transport.\footnote{290}{Radiological Council, \textit{Transport of Radioactive Substances} (2012) <http://www.radiologicalcouncil.wa.gov.au/Pages/Transport.html>; Radiological Council, \textit{Radiation Safety Act – First Application for a Licence / Exemption from Licence – Radioactive Substances} <http://www.radiologicalcouncil.wa.gov.au/PDF/forms/LS%20package.pdf>.} However, a person ‘acting under the direction and supervision’ of the licensee is also authorised to deal with the material.\footnote{291}{Ibid s 25(1).} The licensee must provide an appropriate level of direction and supervision,\footnote{292}{Ibid. Regulations may specify the requisite degree of direction and supervision that is required in the circumstance: ibid s 25(2). See, eg, \textit{Radiation Safety (General) Regulations 1983} (WA) regs 17(4), 23(4)(a), 27(1), (5), 28(2).} and ensure their workers are familiar with the regulations and basic radiation safety practices.\footnote{293}{Radiological Council, \textit{Transport of Radioactive Substances}, above n 290.}

The licence may relate to several matters,\footnote{294}{Radiation Safety Act 1975 (WA) s 26(3).} so a licence for transport may also authorise possession and storage.\footnote{295}{Ibid ss 12(1), 13(a), sch (Form 1).} However, a transport company (through its proposed licensee) must obtain a separate licence.\footnote{296}{Ibid.} Individual drivers do not have to obtain separate licences to transport uranium oxide because they act under the direction and supervision of the transporter’s licensee.

\textit{(b) Northern Territory}

The NT’s licensing scheme is straightforward. The owner of the material, who intends to transport radioactive materials, or their agent,\footnote{297}{The owner cannot transport or cause or allow the transport of radioactive materials unless he has an agent who is a natural person resident in the Northern Territory and employed by the owner: \textit{Radioactive Ores and Concentrates (Packaging and Transport) Act 1980} (NT) 9(1).} applies in the prescribed form for the grant of a licence.\footnote{298}{Ibid ss 12(1), 13(a), sch (Form 1).} The transporter and its drivers do not need to apply for a separate licence because the licence conditions will specify who will transport the material.\footnote{299}{Ibid s 14(2)(b).}
(c) South Australia

The SA Act has multiple licence provisions (see Table 10). There is no specific licence for the transport of radioactive substances under this scheme. Instead, conditions for transport are usually included in a producer’s mining licence (s 24) or facilities licence (s 29A). This is obviously not applicable to WA producers because their mines do not operate in SA.

Table 10: Main licence provisions under the SA Act

<table>
<thead>
<tr>
<th>SA Act provision</th>
<th>Licence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>23A</td>
<td>Licence to test for developmental purposes</td>
<td>Developmental testing operations in mining or mineral processing</td>
</tr>
<tr>
<td>24</td>
<td>Licence to carry out mining or mineral processing</td>
<td>Operations for or in relation to mining or mineral processing</td>
</tr>
<tr>
<td>28</td>
<td>Licence to use or handle radioactive substances</td>
<td>Natural persons using or handling radioactive substances</td>
</tr>
<tr>
<td>29A</td>
<td>Facilities licence</td>
<td>Facilities where a radiation source is produced, used, stored etc</td>
</tr>
<tr>
<td>33A</td>
<td>Licence to possess a radiation source</td>
<td>Persons in possession of a radiation source</td>
</tr>
</tbody>
</table>

On its face, the licence to use or handle radioactive substances under SA Act s 28 seems applicable. However, that licence only applies to natural persons and excludes members of the public who handle radioactive substances packaged for transport.

Instead, the transporter must obtain a licence under s 33A to possess a radiation source. The meaning of ‘possession’ causes some difficulties. Practically, if a producer has contracted a separate transport company to transport uranium oxide from the mine to port, then it is the transport company that is in possession and would require the licence. The SA Act does not define ‘possession’ and the Second Reading Speech provides no further insight. However, the SA Act is currently under review. The draft Bill provides that a person has possession of a radioactive source where it is

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300 Radiation Protection and Control Act 1982 (SA) s 28(1).
301 Radiation Protection and Control (Ionising Radiation) Regulations 2013 reg 124(b)(v).
302 Radiation Protection and Control Act 1982 (SA) s 33A(1). ‘Radiation source’ includes an unsealed radioactive source (which is a radioactive substance that is not a sealed radioactive source): Radiation Protection and Control Act 1982 (SA) s 5. Under this definition, uranium oxide is an unsealed radioactive source, although the term is commonly used to describe substances used in a laboratory.
under their control (whether or not the source is in their custody), but not where the overall control of the source is the responsibility of another person or if the source is being transported by the person. Under the draft Bill then, the producer acquires the licence, rather than the transport company.

(d) Summary

A WA producer requires a licence under either the NT Act or SA Act to transport uranium oxide to the export port. Including the Commonwealth and WA permits, this equates to at least seven different approvals solely for transport. This increases the cost of doing business for WA producers.

Quantifiable costs include the licence application fee. In SA, this could be up to $1,906.00 (plus other fees on licence renewal). Other costs are incurred finding a transporter willing to transport the material. This may be difficult as the transporter incurs licence costs themselves (because they are not covered under the producer’s licence) and through additional training requirements. This may lead to delays in shipment, which has consequences under the contract between the producer and overseas consumer. Unquantifiable costs are the time and effort exerted navigating and satisfying the requirements of duplicate licence conditions, reporting obligations and other legislative duties throughout the various channels in the chain.

3 Dose Limits

An RPP establishes a documented framework of controls for transport that satisfies radiation protection requirements specified by the Transport Code and the International Regulations. The RPP measures must be commensurate with the

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304 Radiation Protection and Control Bill 2013 (SA) cl 4(4)(a), (b); Environment Protection Authority (SA), Radiation Protection and Control Bill 2013 and Explanatory Report (October 2013) 8, 15.

305 Note that a possession licence is also not required where the radiation source is only in possession for the purposes of transportation and is a category 4 or category 5 radiation source under the Code of Practice for the Security of Radioactive Sources (2007): Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA) reg 188(f). A category 4 radioactive source has an activity between 0.01 GBq and 1 GBq. A category 5 radioactive source has an activity below 0.01 GBq. As a single drum of UOC has an activity of 10 GBq, a consignment of UOC will not be excluded under this provision.

306 Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA) sch 4 cl 10(3)(a). The RPP is also known as a TMP or Radiation Management Plan under domestic legislation.

307 See page 73.

'magnitude and likelihood of the radiation exposures’ and should therefore comply with maximum dose and exposure limits.

The NDRP dose limits represent best practice because they reflect the recommendations of the ICRP and ARPANSA’s *Recommendations for Limiting Exposure to Ionising Radiation*. The ICRP’s recommendations have developed over 90 years and reflect the current research on ionising radiation protection. The NDRP dose limits are outlined in Table 11.

### Table 11: NDRP Dose Limits

<table>
<thead>
<tr>
<th>Application</th>
<th>Occupational</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective Dose</td>
<td>20 mSv per year, averaged over period of 5 consecutive years&lt;sup&gt;312&lt;/sup&gt;</td>
<td>1 mSv in a year</td>
</tr>
<tr>
<td>Annual equivalent dose</td>
<td>Lens of the eye: 150 mSv</td>
<td>15 mSv</td>
</tr>
<tr>
<td></td>
<td>Skin: 500 mSv</td>
<td>50 mSv</td>
</tr>
<tr>
<td></td>
<td>Hands and feet: 500 mSv</td>
<td>NA</td>
</tr>
</tbody>
</table>

SA adopts the NDRP dose limits, but additionally requires that the maximum annual effective dose cannot exceed 50 mSv in any single year. The NT Act is silent. However, as the NT Act adopts the Transport Code, the radiation measures outlined there are applicable (see Chapter V).

WA only adopts the NDRP’s *effective dose* limits, but introduces additional time periods from which dose exposure is calculated (see Table 12).
Table 12: Western Australian Dose Limits

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Radiation Worker</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 months</td>
<td>50 mSv per year</td>
<td>1 mSv</td>
</tr>
<tr>
<td>Less than 12 months, more than one month</td>
<td>50 mSv ratio of weeks to 52 weeks</td>
<td>NA</td>
</tr>
<tr>
<td>Less than one month</td>
<td>1/12 of 50 mSv (4.2 mSv)</td>
<td>NA</td>
</tr>
<tr>
<td>One hour</td>
<td>NA</td>
<td>20 mSv</td>
</tr>
<tr>
<td>Seven days</td>
<td>NA</td>
<td>250 mSv</td>
</tr>
</tbody>
</table>

The dose limit inconsistencies are problematic from a safety perspective. This is because individual jurisdictions have modified international best practice without justification. Such inconsistencies raise less concerns for the business costs of WA producers. This is because WA producers are relieved from calculating the additional time periods (identified in Table 12) when they cross into SA or the NT.

4 Reporting Obligations

The NDRP requires competent authorities to report radiation incidents to ARPANSA for inclusion in the ARIR. A radiation incident is:

Any unintended or ill-advised event when using … radioactive substances, which results in, or has the potential to result in, an exposure to radiation to any person or the environment, outside the range of that normally expected for a particular practice including events resulting from operator error, equipment failure, or the failure of management systems that warranted investigations.

The NDRP requires excessive radiation doses to workers or members of the public, damage to packages during transport, and packages transported without the required documentation to be reported. In order for a competent authority to report to ARIR, their legislation must compel the people dealing with the radioactive substances to report in the first instance.

318 The dose limit for a pregnant radiation worker who has notified her employer that she is pregnant is 2 mSv to the surface of her abdomen: Radiation Safety (General) Regulations 1983 (WA) sch I(2).
319 For example, the ratio of 12 weeks to 52 weeks is 3/13. Multiplied by 50, the dose limit for 12 weeks is 11.5 mSv.
320 The frequency of transport incidents, as recorded in the ARIR, were outlined in Chapter II.
322 Ibid.
(a) Western Australia

In WA, the loss or theft of radioactive substances must be reported to the Radiological Council, along with ‘abnormal or unplanned’ radiation exposures. Further, a common licence condition requires the Radiological Council to be notified if there is any incident involving the transport of radioactive material where damage or loss to a package is caused or suspected.

(b) South Australia

In SA, reporting obligations are split between drivers and ‘specified employers’. Specified employers must report ‘radiation emergencies’, including the loss and theft of radioactive substances and radiation accidents where control is not fully regained. A driver must report to the carrier, consignor and Minister if, during transportation:

- a package is lost, wrongfully interfered with, or damaged;
- radioactive material leaks from the package; or
- the vehicle is involved in an accident that results in, or is likely to result in, damage to the package or a leak of radioactive material from the package.

(c) Northern Territory

The NT’s reporting obligations are wider. The person in charge of a vehicle must report if:

- the vehicle carrying radioactive material is involved in an accident or is subject to unusual delay; and

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323 Radiation Safety (General) Regulations 1983 (WA) reg 14.
324 Ibid reg 19A(2)(a). Abnormal and unplanned radiation exposures are outlined in reg 19A(1).
326 A specified employer includes someone who employs a radiation worker. A radiation worker includes a person directly involved in the transport of a radioactive substance: Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA) reg 3(1).
327 Ibid reg 31(1).
328 Ibid reg 7(1)(a).
329 Ibid reg 7(1)(b).
330 Ibid reg 7(1)(c).
331 Once reported, an inspector will report any danger to a person or damage to the environment to the Chief Inspector and Chief Health Officer: Radioactive Ores and Concentrates (Packaging and Transport) Act 1980 (NT) s 22(1).
332 Ibid s 20(1)(a).
• environmental contamination or danger to any person has, or may occur, because of a leakage or spillage of the radioactive material from a container or package.\textsuperscript{333}

\textit{(d) Summary}

The NDRP’s reporting requirements are, to an extent, risk-based; only incidents outside the range ‘normally expected’ need to be reported. This approach is criticised as ambiguous because it does not refer to clear guidelines on what is reportable by reference to significant concentrations or volumes of exposure.\textsuperscript{334} It is unclear whether what is normally expected should be measured by dose limits, or by something else, such as activity limits (ie in Becquerals) or by the material type.

In any event, the NDRP requirements have not been uniformly implemented in the jurisdictions, leading to different reporting obligations across borders. For example, in both SA and WA, if a vehicle carrying radioactive material is involved in an accident, that accident must be reported if it has, or is likely to have, caused a release of the radioactive material. This does not recognise that a release may be minor and pose no radiological threat. The NT goes further – an accident involving a vehicle carrying radioactive material must be reported, whether or not there was a release. These situations do not acknowledge that some radioactive materials pose a very low level of risk, including uranium oxide.\textsuperscript{335} But on the other hand, the NT Act requirements are a ‘bright-line rule’ and although wide-reaching, are easy to satisfy.

5 \textit{Other Obligations on Carriers and Consignors}

Every jurisdiction implements the Transport Code to govern the technical requirements of radioactive materials transport. Different versions of the Transport Code are in force in different jurisdictions,\textsuperscript{336} so producers and transporters face slightly different obligations interstate. The differences between Transport Code editions are analysed in the following Chapter.

The SA and WA regulations highlight certain Transport Code obligations and attach criminal penalties to them for non-compliance. In both jurisdictions, it is an offence to

\textsuperscript{333} Ibid s 20(1)(b).
\textsuperscript{334} Deloitte, above n 51, 63.
\textsuperscript{335} See Chapter II.
interfere with the contents of a consignment or its labels or markings without the permission of the carrier, consignor or competent authority. In WA, it is an offence to display a radioactive warning label on a package, overpack or freight container that does not contain radioactive material. Further, in SA, a carrier must ensure, at all times during carriage, that each package is stowed and secured in a manner that means the package will remain in position despite the vehicle’s movements, and is kept away from heavy articles that are likely to cause damage to the package, and that the package does not project beyond the periphery of the vehicle.

Both jurisdictions also prescribe an overarching obligation to comply with the Transport Code. However, subtle differences in the application of Transport Code may cause inadvertent breaches. For instance, the Transport Code provides that only items necessary for the use of the radioactive material may be transported with it. In SA, this is the consignor’s obligation, whereas it falls to both the carrier and consignor in WA. This means that if a package contains unauthorised equipment in SA, the consignor would be liable (even if the carrier was responsible for the item).

Some domestic requirements also exceed those imposed by the Transport Code. For example, under the Transport Code, the RPP’s development is the carrier’s responsibility. However, in WA, the consignor (producer) must also prepare the RPP for the environmental impact assessment.

6 Criminal Offences and Penalties

Transporting radioactive materials without a licence is a standard offence across the three jurisdictions, but the penalty varies greatly (see Table 13). SA may impose a fine of up to $100,000 for a company’s breach, whereas a company in WA may only be fined $5,000. Large discrepancies in criminal liability are common to other offence

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337 Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) reg 6(3), (4); Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003 (SA) reg 8(1), (2).
338 Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) reg 6(5). The radioactive warning labels are specified in Section V of the International Regulations. See also Appendices F and G.
339 Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003 (SA) reg 6(2).
343 See Chapter III.
provisions in the radiation protection legislation, including failure to report reportable incidents and failure to comply with specified obligations.

Table 13: NT, SA and WA penalties for possessing radioactive material without a licence

<table>
<thead>
<tr>
<th>Region</th>
<th>Fine</th>
<th>Continuing Offence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Territory</td>
<td>40 penalty units ($6,160.00)</td>
<td>4 penalty units per day ($616.00)</td>
</tr>
<tr>
<td>South Australia</td>
<td>$100,000.00</td>
<td>NA</td>
</tr>
<tr>
<td>Western Australia</td>
<td>$1,000.00 (natural person)</td>
<td>$50.00 per day</td>
</tr>
<tr>
<td></td>
<td>$5,000.00 (corporations)</td>
<td>NA</td>
</tr>
</tbody>
</table>

The effectiveness of the legislation is impacted by large differences between fines. The overarching goal of the radiation protection legislation is to protect human health and the environment from the negative impacts of radiation. In practice, the legislation also creates overlapping obligations in each jurisdiction. This may encourage companies to breach their obligations to save costs and simply record fines as a business loss. For a large company, a fine of $5,000 in Western Australia for failing to comply with the Transport Code, or even $10,000 in South Australia, is a minimal loss in the context of the overall business earnings. Any non-compliance impacts the integrity of radiation safety measures generally.

Contrast this with the powers under the EPBC Act to impose significant penalties of up to $9 million on corporate offenders, or even the $250,000 penalty for unlicensed possession of dangerous goods by body corporates under the DGS Act. A higher maximum penalty allows the regulator to impose a penalty commensurate with the seriousness of the offence, rather than a manifestly inadequate penalty.

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345 One penalty unit is equivalent to $154.00: Penalty Units Regulations 2010 (NT) reg 2.
346 Radiation Protection and Control Act 1982 (WA) s 33A(1).
348 Sentencing Act 1995 (WA) s 40(5).
351 Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003 (SA) reg 6(1).
D  Concluding Remarks

The NDRP is a broad framework that attempts to harmonise Australian radiation protection legislation. Its goal of harmonisation has been unsuccessful as the States and Territories are largely free to regulate radiation protection as they see fit, which has created inconsistent regulatory provisions.

Each jurisdiction implements different licensing requirements. Without a mutual recognition scheme in place, this compounds complexity and therefore the business costs of WA uranium producers. Compliance costs are also increased because reporting obligations, dose limits, and definitions change from State to State. This runs the risk of producers ignoring these obligations and relegating fines as simply another business cost. Further, different versions of the Transport Code are implemented across Australia. This creates subtle differences in the obligations imposed on producers interstate. The Transport Code is now considered in Chapter V.
V THE INTERNATIONAL REGULATIONS AND THE TRANSPORT CODE

A Introduction

The safe transport of radioactive material is regulated internationally by the IAEA. Since 1961, the IAEA has continuously developed and published the International Regulations and its associated safety standards. The International Regulations have undergone 12 comprehensive revisions since its initial publication, representing ‘a balance between the need to take account of technical advances, operational experience, and the latest radiation-protection principles while maintaining a stable framework of regulatory requirements’. 355

In Australia, the International Regulations are implemented through the Transport Code published by ARPANSA. 356 Each edition of the Transport Code wholly adopts a version of the International Regulations (see Table 14) 357

|---------------------------|------|------|------|------|------|------|

The Transport Code is intended to establish uniform requirements for the road transport of radioactive material in Australia. 358 The 2008 Transport Code must be adopted by the States and Territories under the NDRP. 359 However, the 2001 Transport Code remains in force in SA and Victoria. 360 Further, the 2008 Transport Code has been superseded by the 2014 version in New South Wales and the Commonwealth. 361

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356 In this Chapter, the Code of Practice for the Safe Transport of Radioactive Material will be referred to as the ‘Transport Code’ with the version indicated in parentheses. The Regulations for the Safe Transport of Radioactive Material will be referred to as the ‘International Regulations’ with the version indicated in parentheses.

357 The Transport Code modifies the International Regulations slightly to deal with local regulatory variations. See, eg, Transport Code (2014) cl 2.

358 See, eg, Transport Code (2012) cl 1.2

359 National Directory for Radiation Protection, above n 255, cl 5.1, sch 11. The NDRP is an agreed framework developed by ARPANSA’s Radiation Health Committee. The role of the NDRP was explained in Chapter IV.


361 Australian Radiation Protection and Nuclear Safety Regulations 1999 (Cth) reg 48(2)(d); Radiation Control Regulation 2013 (NSW) reg 36.
This confused state of affairs regarding the Transport Code causes two primary issues. First, radiological materials transported interstate may be subject to different versions of the Transport Code. WA and the NT both implement the 2008 Transport Code, but SA enforces the 2001 version. However, this should not create issues for uranium producers in practice. Both versions of the Transport Code are substantively similar, although the 2008 edition imposes more obligations. Accordingly, a WA producer would have little difficulty complying with the 2001 Transport Code.

The bigger problem is whether the Transport Code itself is up-to-date with international requirements. The International Regulations are reviewed every two years to ensure they reflect international best practice. It is concerning that two jurisdictions in Australia, including SA, still implement the 2001 Transport Code which mirrors 20-year-old ‘best practice’. The prevalence of different Transport Codes in Australia also demonstrates that the NDRP has failed – first, to compel uniformity, and secondly, to remain up-to-date itself.

This Chapter begins by briefly explaining the fundamental concepts underpinning the International Regulation’s safety requirements. It then explores each section of the International Regulations to highlight the main differences between the 1996, 2005 and 2012 editions (respectively reflecting the 2001, 2008 and 2014 Transport Codes currently in force across Australia). Finally, this Chapter considers the importance of the Transport Code staying up-to-date with international developments, the mechanisms that enable that to occur and why the current Australian situation must improve.

B The Development of the International Regulations

The IAEA was established in 1956, with the main function of establishing standards of safety for the protection of health (Safety Standards). The UN Committee of Experts on the Transport of Dangerous Goods requested the IAEA to draft the recommendations relating to the transport of radioactive materials for inclusion in the

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363 As this thesis focuses on the road transport of uranium oxide, the provisions in the International Regulations specifically related to air, sea and postal transport of radioactive materials have not been considered.

overall system of recommendations for the transport of all dangerous goods. In 1961, the first version of the International Regulations was published.

The International Regulations sit within a system of Safety Standards, divided into three categories (see Figure 2).

*Figure 2: Hierarchy of Safety Standards with Transport-Specific Examples*

The first category is Safety Fundamentals which sets the fundamental objective for all Safety Standards – the protection of people and the environment from the harmful effects of ionising radiation. A further 10 ‘safety principles’ are outlined, including the role of governments in promoting this fundamental safety objective. The second category is Safety Requirements. These facilitate the protection of people and the environment, and include the International Regulations. The third category are Safety Guides. These reflect international good or best practice and guide Safety Requirement compliance. The International Regulations have six applicable Safety Guides, including the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material* (*Advisory Material*).

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365 Rawl, above n 355, 77–8.
366 This is published as International Atomic Energy Agency, *Fundamental Safety Principles* (Safety Fundamentals No SF–1, 2006).
367 Ibid s 2.
368 Ibid cl 3.8–3.11.
370 These latest editions of these publications are: (1) *Planning and Preparing for Emergency Response to Transport Incidents Involving Radioactive Material* (TS–G–1.2 (ST–3) 2002); (2)
C Fundamental Concepts

The core objective of the International Regulations is the safe transport of radioactive materials.\(^{371}\) This is primarily achieved using packaging as a passive safety measure.\(^{372}\) The International Regulations’ standards control two main hazards associated with uranium oxide transport: radiation emanating from the material, and the containment of material during normal and accident transport conditions.\(^{373}\)

Packaging and radiation protection are interrelated concepts as the correct package is determined by the ‘content limit’ of the material. Upper limits on radioactivity are based on the activity content limits of Type A packages (see Table 15).\(^{374}\) These are determined by the ‘Q System’ which describes fixed scenarios of radiation exposure through different pathways.\(^{375}\) Different values are given to radioactive materials based on their form. The A\(_1\) value refers to ‘special form material’ (ie non-dispersible material), while the A\(_2\) value refers to dispersible material (eg gases, liquids, powders). The limits for different radioactive materials are outlined in Section IV of the International Regulations.

Uranium ores and concentrates are given a special classification outside the content limits established by the Q System. They are classed as ‘low specific activity’ (LSA) material.\(^{376}\) This means the material, by its nature, has a low activity per unit mass. LSA materials are divided into three categories: LSA-I, LSA-II, and LSA-III. The classification depends on the origin of the material and its concentration and

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\(^{373}\) A Fairbairn, ‘The IAEA Transport Regulations: A Review of their Development and Coverage’ (1979) 21(6) IAEA Bulletin 2, 2; World Nuclear Transport Institute, *Radioactive Materials Transport: The International Safety Regime – An Overview of Safety Regulations and the Organisations Responsible for their Development* (World Nuclear Transport Limited, 2006) 18. The International Regulations also control the prevention of criticality (ie a chain reaction in fissile material) and the control of high temperatures resulting from decay heat. These concepts are not relevant to uranium oxide. ‘Fissile’ material does not include unirradiated natural uranium, and the control of decay heat is primarily a concern for high level radioactive wastes: see IAEA, *IAEA Safety Glossary: Terminology used in Nuclear Safety and Radiation Protection* (2007) 213; Uranium Mining, Processing and Nuclear Energy Review, above n 120, 20.

\(^{374}\) IAEA Training Materials, above n 372, 56, 92, 195.

\(^{375}\) Ibid 85. These pathways include inhalation and consumption.

distribution of radioactivity.\textsuperscript{377} Uranium ores and concentrates fall under the LSA-I category. Consequently, LSA-I material is transported in a Type IP-1 package (see Table 15).

\textit{Table 15: Package Types}\textsuperscript{378}

<table>
<thead>
<tr>
<th>Package (IR 2012 paragraph)</th>
<th>Material type</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpackaged (520)</td>
<td>Certain LSA-I and SCO-I materials</td>
<td>Smoke detectors Small sealed sources Radiopharmaceuticals for medical purposes</td>
</tr>
<tr>
<td>Excepted (622)</td>
<td>Contents with low radioactivity, where potential hazards are insignificant</td>
<td></td>
</tr>
<tr>
<td>Industrial Type 1 (IP-1) (623–630)</td>
<td>Solid LSA-I material Liquid LSA-I material under exclusive use\textsuperscript{379} SCO-I\textsuperscript{380}</td>
<td>Uranium ores and concentrates Very low level waste Reactor maintenance equipment</td>
</tr>
<tr>
<td>Industrial Type 2 (IP-2) (623–630)</td>
<td>Liquid LSA-I not under exclusive use Solid and gaseous LSA-II material LSA-III material under exclusive use SCO-II</td>
<td>Solid low-level radioactive waste (eg contaminated rubber gloves) Fresh fuel assemblies</td>
</tr>
<tr>
<td>Industrial Type 3 (IP-3) (623–630)</td>
<td>Liquid and gaseous LSA-II material not under exclusive use LSA-III material not under exclusive use</td>
<td></td>
</tr>
<tr>
<td>Type A (635–651)</td>
<td>Falls within the $A_1$ or $A_2$ levels and is not otherwise excepted or LSA</td>
<td>Radioisotopes Industrial sources (eg well logging)</td>
</tr>
<tr>
<td>Type B(U) and Type B(M)\textsuperscript{381} (652–668)</td>
<td>Materials exceeding the $A_1$ or $A_2$ levels</td>
<td>Bulk radioisotopes Highly enriched uranium Irradiated fuel</td>
</tr>
<tr>
<td>Type C (669–672)</td>
<td>Air transport</td>
<td></td>
</tr>
<tr>
<td>Additional requirements (631–634, 673–686)</td>
<td>Fissile materials and uranium hexafluoride</td>
<td></td>
</tr>
</tbody>
</table>

Type IP-1 packages must comply with the minimum standards for packaging outlined in Section VI of the International Regulations. For example, the package must be

\textsuperscript{377} IAEA Training Materials, above n 372, 225.

\textsuperscript{378} These examples were extracted from the IAEA Training Materials, above n 372, ch 7.

\textsuperscript{379} ‘Exclusive use’ refers to the situation where a consignor or consignee has total control over a shipment, such that all loading or unloading of the consignment is carried out in accordance with the instructions of that consignor or consignee: IAEA Training Materials, above n 372, 67; International Regulations (1996, 2005, 2012) para 221.

\textsuperscript{380} ‘SCO’ stands for ‘surface contaminated object’ and is an object which is not itself radioactive, but which has radioactive material distributed on its surface: International Regulations (1996, 2005) para 241; International Regulations (2012) paras 214, 412–4, 517–22.

\textsuperscript{381} Type B(U) packages are unilaterally approved by a single jurisdiction, whereas Type B(M) packages require multilateral approval by the competent authorities in each country of shipment. Otherwise, the requirements are the same.
designed so it cannot collect water and must be able to withstand the routine elements of transport.\textsuperscript{382} All other package types are subject to additional requirements.\textsuperscript{383}

There are very few substantive changes in Sections VI and VII of the 1996, 2005 and 2012 International Regulations. The main difference are changes to paragraph numbers. However, the 2012 edition also includes a new provision that requires a package to provide sufficient shielding to ensure it does not exceed the specified radiation values.\textsuperscript{384} ARPANSA believes that this provision bridges other requirements and does not impose any additional burdens on stakeholders.\textsuperscript{385} Other sections have undergone much more significant change.

\textbf{D Disparity Between Different Versions of the International Regulations and Transport Code}

The International Regulations class uranium oxide concentrate as UN2912 ‘Radioactive Material Low Specific Activity (LSA-I), Non-Fissile or Fissile Excepted’ (UN2912).\textsuperscript{386} The International Regulations set out a Schedule for UN2912 which specifies its carriage requirements,\textsuperscript{387} and is a useful tool to assess the differences for UN2912 across the International Regulations’ versions.

The Transport Code clarifies the International Regulations’ application in the Australian context. Clauses 2.8 and 2.9 of the Transport Code specify carrier and consignor obligations and responsibilities. The clauses are also useful in highlighting the differences across versions of the Transport Code.

The International Regulations are divided into eight sections (Table 16). This Chapter analyses Sections II, III and V. The other Sections are uncontentious because there are minimal changes between editions.


\textsuperscript{383} These requirements include that a package is able to withstand the accident conditions of transport. Section VII outlines test procedures to check the strength of each package type.

\textsuperscript{384} International Regulations (2012) para 617.


\textsuperscript{386} See Uranium Council Transport Working Group, above n 90, 7.

\textsuperscript{387} The Schedule’s objective is to assist users of the International Regulations to identify the correct package type and the appropriate requirements necessary for the material’s transport: See, eg, IAEA, \textit{Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)} (Specific Safety Guide No. SSG–33, 2015) cl 1.8.
Table 16: Sections in the International Regulations

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Introduction</td>
</tr>
<tr>
<td>II</td>
<td>Definitions</td>
</tr>
<tr>
<td>III</td>
<td>General Provisions</td>
</tr>
<tr>
<td>IV</td>
<td><strong>1996/2005 IR</strong>: Activity Limits and Material Restrictions</td>
</tr>
<tr>
<td></td>
<td><strong>2012 IR</strong>: Activity Limits and Classification</td>
</tr>
<tr>
<td>V</td>
<td>Requirements and Controls for Transport</td>
</tr>
<tr>
<td>VI</td>
<td>Requirements for Radioactive Materials and for Packagings and Packages</td>
</tr>
<tr>
<td>VII</td>
<td>Test Procedures</td>
</tr>
<tr>
<td>VIII</td>
<td>Approval and Administrative Requirements</td>
</tr>
</tbody>
</table>

1 **Section II – Definitions**

Several key definitions remain constant throughout each version. These include ‘carrier’,388 ‘competent authority’,389 ‘consignment’,390 and ‘shipment’.391 However, other central definitions change, in particular, the definitions of ‘consignee’, ‘consignor’ and ‘quality assurance’.

The 1996 and 2005 International Regulations define ‘consignee’ as any person, organisation or government which receives a consignment.392 The 2012 edition extends the definition to any person, organisation or government that is entitled to take delivery of a consignment.393 No reasons are given in the Advisory Material for this change. The older wording suggests that a consignee was any person who received a consignment, whether authorised or not. If so, technically, this would impose obligations on ‘accidental’ consignees. Practically, it is unlikely this would occur given the level of control imposed by the Australian licensing scheme.394 It is more likely that the definitional change simply reflects the 2012 International Regulations’ overall objective to clarify existing provisions.395

‘Consignor’ is defined in the 2005 and 2012 editions as any person, organisation or government which prepares a consignment for transport.396 The definition in the 1996 version also requires that a consignor is named in the transport documents.397 The requirement to be named in the transport documents is moved in the later versions to Section V of the International Regulations. In any event, it is unlikely that a consignor

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389 Ibid para 207.
390 Ibid para 211.
391 Ibid para 237.
393 International Regulations (2012) para 210 (emphasis added).
394 See Chapters III and IV.
395 Transport Code (2014) i.
397 International Regulations (1996) para 212.
would not be named in the transport documents. For example, the Safety Data Sheet for drummed uranium oxide concentrate must identify the name and contact details of the supplier.  

‘Quality assurance’ is defined in the 1996 and 2005 editions as a systematic programme of controls and inspections applied by an organisation or body involved in the transport of radioactive material ‘aimed at providing adequate confidence’ that the standards prescribed by the International Regulations are achieved in practice. The 2012 edition removes this term and replaces it with ‘management system’. This refers to a system that establishes policies and objectives, and enables those objectives to be achieved efficiently and effectively. The new terminology reflects the IAEA’s desire to assimilate the International Regulations’ definition with internationally recognised standards for quality management systems.  

ARPANSA predicts the change will not impact industry because the transition to quality management systems have already occurred. 

Overall, the changes in definitions between different editions of the International Regulations either simplify existing definitions or bring them within the meaning of other international developments. Minor definitional changes are unlikely to impact WA uranium producers interstate because they do not, by themselves, impose any obligations on carriers and consignors. 

2 Section III – General Provisions 

Section III’s evolution demonstrates the importance of staying up-to-date with the International Regulations’ development. Section III introduces general provisions relating to radiation protection, emergency response, quality assurance/management systems, and importantly, training requirements. The 2005/2012 International Regulations differ from the 1996 edition by introducing new provisions for non-compliance, training and segregation. Some changes are very minor, comprising paragraph reshuffling or sentence simplification.

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398 Uranium Council Transport Working Group, above n 90, 19.  
400 International Regulations (2012) para 228.  
401 2012 Advisory Material, above n 371, cl 228.1–3.  
402 ARPANSA Comparison Table, above n 385, 3.  
Broadly, radiation protection and emergency procedures are the responsibility of the carrier, while training, quality assurance/management systems, segregation and non-compliance are the responsibility of both the carrier and the consignor.\textsuperscript{405}

(a) Non-compliance
The 2005 International Regulations introduce specific provisions for non-compliance.\textsuperscript{406} ‘Non-compliance’ has a very broad meaning and includes all situations where a shipment does not fully accord with the regulation’s requirements.\textsuperscript{407} The 2005 International Regulations state that the carrier or consignee must inform the consignor if the consignment does not comply with the provisions applicable to radiation levels and contamination.\textsuperscript{408} The 2012 edition broadens this notification requirement: the consignee, carrier and ‘any organisation involved during transport who may be affected’ must also be notified of non-compliance.\textsuperscript{409} ARPANSA considers that this change improves regulatory oversight, transparency and safety.\textsuperscript{410} But it also imposes another duty on carriers, who if operating under the 2005 International Regulations, may inadvertently overlook this change.

(b) Training
Workers must receive general radiation protection training, including precautions to restrict occupational exposure and the exposure of other persons.\textsuperscript{411} The 2009 and 2012 International Regulations also introduce general training requirements for persons ‘engaged in the transport of radioactive material’,\textsuperscript{412} and specific training for individuals who, inter alia, classify, pack, mark, label and handle radioactive material.\textsuperscript{413} Additionally, the 2012 edition requires records of this training to be kept.\textsuperscript{414} These new provisions are unlikely to impose additional burdens on producers and transporters because legislation already compels training and record-keeping.

\textsuperscript{405} Note that the 2014 Transport Code incorrectly assigns the competent authority’s responsibilities (to ensure compliance with the International Regulations and arrange for periodic dose assessments) to the carrier: International Regulations (2012) paras 307, 308.

\textsuperscript{406} These provisions were developed in response to non-compliance with contamination requirements in Europe during the late-1990s. This non-compliance resulted in a shutdown of irradiated fuel requirements: International Atomic Energy Agency, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (No TS–G–1.1, 1st revised ed, 2008) (2005 Advisory Materials) cl 309.1.

\textsuperscript{407} Ibid cl 309.3.

\textsuperscript{408} International Regulations (2005, 2012) para 309.

\textsuperscript{409} International Regulations (2012) para 309(a).

\textsuperscript{410} ARPANSA Comparison Table, above n 385, 5.


\textsuperscript{412} International Regulations (2005, 2012) para 312.

\textsuperscript{413} International Regulations (2005, 2012) para 313.

\textsuperscript{414} International Regulations (2012) para 314.
requirements. Instead, these provisions aim to ‘complement a uniform approach to training’.

(c) Segregation

The 1996 International Regulations provide:

Radioactive material shall be segregated sufficiently from workers and from members of the public. The following values for dose shall be used for the purpose of calculating segregation distances or radiation values:

(a) for members in regularly occupied working areas a dose of 5 mSv in a year;

(b) for members of the public, in areas where the public has regular access, a dose of 1 mSv in a year to the critical group.

In the 2005 and 2012 versions, the segregation requirement is removed from Section III and relocated to Section V. There, the requirements extend only to packages, overpacks and freight containers containing radioactive material during transport and in storage during transit. The 1996 version application is much wider. This may be a problem for WA producers shipping into SA because the requirements for segregation extend to radioactive materials generally, rather than the package itself.

3 Section V – Requirements and Controls for Transport

Section V articulates requirements to ensure appropriate safety controls are followed, and communication is facilitated, during transport. Broadly, the changes between editions can be split between: (a) general package requirements; (b) marking and labelling; and (c) transport documents.

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415 2005 Advisory Materials, above n 406, cl 312.2.
416 International Regulations (1996) para 306. This provision reflects a change from the previously conservative constraint value of 0.7 mSv included in the earlier versions of the International Regulations. The 2005 Advisory Material criticised the supporting documents of the International Regulations (1996) which represented the dose constraint as a realistic model of radiation exposure, rather than a pessimistic one: ibid cl 563.3.
417 Another difference between editions concerns the protection of undeveloped photographic film. The International Regulations (1996) paras 306–7 require radioactive materials to be segregated from undeveloped photographic film: See paras 306–7. This can be achieved by maintaining a distance of 2 metres from other vehicles when parking: see ibid 563.13. This provision is echoed in Section V of the International Regulations (1996). In the International Regulations (2005, 2012), the provision in Section III is removed.
419 IAEA Training Materials, above n 372, 189.
(a) General package requirements

The package requirements for LSA packages do not vary between editions. For instance, the quantity of LSA material in a Type IP-1 package is restricted so the external radiation level at three metres from an unshielded object does not exceed 10 mSv per hour.

However, the 2012 International Regulations extend some general provisions that are applicable to all packages. A package must be manufactured in conformity with design specifications before it can be first used to transport radioactive materials. ARPANSA believes this requirement promotes further safety in packaging as the obligation was previously implied.

Further, under the 2012 edition, shipments cannot contain radionuclides different from those specified on the package design. This obligation only existed previously for Type B and C packages, but is now extended to Type A packages and IPs.

Generally, a package cannot contain any items other than those necessary for the use of the radioactive material. Under the 1996 International Regulations, the transport of other items with LSA material is not precluded provided there is no interaction. This obligation rests solely on the consignor. The 2005 and 2012 International Regulations delete the reference to LSA material and place the obligation on both the carrier and consignor. This is a sensible change as the consignor may not have control during transport of any items that are packaged with the radioactive material.

(b) Marking and labelling

Markings and labels communicate hazards to different parties during transport, including to emergency response personnel. As a prerequisite to labelling, all packages are assigned a category to identify the radioactive nature of the contents. These categories are I-WHITE, II-YELLOW and III-YELLOW and are assigned

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421 Except for LSA material that is also fissile material. This is not relevant for uranium oxide: see, eg, International Regulations (2012) para 518.
423 International Regulations (2012) para 501. This is to ensure compliance with the International Regulations and any applicable certificate of approval. This requirement does not exist in the 1996 and 2005 versions.
424 ARPANSA Comparison Table, above n 385, 8–9.
426 ARPANSA Comparison Table, above n 385, 9.
429 IAEA Training Materials, above n 372, 197.
based on the ‘transport index’ (TI) and the surface radiation level of the package. The TI is calculated by the maximum radiation level of the package. For uranium ores and concentrates, the TI is taken as four. A container of uranium oxide is usually classed as YELLOW-III because the TI is more than 1 but less than 10.

Other marking and labelling requirements for LSA-I material include:

- the UN number and proper shipping name must be legibly and durably marked on the outside of the packaging.
- the outside of the packaging must identify the consignor, consignee or both.
- packages with a gross mass exceeding 50kg must have its permissible gross mass legibly and durably marked on the outside of the packaging. A typical container containing uranium oxide concentrate will weigh somewhere between 17 and 22 tonnes, and a single drum around 400 kg.
- a Type IP-1 design must be legibly and durably marked on the outside of the packaging with ‘TYPE IP-1’.
- the outer surface of receptacles or wrapping materials containing LSA-I transported under exclusive use may bear ‘RADIOACTIVE LSA-I’.
- each package, overpack and freight container must bear the appropriate category label. The label is fixed to the two opposite sides of the outside of the package or overpack or on the outside of all four sides of a freight container.

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434 Although the maximum radiation level on the external surface is only 0.06 mSv/h (assigned to YELLOW-II), the highest category is assigned: International Regulations (1996, 2005) para 533(a), Table 7; International Regulations (2012) para 529(a), Table 8; Uranium Council Transport Working Group, above n 90, 14.
438 Uranium Council Transport Working Group, above n 90, 15.
439 Ibid 16.
443 International Regulations (1996) para 542; International Regulations (2005) para 543; International Regulations (2012) para 539. Large freight containers must bear four placards which conform to the model in Appendix G. Enlarged labels can be used in the place of both labels and placards:
for LSA-I material, the label only needs to read ‘LSA-I’, and include the maximum activity of the radioactive contents and the TI.  

a freight container containing unpackaged LSA-I or an exclusive use consignment must display the UN number in either a placard label or on a separate placard on all four sides of the freight container.  

The 1996 and 2005 International Regulations designate these requirements as the consignor’s responsibility. However, the corresponding 2001 and 2008 Transport Codes set the labelling requirements as the dual responsibility of the carrier and consignor. The 2012 International Regulations simply provides that no person may offer radioactive materials for transport unless properly marked, labelled, placarded, described and certified on a transport document. However, this provision is marked only as the responsibility of the consignor. The requirements of the Transport Code complicates the application of the International Regulations. The consignor should be responsible for labelling (rather than the carrier) because they know what they have packaged and will have calculated the maximum activity and TI of the consignment. This is an instance where domestic requirements exceed international standards for no explainable reason.

(c) Transport documents

The information included in transport documents (and the order in which that information must appear) varies between versions. While the 1996 and 2005 versions are near identical, the 2012 International Regulations changes the order and imposes an additional requirement to include the subsidiary hazard class or division number.
This difference is unlikely to burden WA uranium producers because there are no subsidiary risks allocated to uranium oxide concentrate.\(^{453}\)

The 2012 International Regulations also provide additional requirements to bridge compliance with the IMDG Code. For instance, if radioactive material is packed into a freight container that will be transported by sea, the person responsible for packing the container (the consignor, under the Transport Code) must provide a certificate certifying that the operation has been carried out in accordance with the IMDG Code.\(^{454}\)

Further, the carrier must ensure:

- the consignment is accompanied by a copy of the transport documents;\(^ {455}\)
- the information applicable to the consignment accompanies the consignment to its final destination and must be given to the consignee when delivered;\(^ {456}\)
- if that information is given to the carrier in electronic form, it must be available at all times during transport to the final destination and must be able to be produced without delay as a paper document;\(^ {457}\) and
- that a copy of the transport documents (and additional information) is kept for a minimum of three months.

ARPANSA does not believe that these requirements will increase the burden on producers because it is already expected that such records are being kept.\(^ {458}\) However, they acknowledge that international stakeholders already complying with the 2012 International Regulations will also expect their Australian counterparts to comply.\(^ {459}\) This may influence shipment denials where producers have only complied with the 2005 International Regulations.\(^ {460}\)

E. The Importance of Staying Up to Date

Australia has three different versions of the International Regulations/Transport Code in force across the States, Territories and Commonwealth. Many of the changes in the International Regulations have occurred in the transition between the 2005 and 2012

\(^{453}\) See Uranium Council Transport Working Group, above n 90, 24. An example of a subsidiary risk is ‘corrosive’ (UN Class 8) for uranium hexafluoride.


\(^{455}\) Ibid para 584.

\(^{456}\) Ibid para 585.

\(^{457}\) Ibid paras 586, 588.

\(^{458}\) ARPANSA Comparison Table, above n 385, 12.

\(^{459}\) Ibid.

\(^{460}\) This is discussed later in this Chapter at page 73.
editions. On their face, these changes do not impose greater compliance burdens on WA producers. This is because the NT also implements the 2005 edition, while SA implements the older 1996 version. However, this has consequences for the NFC industry more broadly.

First, the failure to implement the 2014 Transport Code nationally indicates that both the NDRP and the majority of competent authorities are not up-to-date with international best practice for the transport of radioactive materials. This has safety implications. As observed by Rawl:

> During the 40+ years since the Transport Regulations were first published, there have been dramatic changes in the types of radioactive material transported, materials of construction, and technologies available for packaging, as well as transport conditions. Similarly, the ways in which safety is examined and the standards for acceptable societal risk have also changed. 461

The NDRP is only reviewed when the RHC request the Radiation Health and Safety Advisory Council to do so.462 The most recent meeting of the RHC in March 2017 indicates that discussions regarding redesigning the radiation regulatory system will not occur until March 2018.463 The IAEA reviews the International Regulations every two years and is currently in its 2015 review cycle.464 By the next RHC meeting, the IAEA may have updated the International Regulations and will be in its 2017 review cycle. Reforms to compel the radiation protection legislation to stay updated are discussed in the following Chapter.

The second issue concerns denials of shipment.465 Denials of shipment can occur for many reasons,466 including where a shipment does not comply with the provisions of the International Regulations expected by international stakeholders.467
Eurotom have recognised a lack of harmonisation in nuclear transport across borders is a main factor in shipment denial.\footnote{Eurotom Supply Agency, *Report on Nuclear Fuel Security of Supply* (European Commission, 2015) 16 (emphasis added).} According to Young, the role of the competent authority is to:

Implement the IAEA Regulations, and [to update] them when necessary. The national regulations must fully and accurately reflect the requirements of the IAEA Regulations. This is necessary to ensure **harmony with other countries’ regulations and with the international modal transport authorities, thus facilitating international trade.**\footnote{C N Young, ‘The Role of National Competent Authorities in Facilitating Regulation of the Transport of Radioactive Material’ (Paper presented at Safety of Transport of Radioactive Material, Vienna, 7–11 July 2013) 94, 95–6 (emphasis added).}

As identified above, ARPANSA have noted that a lack of compliance with the 2012 International Regulations may impact the export of uranium oxide overseas.

**F  Concluding Remarks**

The IAEA has regulated the international transport of radioactive materials for over fifty years. Regular reviews have ensured that the International Regulations remain up-to-date with technological developments, research in radiological protection and societal standards.

The Transport Code reflects the International Regulations’ provisions. However, the Transport Code is not uniformly implemented across Australia (despite the efforts of the NDRP) and consequently, the 2001, 2008 and 2014 versions are in force in different jurisdictions. This creates two major issues.

First, different obligations apply across the States and Territories. For example, the 2005 International Regulations introduced new provisions for non-compliance, specific training requirements for transport workers, and segregation provisions. These provisions do not apply in jurisdictions implementing the 2001 Transport Code (ie SA).

Secondly, disparity between Transport Codes demonstrates Australia does not have in place adequate procedures to keep up-to-date with international developments. Numerous changes have occurred between the 2005 and 2012 International Regulations. In particular, the 2012 International Regulations introduced requirements for package shielding, broader notification duties, record keeping obligations, changes
to packages, marking and labelling, and further obligations relating to transport documents. The 2012 International Regulations also simplified its previous iterations and increased consistency with other international developments, such as the IMDG Code and management systems.

This Chapter, alongside Chapters III and IV, demonstrate the complexity of the current scheme regulating the transport of radioactive materials in Australia, and the consequent problems facing future WA uranium oxide producers. The following Chapter proposes solutions to reform the scheme and simplify procedures and laws.
VI REFORMING THE URANIUM OXIDE TRANSPORT REGIME

A Introduction

The previous chapters highlighted significant issues with the current scheme for the transport of uranium oxide in Australia. Chapter II introduced the policy ban which prohibits uranium oxide exports from WA ports. Consequently, WA uranium oxide must travel interstate. In Chapter III, we saw that the responsibility for the regulation of radioactive materials is primarily the domain of the States and Territories, with Commonwealth intervention in the fields of non-proliferation and exports. For this reason, multiple regulators govern the current uranium oxide transport regime. Chapter IV examined the consequences of interstate transport, highlighting inconsistencies between the radiation protection legislation of the NT, SA and WA. Further, in Chapter V, the discrepancies between different versions of the Transport Code were explained.

The current scheme regulating the transport of uranium oxide is therefore overly complex. This renders compliance difficult, compounds the cost of doing business and threatens the viability of the developing WA uranium industry. This Chapter proposes reform options to simplify the regime and make it fit for purpose. It first delimits the scope of potential reforms. Secondly, this Chapter identifies the objectives of reform. Finally, it considers three reform options: (1) the internal reform of State-based radiation protection legislation; (2) the development of model laws for uranium oxide transport; and (3) the establishment of a national regulator.

B Scope of Reforms

This thesis addresses the numerous shortcomings of the current regime that impact WA uranium oxide producers. The transport of uranium oxide is a subset of a conglomeration of legal areas (see Figure 3). In many ways, reform of this area is like fighting the Hydra—470 it is impossible to completely unify all aspect of uranium oxide transport because other areas inevitably ‘spring up’.

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470 The Hydra is a water serpent from Greek mythology. Hercules was tasked with destroying the Hydra, but found for each of its heads he cut off, another two grew back in their place. Susie Dent (ed), Brewer’s Dictionary of Phrase and Fable (Chambers Harrap, 19th ed, 2013) 682–3; Editors of the Encyclopaedia Britannica, Hydra (16 March 2016) Encyclopaedia Britannica <http://www.britannica.com/topic/Hydra-Greek-mythology>.
Accordingly, it is beyond the scope of this thesis to address overarching reforms to the radiation protection legislation, the transport of radioactive materials generally, or the Australian nuclear fuel cycle. Further, this thesis is not an exercise in constitutional law. This Chapter does not consider whether the Commonwealth can take unilateral action to reform the transport of uranium oxide. Instead, it examines State-based and cooperative solutions for reform.

C Objectives of Reform

Reform objectives guide the process of reform and can be thought of in terms of economic, social and governmental policy goals. Cost-benefit analysis is an important regulatory tool to ensure that legislation is evidence-based and meets

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471 Picture from original thesis replaced for copyright reasons.
472 Reform of Australian radiation protection legislation was attempted under the NDRP (see page 41). Radiation protection legislation regulates multiple industries beyond the uranium industry. Any reforms to radiation protection legislation would need to consider their impact on radiology, diagnostic medicine, radiopharmaceuticals and industry radiography, among other things.
473 Uranium oxide is classed as LSA-I radioactive material under the Transport Code/International Regulations (see page 61). It is subject to less regulation that other radioactive materials that are transported as Type A, Type B and Type C packages. Uranium oxide is not fissile and is only mildly radioactive (see Chapter II). Reforms to the entire scheme for the transport of radioactive materials would need to consider other types of material, such as high-level radioactive waste. See, eg, Nuclear Fuel Cycle Royal Commission, above n 7, chs 5, 9; Prosser Report, above n 159, ch 5; Department of Industry, Innovation and Science, National Radioactive Waste Management Facility (2017) <http://www.radioactivewaste.gov.au/>.
475 Chapter III explained that the Commonwealth may have power under the external affairs and trade and commerce power in s 51 of the Australian Constitution. However, the use of these powers has not been tested in the transport sphere. Instead, transport reforms have been exercises in cooperation under the Council of Australian Governments (COAG) and the National Transport Commission (NTC).
discernable outcomes.\textsuperscript{477} Australian Government policies that wish to abolish or introduce legislation must be accompanied by a Regulatory Impact Statement (RIS). Among other things, the RIS examines the problem to be solved and why government action is needed.\textsuperscript{478} Reform is more likely to be justified where it achieves its stated goal and further, is cost-effective, flexible in its implementation, and is compatible with international developments.\textsuperscript{479} While this Chapter does not attempt to write a RIS for the proposed reforms, it identifies three major objectives.\textsuperscript{480} These are: (1) to improve efficiency in regulation; (2) to reduce instances of shipment denial; and (3) to improve competition.

1 \textit{Improving Efficiency in Regulation}

The current regime for the transport of uranium oxide is burdensome.\textsuperscript{481} A WA producer must contend with at least five agencies to obtain the relevant transport permits and approvals.\textsuperscript{482} The time to approve each permit varies,\textsuperscript{483} as does the permit’s expiry date.\textsuperscript{484} Producers incur costs preparing these applications.\textsuperscript{485} Here, ‘time is money’ – if an approval is delayed, it has flow-on effects for the relationship between the producer and the overseas consumer because the consignment can, literally, miss the boat. Further costs are associated with compliance (such as training or meeting different obligations across jurisdictions).


\textsuperscript{478} See Australian Government, \textit{The Australian Government Guide to Regulation} (Department of Prime Minister and Cabinet, 2014) 17, 21.


\textsuperscript{480} Another potential objective is to improve safety. However, as was identified in Chapter II, the radiological and chemical risks of uranium oxide are well-managed. In reality, the real safety concern derives from long-distance transport between the mine site in Western Australia and to the Port of Darwin or Port of Adelaide. Reforms to improve general heavy vehicle safety is the domain of the National Heavy Vehicle Regulator, and is beyond the scope of this thesis.

\textsuperscript{481} This has been noted in previous reviews of the uranium industry: see, eg, Deloitte, above n 51, 77, 80.

\textsuperscript{482} See Chapter III, Chapter IV and \textit{Table 5}.

\textsuperscript{483} For example, a licence to deal with radioactive substances from the Radiological Council takes approximately 21 days, while the environmental approval process can take up to 2 years: see \textit{Table 5}.

\textsuperscript{484} For example, the Mineral Export Permit (issued by DIIS) is usually granted for a period of 10 years, whereas the licence to deal with radioactive substances (issued by the Radiological Council) is issued for 3 years.

\textsuperscript{485} Costs encompass the time it takes to fill out the paperwork and hiring experts to prepare reports (especially in the case of environmental approvals).
These costs have not been quantified here, but other transport reforms suggest that significant economic benefits can be achieved by simplifying the current regime.\footnote{486} For example, between 2008 and 2013, the National Transport Commission (NTC) consolidated 23 regulators for heavy vehicles, rail safety and maritime safety into three national bodies.\footnote{487} Prior to this reform, compliance costs for interstate heavy trucking operations were $17.8 million annually.\footnote{488} The overall economic benefits of the reforms for heavy vehicles alone is estimated at $12 billion.\footnote{489} Therefore, it is predicted that reducing the number of regulators involved in uranium oxide transport would likely also reduce costs associated with multiple approvals, delays and compliance costs.

\section{Reducing Instances of Shipment Denial}

Overseas consumers of Australian uranium expect consignments to meet the standards required by the 2012 International Regulations.\footnote{490} Shippers, intermediate ports and consumers can refuse a shipment where it does not comply.\footnote{491} To reduce the chance of a shipment denial, the Transport Code must be up-to-date with these requirements in all Australian jurisdictions. Consequently, a major objective of reform is to develop and implement mechanisms to keep the Transport Code current.

\section{Increasing Competition}

Competition is inhibited by legislation that confers significant costs on business.\footnote{492} The Australian Government in their \textit{Industry Innovation and Competitiveness Agenda} recognise that ‘remov[ing] inefficient regulation, simplif[y] compliance and...
improve[ing] regulator responsive [will] help small and large businesses thrive’. Increasing competition is important to the uranium industry generally because of the small number of transport companies that will agree to transport uranium oxide. If there are more transport companies, then it is less likely that a denial of shipment will occur. Further, cost-efficient regulation might offset other concerns, such as insurance costs or public perceptions.

WA businesses already are at a disadvantage compared to their NT and SA counterparts because of the local uranium export ban. In addition, newcomers to the industry may be discouraged from entering the market due to the compliance burden. Licensing is a major barrier because it differs in each jurisdiction and requires specific qualifications or experience as a prerequisite. Simplifying the current regime is therefore predicted to increase competition.

D Proposed Reforms

‘Harmonisation’ is a term used to describe reform where there is a desire to unify the rules, policies or institutions of different jurisdictions. This can comprise total unification, greater consistency, or even mere compatibility. This Part examines three approaches to the harmonisation of the uranium oxide transport regime. These are: (1) the internal reform of State-based radiation protection legislation; (2) the development and application of model laws for the transport of uranium oxide; and (3) the establishment of a single national regulator for uranium oxide transport.

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494 Prosser Report, above n 159, para 11.125.
495 That is, a denial of shipment unrelated to non-compliance with the International Regulations: see page 73.
496 World Nuclear Transport Institute, above n 152, 4; Prosser Report, above n 159, para 11.125.
497 See page 73.
499 ARPANSIA Competition Review, above n 246, 42.
Internal Reform of State-Based Radiation Protection Legislation

The first reform proposal amends the existing radiation protection scheme in WA. At present, the WA Transport Regulations are made under the RSA. This means that the overarching regulations applicable to general radiation protection also apply to uranium oxide transport. In contrast, the NT Act exclusively regulates the transport of radioactive ores and concentrates. The NT Act has operated in the NT since 1981, regulating an active uranium mining industry.

Removing uranium oxide transport from the RSA and placing it in a separate Act has several predicted benefits. First, a separate Act would consolidate the requirements under the RSA, WA General Regulations and WA Transport Regulations applicable to uranium oxide. The WA Transport Regulations only function to implement the Transport Code and require carriers to develop an RPP; it does not legislate licensing, training requirements or reporting obligations.

Secondly, a separate Act resolves definitional conflict between the RSA and the Transport Code. The RSA has a very wide definition of ‘radioactive substance’ based on a material’s radioactivity. The Transport Code regulates uranium oxide because it is classed as LSA-I material by virtue of being the concentrate of uranium ore. Under the NT Act, ‘radioactive material’ is simply defined as uranium ores and concentrates. A separate Act would also clarify variances in reporting obligations, training requirements and the duties of carriers and consignors between the RSA and the Transport Code.

Finally, a separate Act recognises the special character of uranium oxide. On one hand, it demonstrates to the public that the perceived risk of uranium oxide is being adequately managed. On the other hand, a separate Act also recognises that uranium

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502 This part refers to abbreviations of legislation referenced in Chapter IV eg the Radiation Safety Act 1975 (WA) is referred to as the ‘RSA’. See Table 6.
504 A brief history of uranium mining in the Northern Territory was given in Chapter I.
505 See Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) ss 4, 5.
506 These are contained in the Radiation Safety Act 1975 (WA) and the Radiation Safety (General) Regulations 1983 (WA). See Chapter IV.
507 See Radiation Safety Act 1975 (WA) s 4; Radiation Safety (General) Regulations 1983 (WA) reg 5(1)(a), (b). Natural uranium is only a ‘radioactive substance’ for the purposes of the RSA if it exceeds 4.0 MBq.
509 Radioactive Ores and Concentrates (Packaging and Transport Act 1980 (NT) s 3 (definition of ‘radioactive material’).
510 See Chapter II for a discussion on the perceived risks of uranium oxide.
oxide has a different radiological and chemical risk to other radioactive materials transported by road in WA. A separate Act would avoid unnecessary regulation that does not add to the safety of uranium oxide transport. Further, a separate Act can recognise the special risk posed by the long-distance interstate transport unique to WA uranium oxide and legislate measures to alleviate that risk.

However, internal reform in WA cannot compel similar action in SA, although SA would also benefit from internal reform. Like WA, the SA Transport Regulations are attached to the SA Act. Further, the SA Act’s licensing provisions are extensive, but plagued with interpretation difficulties. Incorporating a licence requirement in a separate Act would clarify the position for stakeholders.

Internal reform of radiation protection legislation can be achieved by creating a separate Act for uranium oxide transport in the spirit of the NT Act. This would overcome some of the problems inherent in the current regime, but not all. Inconsistencies between licensing, obligations and the application of the Transport Code remain. However, this can be resolved through the application of a model law.

2 Development and Application of Model Laws

Model laws are templates used by individual jurisdictions to draft their own legislation. They allow flexibility for the drafter to accommodate the idiosyncrasies of their jurisdiction (such as drafting conventions or existing laws). Australian

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511 For example, medical radioactive waste: see Department of Health, Clinical and Related Waste Management Policy (Operational Directive No 0651/16, 2016).
512 See Chapter II.
514 Although South Australia may choose to ‘observe, evaluate and emulate the policies and programs of other governments’ in pursuit of harmonisation: Windholz, above n 476, 332; Opeskin, above n 247; A Breton, Competitive Governments; An Economic Theory of Politics and Public Finance (Cambridge University Press, 1996); Cliff Walsh, ‘The Economics of Federalism and Federal Reform’ (2008) 31(2) University of New South Wales Law Journal 553.
515 See Chapter IV on page 48.
516 See, eg, Productivity Commission, Chemicals and Plastics Regulations: Lessons for National Approaches to Regulation (Supplement to Research Report, Commonwealth of Australia, 2009) 24. Contrast the concept of ‘model laws’ to ‘applied laws’. Applied law refer to a law which is enacted by one jurisdiction and then mirrored in all other jurisdictions.
governments have used model laws to harmonise, inter alia, the legal profession, road rules, and work health and safety. Model laws have also been utilised to uniformly implement international model laws, including the United Nations Recommendations on the Transport of Dangerous Goods (DG Model Law). A model law for the transport of uranium oxide can also be developed. It will be referred to in this part as the ‘Model Law for Uranium Oxide Transport’ (or MLUOT). MLUOT could either be promulgated as a model law by the Commonwealth (with no legislative force) which is then adopted in each State or Territory, or enacted in a ‘host’ jurisdiction and then mirrored by the remaining States and Territories.

MLUOT’s development depends on three factors: (a) the content of the model law; (b) the entity responsible for drafting and maintaining the model law; and (c) the mechanisms that will keep the model law up-to-date.

(a) Content of the Model Law

MLUOT would consolidate the central provisions of the radiation protection legislation applicable to uranium oxide transport. MLUOT would:

- implement the 2014 Transport Code;
- define ‘radioactive material’ by reference to uranium ores and concentrates, consistent with the 2014 Transport Code;
- implement consistent licensing provisions, including set fees, licence expiry periods, and standard conditions;
- prescribe training requirements and reporting obligations consistent with the 2014 Transport Code; and

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• implement the obligations of carriers and consignors consistently with the 2014 Transport Code.

(b) Who will draft MLUOT and keep it updated?

There are two existing agencies with the potential to draft and administer the MLUOT: ARPANSA and the NTC.\textsuperscript{523}

On one hand, ARPANSA is well-placed to draft the MLUOT because they are already responsible for the development of the Transport Code and other radiation protection guidance material.\textsuperscript{524} The RHC is empowered to formulate codes, policies and standards in relation to radiation protection legislation for consideration by the Commonwealth, States and Territories.\textsuperscript{525} However, there is no provision giving ARPANSA power to create model laws.

The NTC’s position to develop the MLUOT is stronger. The NTC’s functions are conferred by the COAG Transport and Infrastructure Council (\textit{Transport Council}).\textsuperscript{526} The Transport Council has charged the NTC with developing nationally consistent regulatory and operational arrangements for road transport.\textsuperscript{527} Model legislation may be set out in regulations made under the \textit{National Transport Commission Act 2003} (Cth).\textsuperscript{528}

The NTC is responsible for the DG Model Law and the ADG Code.\textsuperscript{529} Radioactive materials have not historically been regulated under the ADG Code because of the special risks associated with radioactivity.\textsuperscript{530} Despite this, there is nothing in the NTC’s mandate that would prohibit them from developing the MLUOT. In any event, the NTC must, where appropriate to do so in the performance of its functions, consult with governments and government bodies, industry stakeholders, and other interested

\textsuperscript{523} The National Road Transport Commission was established in 1991 under the \textit{National Road Transport Commission Act 1991} (Cth). It was replaced by the National Transport Commission in 2003 under the \textit{National Transport Commission Act 2003} (Cth) s 5(1). The COAG Transport and Infrastructure Council oversees the NTC under the \textit{Inter-Governmental Agreement for Regulatory and Operational Reform in Road, Rail and Intermodal Transport}.

\textsuperscript{524} The general functions of ARPANSA were outlined in Chapter IV.

\textsuperscript{525} \textit{Australian Radiation Protection and Nuclear Safety Act 1998} (Cth) s 23(1)(c).

\textsuperscript{526} \textit{National Transport Commission Act 2003} (Cth) s 6(1)(c).

\textsuperscript{527} \textit{Inter-Governmental Agreement for Regulatory and Operational Reform in Road, Rail and Intermodal Transport} cl 5.1(a).

\textsuperscript{528} \textit{National Transport Commission Act 2003} (Cth) s 7(1). This legislation does not have the force of law: s 7(2)(a).


\textsuperscript{530} See Chapter III.
people, bodies and organisations. This would compel the NTC to consult with ARPANSA, alongside ASNO and the State-based radiation protection authorities. The NTC is therefore the most appropriate existing agency to draft the MLUOT. But how can the NTC ensure that the MLUOT remains up-to-date?

(c) How will the MLUOT stay updated?

There is no mechanism within the current radiation protection scheme in WA to compel regulators to keep their legislation up-to-date with either Australian or international developments. ‘Sunsetting’ is one option to keep the MLUOT current. In SA, certain regulations expire every ten years. This can be postponed for periods not exceeding two years. The SA Transport Regulations will expire on 1 September 2017. The MLUOT can contain a sunset clause to ensure it is reviewed at regular intervals. Alternatively, the MLUOT can mandate regular reviews. For example, the IAEA reviews the International Regulations biannually. This accords with the biannual review of the Recommendations on the Transport of Dangerous Goods internationally and the ADG Code in Australia.

A further option is to implement the Transport Code ‘as amended from time to time’ or a wording variation giving effect to the latest reiteration of the Transport Code, as published by ARPANSA. A drawback of this approach is that stakeholders may be

532 See Table 7 in Chapter IV.
533 This part discusses how the MLUOT can stay up-to-date. These suggestions are also applicable to the internal reforms discussed above. In addition, the WA Transport Regulations could stay up-to-date by changing the way the Transport Code is implemented. The WA Transport Regulations directly implement the Transport Code and the International Regulations: Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) s 2 (definition of ‘Code’ and ‘International Regulations’). The SA Transport Regulations also directly implement the Transport and International Regulations: Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2003 (SA) reg 3(1) (definition of ‘Transport Code’ and ‘International Regulations’). On the other hand, the NT Act adopts the Transport Code via the Government Gazette. This is a much more flexible option because it does not require regulations to be amended.
534 Subordinate Legislation Act 1978 (SA) s 16A. For instance, local government by-laws are excluded from sun-setting.
535 Specifically, the regulations expire on 1 September of the year following the year in which the tenth anniversary of the day on which the regulations were made: Subordinate Legislation Act 1978 (SA) 16B(1)(g).
536 Subordinate Legislation Act 1978 (SA) 16C.
537 This was postponed from 1 September 2014.
538 This does not mean that new International Regulations are developed every two years, but rather, gives different agencies around the world the opportunity to provide feedback on their operation. See Fasten and Nitsche, above n 464.
surprised by new versions of the Transport Code if ARPANSA did not advertise upcoming editions.

(d) But what about multiple regulators?

Even if model legislation was established and implemented in each jurisdiction, without a national regulator, licences would be separately issued by the competent authority in each jurisdiction. This overlap can be resolved through a mutual recognition scheme.

A widely-recognised mutual recognition scheme is established under the *Mutual Recognition Act 1992* (Cth) (MRA).540 The MRA enables a person licenced in an occupation in one jurisdiction to apply for registration in an equivalent occupation in another jurisdiction. This circumvents additional training and the associated cost.541 However, the MRA only extends to the licence’s authority; it does not unify the obligations attached to the occupation, which will still vary in each jurisdiction.542 This would not be problematic under the MLUOT because obligations would be uniform in each jurisdiction anyway.543 However, the MRA does not reduce the number of regulatory bodies operating in a particular field,544 and is not ideal for dealing with cross-border practices.545 Consequently, the inability of the MRA to handle multiple regulatory bodies hinders the intended results of the scheme.

The mutual recognition provisions under the *Transport of Dangerous Goods Model Law* work differently to the MRA.546 Proponents do not need to apply for mutual recognition in each jurisdiction because the licence is automatically recognised
Automatic mutual recognition would be effective under MLUOT. MLUOT is based on the existing State radiation protection framework and the Transport Code. The current radiation protection legislation, despite jurisdictional differences, successfully achieves the same objective to protect the health and safety of people and the environment Australia-wide (even if this objective is not uniformly espoused in the legislation).

Alternatively, the problem of multiple regulators can be addressed by creating a single national regulator for the transport of uranium oxide.

3 Single National Regulator

A single national regulator can be established under the Transport Council. This was the process for establishing the National Rail Safety Regulator (NRSR). The NRSR (and a corresponding national law) was created by COAG under an Intergovernmental Agreement between the Commonwealth and all States and Territories.

Indeed, the IAEA suggested that ARPANSA assume the powers of a national transport regulator. This idea was ultimately rejected because a review of the ARPANS Act concluded that there was no legislative basis for ARPANSA to actively regulate the land transport of radioactive materials. The Deloitte Report also suggested the creation of the ‘Australian Radiation Management Authority’ (or ARMA). ARMA would be a statutory body established by COAG and comprised of consultants from ARPANSA, ANSO domestic security advisors, and the responsible agencies for radiation and environment protection and uranium mining in the NT and SA. ARMA has not been adopted.

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548 Other reviews of the Australian uranium industry have also suggested the creation of a national regulator (albeit with functions wider than transport): see Fahey and Pu, above n 179.

549 Intergovernmental Agreement on Rail Safety Regulation and Investigation Reform (2009).


553 Deloitte, above n 51, 85. ARMA would not be responsible for ASNO’s non-proliferation functions or the functions of DIIS.
A national regulator can be developed on the same principles as the NRSR. It would regulate the transport of uranium oxide by assuming the functions currently being performed by the State-based competent authorities.\textsuperscript{554} Like the Deloitte Report, this reform does not propose that a national regulator should also assume responsibility for non-proliferation and exports.\textsuperscript{555}

Even if a national regulator was created consolidating the functions under the current radiation protection scheme, Commonwealth approvals would still be managed by separate agencies.

However, the national regulator could be a single point of contact for all uranium approvals, even if it did not exercise the powers of ASNO or DIIS.\textsuperscript{556} An information sharing agreement between the bodies would reduce the amount of applications made and thereby the duplication of information. This could be achieved via a Memorandum of Understanding (MOU) between agencies. A MUO clarifies the responsibilities of the Radiological Council and the DMP in WA regarding radiation protection on mine sites.\textsuperscript{557} Further, a bilateral agreement between the Commonwealth and States enables environmental approvals that would otherwise need to be obtained under the EPBC Act to be granted under the State assessment.\textsuperscript{558}

A drawback of the MUO approach is that approvals for uranium oxide transport are issued at different times. Even if licences under radiation protection were unified (eg under the MLUOT), Commonwealth approvals would remain out of sync. For instance, the Mineral Export Permit is issued for ten years, but DIIS must also approve every other shipment. Consequently, it may be illogical for a proponent to go through the radiation protection body where, for example, they only need a single permit from DIIS.

\textsuperscript{554} See Table 7 in Chapter IV for all Australian competent authorities for the transport of radioactive materials.
\textsuperscript{555} Although the Deloitte Report did suggest a single national regulator for uranium transport could be established under ASNO: Deloitte, above n 51, 104.
\textsuperscript{556} The Commonwealth Government in submissions to the Uranium Mining Implementation Committee (Queensland) suggested the best practice for approvals would be multiple authorities working through a single point of contact with the proponent: Uranium Mining Implementation Committee, above n 153, Appendix B, 17.
\textsuperscript{557} See Memorandum of Understanding in Relation to the Regulation of Radiation Safety for Mining Operations Between the Department of Mines and Petroleum and the Radiological Council in Western Australia (December 2012).
\textsuperscript{558} That is, under the EP Act: see Bilateral Agreement Made Under Section 45 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) Relating to Environmental Assessment (Commonwealth of Australian and Western Australia) executed 3 October 2014.
E Concluding Remarks

This Chapter has recommended three sweeping reforms to the current scheme for the transport of uranium oxide in Australia. First, it suggests the internal reform of State-based radiation protection legislation by separating the requirements for the transport of uranium oxide into an independent Act, based on the NT’s model. This reform cannot compel consistent change in other jurisdictions, but a model law (here, MLUOT) can.

The MLUOT consolidates the radiation protection legislation consistently with the Transport Code’s requirements. It would be developed by the NTC and include mechanisms (eg sunsetting) to ensure it remained up-to-date. The MLUOT does not reduce the number of regulators, although an automatic mutual recognition scheme can reduce agency contact across borders. Alternatively, a national regulator can be established which consolidates these functions. It would not consolidate Commonwealth approvals, but would represent a single point of contact (through a MOU) to reduce administrative costs.

These reforms will achieve greater efficiency in regulation, decrease instances of shipment denial, and improve competition. However, in practice, it is difficult to propose a comprehensive solution for reform. This is because the scheme for the road transport of uranium oxide canvasses multiple legal areas and exists within a complicated legislative framework. The situation is ‘hydra-headed’ – the transport of uranium oxide cannot be reformed without also considering reforms to the transport of all radioactive materials, uranium mining, and the entirety of the Australian nuclear fuel cycle. In summary, such reform cannot occur in a vacuum and must consider its impact on other legal areas and industries.
VII CONCLUSION

This thesis examined the legislative regime for the transport of uranium oxide in WA. The WA uranium industry is slowly developing, with four major projects at various stages of approval. When these mines do commence production, the milled uranium oxide will travel interstate for export from Port Adelaide or Port Darwin. This is because a policy ban prohibits the export of uranium oxide from WA. This ban is largely influenced by the negative public perceptions of uranium oxide, caused in part by misunderstandings of the level of risk the material poses. The policy is unlikely to change soon – the recently elected WA Labor Government is ideologically opposed to uranium mining. Further, the low-volume nature of uranium and the availability of willing carriers means a WA port is unlikely to be economically viable at this stage.

In the absence of WA export ports, uranium oxide must travel interstate. Each State and Territory implements its own scheme of radiation protection legislation. Without national uniformity, WA producers must comply with three separate legislative regimes when they cross the State border. On the other hand, NT and SA producers must comply only with their own legislation and the Commonwealth regime.

It is apparent that the overarching regime for the transport of uranium oxide is complicated and overlapping. Besides the State-based radiation protection legislation, Australian producers must also obtain Commonwealth approvals. These include approvals under the EPBC Act for the mine generally (although these do not impact the transport of uranium oxide directly), possession and transport permits from ASNO, and Mineral Export Permits plus individual consignment approval from DIIS. Coupled with the State-based radiation and environmental approvals, WA producers face obtaining up to seven different approvals, from five regulatory agencies across three governments.

The current scheme compounds the cost of doing business for Australian producers, and disproportionally affects the nascent WA uranium industry. Some costs can be quantified, such as licence fees. Other costs are trickier to calculate, such as the compliance cost of abiding by multiple regulatory regimes and training requirements. Further, delays in the approvals process can impact the contractual relationship with the overseas consumer.

Another issue with the scheme is the enforcement of the Transport Code, implementing the International Regulations. Three different versions of the Transport Code are in force across Australia, although the NDRP requires the 2008 Transport Code...
Code to be implemented across Australia. This has occurred in WA and the NT. However, SA continues to use the 2001 Transport Code, while the Commonwealth (through ARPANSA) has adopted the 2014 Code, based on the latest edition of the International Regulations. These discrepancies demonstrate that the current regime is incapable of staying up-to-date. This has safety implications, especially where the International Regulations are reviewed biannually to implement the latest radiological research and technological developments. Overseas consumers will expect Australian producers to comply with the latest version of the International Regulations. Non-compliance may result in shipment denials. This is undesirable, especially in Australia where there are limited ports and carriers willing to handle uranium oxide.

A solution to the current problem is not straightforward. The transport of uranium oxide exists within a mass of other legal areas, including radiation protection, the transport of radioactive materials generally, and within the NFC. Any change to the regime has the capacity to inadvertently impact these other areas. Despite this, some reform can be attempted through the internal revision of State-based radiation protection measures, the development of a model law, and the creation of a single national regulator. Until that occurs, future WA uranium producers must contend with an expensive, overly complex, and outdated regime for the transport of uranium oxide.
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Radiation Protection and Control Act 1982 (SA)

Radiation Protection and Control Bill 2013 (SA)

Radiation Protection and Control (Ionising Radiation) Regulations 2015 (SA)

Radiation Protection Regulations 2007 (NT)

Radiation Safety Act 1975 (WA)

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## APPENDICES

### A Australia’s Bilateral Nuclear Cooperation Agreements

<table>
<thead>
<tr>
<th>Country</th>
<th>Agreement</th>
<th>Date of Entry into Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Agreement between Australia and the Argentine Republic Concerning Cooperation in the Peaceful Uses of Nuclear Energy</td>
<td>12 January 2005</td>
</tr>
<tr>
<td></td>
<td>[2005] ATS 5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1981] ATS 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2002] ATS 8</td>
<td></td>
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<tr>
<td></td>
<td>[1989] ATS 14</td>
<td></td>
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<tr>
<td>Euratom(^\text{560})</td>
<td>Agreement between the Government of Australian and the European Atomic Energy Community (Eurotom) for Co-Operation in the Peaceful Uses of Nuclear Energy</td>
<td>1 January 2012</td>
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<tr>
<td></td>
<td>[2012] ATS 3</td>
<td></td>
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<tr>
<td>Finland</td>
<td>Agreement between the Government of Australia and the Government of the Republic of Finland concerning the Transfer of Nuclear Material between Australia and Finland</td>
<td>9 February 1980</td>
</tr>
<tr>
<td></td>
<td>[1980] ATS 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1981] ATS 23</td>
<td></td>
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<table>
<thead>
<tr>
<th>Country</th>
<th>Agreement Description</th>
<th>Date</th>
</tr>
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<tbody>
<tr>
<td>Republic of Korea (South Korea)</td>
<td>Agreement between the Government of Australia and the Government of Korea concerning Cooperation in Peaceful Uses of Nuclear Energy and the Transfer of Nuclear Material</td>
<td>2 May 1979</td>
</tr>
<tr>
<td>Country</td>
<td>Agreement Description</td>
<td>Date</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------</td>
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<tr>
<td>Switzerland</td>
<td>Agreement between the Government of Australia and the Government of the Swiss Confederation concerning the Peaceful Uses of Nuclear Energy</td>
<td>27 July 1988</td>
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<td></td>
<td>Exchange of Notes Constituting an Agreement between Australia and the United States of America Concerning Cooperation on the Application of Non Proliferation Assurances on Retransfer to Taiwan</td>
<td>17 May 2002</td>
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</table>
## International System of Units (SI) Prefixes

<table>
<thead>
<tr>
<th>Name</th>
<th>Symbol</th>
<th>Factor</th>
<th>Name</th>
<th>Symbol</th>
<th>Factor</th>
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<tbody>
<tr>
<td><strong>Multiples</strong></td>
<td></td>
<td></td>
<td><strong>Fractions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deca</td>
<td>da</td>
<td>$10^1$</td>
<td>Deci</td>
<td>d</td>
<td>$10^{-1}$</td>
</tr>
<tr>
<td>Hecto</td>
<td>h</td>
<td>$10^2$</td>
<td>Centi</td>
<td>c</td>
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<tr>
<td>Kilo</td>
<td>k</td>
<td>$10^3$</td>
<td>Milli</td>
<td>m</td>
<td>$10^{-3}$</td>
</tr>
<tr>
<td>Mega</td>
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<td>$10^6$</td>
<td>Micro</td>
<td>μ</td>
<td>$10^{-6}$</td>
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<tr>
<td>Giga</td>
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<td>Nano</td>
<td>n</td>
<td>$10^{-9}$</td>
</tr>
<tr>
<td>Tera</td>
<td>T</td>
<td>$10^{12}$</td>
<td>Pico</td>
<td>p</td>
<td>$10^{-12}$</td>
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<tr>
<td>Peta</td>
<td>P</td>
<td>$10^{15}$</td>
<td>Femto</td>
<td>f</td>
<td>$10^{-15}$</td>
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<tr>
<td>Exa</td>
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<td>Atto</td>
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<tr>
<td>Zetta</td>
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<td>Zepto</td>
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<td>$10^{-21}$</td>
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<tr>
<td>Yotta</td>
<td>Y</td>
<td>$10^{24}$</td>
<td>Yocto</td>
<td>y</td>
<td>$10^{-24}$</td>
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</table>
### Factors and Objectives Considered by the Environmental Protection Authority under s 44(2) of the Environmental Protection Act 1986 (WA)^561^

<table>
<thead>
<tr>
<th>Theme</th>
<th>Factor</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sea</strong></td>
<td>Benthic Communities and Habitats</td>
<td>To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained.</td>
</tr>
<tr>
<td></td>
<td>Coastal Processes</td>
<td>To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected.</td>
</tr>
<tr>
<td></td>
<td>Marine Environmental Quality</td>
<td>To maintain the quality of water, sediment and biota so that environmental values are protected.</td>
</tr>
<tr>
<td><strong>Marine Fauna</strong></td>
<td></td>
<td>To protect marine fauna so that biological diversity and ecological integrity are maintained.</td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td>Flora and Vegetation</td>
<td>To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</td>
</tr>
<tr>
<td></td>
<td>Landforms</td>
<td>To maintain the variety and integrity of distinctive physical landforms so that environmental values are protected.</td>
</tr>
<tr>
<td></td>
<td>Subterranean Fauna</td>
<td>To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</td>
</tr>
<tr>
<td></td>
<td>Terrestrial Environmental Quality</td>
<td>To maintain the quality of land and soils so that environmental values are protected.</td>
</tr>
<tr>
<td><strong>Terrestrial Fauna</strong></td>
<td></td>
<td>To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</td>
</tr>
</tbody>
</table>

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^561 Environmental Protection Authority, Statement of Environmental Principles, Factors and Objectives (December 2016) 6.
<table>
<thead>
<tr>
<th>Water</th>
<th>Hydrological Processes</th>
<th>To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inland Waters</td>
<td>To maintain the quality of groundwater and surface water so that environmental values are protected.</td>
</tr>
<tr>
<td></td>
<td>Environmental Quality</td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td>Air Quality</td>
<td>To maintain air quality and minimise emissions so that environmental values are protected.</td>
</tr>
<tr>
<td>People</td>
<td>Social Surroundings</td>
<td>To protect social surroundings from significant harm.</td>
</tr>
<tr>
<td></td>
<td>Human Health</td>
<td>To protect human health from significant harm.</td>
</tr>
</tbody>
</table>
### Timeline of Approval Process under the Environmental Protection Act 1986 (WA)\(^{562}\)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Process</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referral of proposal</td>
<td>Pre-referral process</td>
<td>Variable</td>
</tr>
<tr>
<td></td>
<td>Meeting with EPA</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Preparing contents of referral</td>
<td>Variable</td>
</tr>
<tr>
<td>Decision to assess referred proposal</td>
<td>EPA may request further information from proponent</td>
<td>Variable</td>
</tr>
<tr>
<td></td>
<td>Referral published for public comment</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>EPA decides whether to assess</td>
<td>28 days</td>
</tr>
<tr>
<td>Public environmental review</td>
<td>Scoping proponent’s environmental review</td>
<td>10–16 weeks</td>
</tr>
<tr>
<td></td>
<td>Preparation of Environmental Review Document and additional assessment information</td>
<td>6 weeks</td>
</tr>
<tr>
<td></td>
<td>Public review</td>
<td>11–21 weeks</td>
</tr>
<tr>
<td>Preparation of draft assessment report</td>
<td></td>
<td>6 weeks</td>
</tr>
<tr>
<td>Finalisation of report</td>
<td></td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>Proponent comment on conditions</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Publishing</td>
<td>3 days</td>
</tr>
<tr>
<td>Decision on proposal</td>
<td></td>
<td>2 weeks</td>
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</tbody>
</table>

\(^{562}\) This Appendix’s information is extracted from Environmental Protection Authority, above n 233, and *Environmental Protection Act 1986 (WA).*
## Classes of Dangerous Goods under the ADG Code

<table>
<thead>
<tr>
<th>Class and Division</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 1: Explosives</strong>&lt;sup&gt;563&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>1.1 Substances and articles which have a mass explosion hazard</td>
<td>Gunpowder, Rocket fuel, Trinitrotoluene (TNT)</td>
</tr>
<tr>
<td>1.2 Substances and articles which have a projection hazard but not mass explosion hazard</td>
<td>Preloaded mortar shells, Roman candles</td>
</tr>
<tr>
<td>1.3 Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard</td>
<td>Surface flares</td>
</tr>
<tr>
<td>1.4 Substances and articles which present no significant hazard</td>
<td>Fuse lighters, Handheld sparklers</td>
</tr>
<tr>
<td>1.5 Very insensitive substances which have a mass explosion hazard</td>
<td>Blasting agents</td>
</tr>
<tr>
<td>1.6 Extremely insensitive articles which do not have a mass explosion hazard</td>
<td></td>
</tr>
<tr>
<td><strong>Class 2: Gases</strong></td>
<td></td>
</tr>
<tr>
<td>2.1 Flammable gases</td>
<td>Butane</td>
</tr>
<tr>
<td>2.2 Non-flammable, non-toxic gases</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>2.3 Toxic gases</td>
<td>Ammonia</td>
</tr>
<tr>
<td><strong>Class 3: Flammable liquids</strong></td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>Acetone, Petroleum</td>
</tr>
<tr>
<td><strong>Class 4: Flammable solids</strong></td>
<td></td>
</tr>
<tr>
<td>Substances liable to spontaneous combustion</td>
<td></td>
</tr>
<tr>
<td>Substance which on contact with water emit flammable gases</td>
<td></td>
</tr>
<tr>
<td>4.1 Flammable solids, self-reactive substances and solid de-sensitized explosives</td>
<td>Sulphur</td>
</tr>
<tr>
<td>4.2 Substances liable to spontaneous combustion</td>
<td>Wet cotton</td>
</tr>
</tbody>
</table>

<sup>563</sup> Explosives are regulated by separate legislation (ie not by the ADG Code) in New South Wales (Explosives Act 2003), Queensland (Explosives Act 1999) and South Australia (Explosives Act 1936).
4.3 Substances which in contact with water emit flammable gases

<table>
<thead>
<tr>
<th>Class 5: Oxidizing substances and organic peroxides</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Oxidizing substances</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
</tr>
<tr>
<td>5.2 Organic peroxides</td>
</tr>
<tr>
<td>Luperox®</td>
</tr>
</tbody>
</table>

Class 6: Toxic and infectious substances

| 6.1 Toxic substances                              |
| Arsenic                                           |
| Calcium cyanide                                  |
| 6.2 Infectious substances\textsuperscript{564}   |
| Clinical waste                                   |
| Polio virus                                      |

Class 7: Radioactive materials\textsuperscript{565}

| NA                                               |
| Uranium oxide concentrate                        |
| Uranium hexafluoride                             |

Class 8: Corrosive substances

| NA                                               |
| Hydrochloric acid                                |

Class 9: Miscellaneous dangerous substances and articles, including environmentally hazardous substances

| NA                                               |
| Dry ice                                          |
| Asbestos                                         |

\textsuperscript{564} Infectious substances are not regulated under the ADG Code in Western Australia. See Dangerous Good Safety (General) Regulations 2007 (WA) reg 4(4)(a); Health (Miscellaneous Provisions) Act 1911 Part IX.

\textsuperscript{565} Radioactive substances are not regulated under the ADG Code in Western Australia. See Dangerous Good Safety (General) Regulations 2007 (WA) reg 4(4)(b); Radiation Safety Act 1975 (WA).
F  Category III Placard Label\textsuperscript{566}

\begin{center}
\includegraphics[width=0.8\textwidth]{image1.png}
\end{center}

G  Placard Label\textsuperscript{567}

\begin{center}
\includegraphics[width=0.8\textwidth]{image2.png}
\end{center}

\textsuperscript{566} International Regulations fig 4.

\textsuperscript{567} International Regulations fig 6.