CHAPTER 8: NON-PROLIFERATION AND SECURITY

117. Australia has sound non-proliferation and nuclear security credentials developed over many decades. Maintaining that reputation would be critical in contemplating participation in new nuclear fuel cycle activities.

In considering the nuclear proliferation and security risks associated with new nuclear activities in South Australia, the focus should be on Australia's policies and international reputation in relation to these issues and the relevant geopolitical environment. Any further nuclear activities in South Australia would be subject to the current international and domestic regulatory regime that is concerned with nuclear proliferation and security. It follows that the proliferation and security risks associated with further nuclear activities must be considered in the South Australian context, rather than circumstances which apply to other countries or which existed in the past.

The Commission's attention has been drawn to Australia's more supportive attitude towards nuclear weapons in the past. It was said there is no guarantee it would not revert to this policy position given the right circumstances.[1] That argument fails to consider the significant changes since the peak of the Cold War era, primarily the establishment and adoption of the international legal regime for non-proliferation. In light of the following, the Commission does not accept that it is credible to suggest Australia has nuclear weapons ambitions.

Underpinning the non-proliferation framework is the Treaty on the Non-proliferation of Nuclear Weapons (NPT), which seeks to constrain the number of countries that possess nuclear weapons by prohibiting their development or acquisition (Article II) and mandating the implementation of measures known as safeguards to verify compliance with that prohibition (Article III). Australia has been a party to the NPT since 1970 and ratified its requirements in 1973, legally committing to the international community not to develop or acquire nuclear weapons.

Since that time, Australia has developed a strong reputation in non-proliferation because of its active involvement in strengthening the international safeguards system and by undertaking measures to facilitate global non-proliferation efforts in addition to the minimum requirements of the NPT.[2] Australia is a party to the South Pacific Nuclear Free Zone Treaty through which it relinquishes any potential decision to acquire or possess nuclear weapons (Article 3) and commits to preventing the stationing (Article 5) or testing (Article 6) of any nuclear weapon in its territory by others. It is also a member of the Nuclear Suppliers Group, a collective of countries that supply nuclear materials and technologies only in accordance with guidelines that are complementary to the NPT arrangements.[3] Australia has a longstanding history of supporting strengthened International Atomic Energy Agency (IAEA) safeguards, including through its chairing of the IAEA's Standing Advisory Group on Safeguards Implementation, facilitating field trials for new safeguards technologies and procedures, and being the first country to conclude an Additional Protocol to its safeguards agreement with the IAEA.[4]

Regarding nuclear security, Australia has demonstrated a successful approach to managing security risks at its existing nuclear fuel cycle facilities. It is involved in several international measures to promote the importance of nuclear security, including as a founding member of the Global Initiative to Combat Nuclear Terrorism, a member of numerous IAEA bodies concerned with nuclear security and a regular contributor to the IAEA Nuclear Security Fund.[5] Recently, the Nuclear Threat Initiative ranked Australia as first in the world based on the security measures in place to protect its nuclear materials and facilities.[6]

Australia's compliance with the NPT is verified through its application of IAEA safeguards to all nuclear activities.

118. Any nuclear fuel cycle facility to be built in South Australia would need to be constructed and operated in accordance with the strengthened international safeguards system, thereby assuring other countries that the facility is used solely for peaceful purposes.

In addressing international non-proliferation objectives, it is important for countries to not only act in accordance with global norms directed towards that end, but also to be seen as doing so by other nations. Concerns have been expressed that, in some circumstances, a nation's entry into or expanded involvement in the nuclear fuel cycle could create an impression in other countries that such actions might be taken for non-peaceful purposes.[7] The issue is said to arise particularly where nuclear fuel cycle activities are undertaken in the absence of any clear economic rationale, potentially creating the impression that national security considerations are driving their development.[8]

Generally, the separation between civil and military uses of nuclear technology and materials is well understood by countries.[9] However, the precise international policy implications associated with the development of new nuclear activities can differ based on the specific activity contemplated. Activities involving uranium mining, uranium conversion and fuel fabrication, power generation using nuclear fuels, and nuclear waste storage and disposal are unlikely to raise international concerns about Australia's intentions.[10]

In the context of uranium mining, different views have been expressed regarding the recently concluded bilateral agreement to export Australian uranium to India. The reservations are largely founded on India's non-membership of the NPT and Comprehensive Nuclear-Test-Ban Treaty (CTBT), and the potential for the supply of uranium to create surplus capacity in a customer's domestic stocks for use in weapons production.[11]

While these are legitimate concerns to hold, it is important for countries such as Australia to engage in diplomacy as a way of expanding the reach of global non-proliferation norms.[12] The Parliament of Australia's Joint Standing Committee on Treaties (JSCOT) recognised this issue in its appraisal of the proposed agreement with India.[13] In its response to that appraisal, the Australian Government indicated that it is already engaged in dialogue with India consistent with JSCOT's recommendations in this regard.[14]

The position would be more complex if uranium enrichment or used fuel reprocessing operations were established in Australia, especially without economic justification.[15] It might be difficult in that case to convince other countries that these capabilities were being developed exclusively for peaceful purposes, even though that would be true in Australia. There is also a risk that doing so might set an international precedent and lead others to consider doing the same for national security reasons.[16] For this reason, if enrichment or reprocessing activities were to be undertaken in the future, they should take place on a multilateral basis as discussed further in Finding 121.

If Australia were to widen its involvement in nuclear activities, it would need to be proactive in assuring other countries that it remains committed to its international and domestic non-proliferation obligations. Several means of doing so are already in train. Australia is active in supporting the development of verification infrastructure to promote the CTBT's entry into force.[17] In addition, Australia was central to establishing the Asia-Pacific Safeguards Network (APSN). Consisting primarily of regional organisations involved in nuclear safeguards, APSN seeks to promote greater quality in safeguards implementation through training and information sharing in collaboration with the IAEA.[18]

119. The potential for proliferation risks from nuclear fuel cycle activities is greatest for enrichment or reprocessing because those facilities can produce highly enriched uranium or separated plutonium capable of use in nuclear weapons.

The extent to which each nuclear fuel cycle activity gives rise to proliferation risks is closely associated with the potential production of weapons-usable material during the activity.

Nuclear weapons require either highly enriched uranium (HEU), which comprises about 90 per cent of the uranium-235 isotope, or plutonium, which, in the context of weapons, should be made up of primarily plutonium-239.[19] Enriched uranium and separated plutonium are produced using technologies for, respectively, uranium enrichment and used fuel reprocessing. Ordinarily, nuclear fuel cycle activities undertaken for the purpose of power generation do not produce HEU or plutonium with the ideal isotopic composition for use in nuclear weapons. However, uranium enrichment and used fuel reprocessing provide at least the basic capability to acquire these materials and are therefore of greatest concern to the non-proliferation regime.[20]

International bodies, national governments and industry recognise that these processing activities are most sensitive to proliferation risks, therefore the technologies' use is subject to a range of measures that seek to limit those risks. International transfers of nuclear material and technologies are performed in accordance with bilateral agreements executed between the governments of the countries involved in the transactions.[21] Australia already has bilateral arrangements with every nation to which it exports UOC. These agreements impose numerous conditions on the recipient nation, including the acceptance of IAEA safeguards on the material and establishment of administrative arrangements to account for the material to the Australian Safeguards and Non-Proliferation Office (ASNO).[22]

The Nuclear Suppliers Group has issued Guidelines which set out detailed conditions for the supply of enrichment technology, such as measures against replication of the technology and alternative arrangements to the establishment of national facilities including supplier involvement and appropriate multinational participation.[23] Consistent with this, the existing enrichment technology providers, namely URENCO and TENEX, do so on a 'black box' basis, whereby critical design information relating to the technology is withheld as a barrier to its replication.[24] Although black box arrangements are not impregnable,[25] they are an additional barrier to improper application of the technology, increasing the number of measures in place to minimise proliferation risks.[26]

Other stages of the nuclear fuel cycle can give rise to proliferation concerns, but to a far lesser degree than uranium enrichment and used fuel reprocessing. They include[27]:

- uranium mining and conversion, the products of which are unusable in a nuclear weapon without enrichment or, if already incorporated into used fuel, reprocessing
- the storage and disposal of low and intermediate level wastes, being either contaminated materials or wastes immobilised in glass, ceramic or concrete. Even if some wastes contain trace amounts of enriched uranium or separated plutonium, they are practically irrecoverable for weapons use
- the storage and disposal of high level wastes, which do not contain materials readily recoverable for use in weapons
- the storage and disposal of used fuel. Although it contains plutonium, used fuel would require the further step of reprocessing before the plutonium could be used in a weapon
- nuclear power plants. Although such plants produce plutonium in uranium fuel, that plutonium is not usable in weapons unless it is separated through reprocessing.

120. Engagement in new nuclear fuel cycle activities would require further regulation in Australia. Models of regulation addressing proliferation from other jurisdictions could be applied to an Australian context for any potential new activity.

The proliferation risks associated with the nuclear fuel cycle are managed through a combination of technical and regulatory means. Where a Comprehensive Safeguards Agreement (CSA) has been concluded with the IAEA, a country is required to accept IAEA safeguards on all nuclear material within the nation's control and used for peaceful purposes.[28]

Safeguards allow nuclear material flows to be tracked such that any diversion for non-peaceful purposes would be detected. The IAEA implements safeguards using the state-level concept: a means by which it is able to allocate safeguards efficiently by considering a country's entire nuclear fuel cycle.[29] In practice, safeguards require the nation state to provide information to the IAEA about nuclear material flows, which is subsequently audited based on the IAEA's own field observations (incorporating various surveillance, containment and process monitoring techniques) and information it receives from other sources.[30]

Claims have been made that the utility of IAEA safeguards is adversely affected by countries providing limited information.[31] However, limits placed on the information provided to the IAEA, whether resulting from commercial confidentiality or national security reasons, are unlikely to be a barrier to nuclear materials accounting. Arrangements can be devised that balance the need for effective verification with the need for maintaining the confidentiality of sensitive technological aspects.[32]

It is also said that material accounting discrepancies (known as material unaccounted for, or MUF) are commonplace.[33] The concept of MUF relates to the variation between the estimated and measured samples of nuclear materials that are being processed during a nuclear fuel cycle activity at a given time. The variance could be positive or negative and does not necessarily indicate that any nuclear material is absent.[34] Further, nuclear materials accounting is complemented by containment and surveillance measures, such as cameras, portal monitors and radiation monitors, to provide assurance that nuclear material has not been removed.[35]

A CSA (including an Additional Protocol) has been implemented in Australia for many years. The arrangements under the agreement are managed by ASNO, which monitors the production and movement of nuclear materials to, from and within all Australian states.[36] An expansion of South Australia's involvement in the nuclear fuel cycle would have implications for both the IAEA's and ASNO's roles in managing the associated proliferation risks, commensurate with the level of risk associated with the specific activity.[37] Other nation states, such as Japan, already manage proliferation risks in the context of a more comprehensive nuclear fuel cycle. Australia would be able to draw on that experience should a decision be made to proceed in that direction.[38]

121. In the event that a fuel leasing arrangement provided the basis to establish enrichment facilities, that activity should be carried out under an appropriate multilateral arrangement with partner countries.

A nation's engagement in domestic enrichment activities can cause other countries to question whether those activities are for exclusively peaceful purposes. In the absence of appropriate assurances, such a scenario is likely to have a negative impact on regional diplomatic relations.[39] If South Australia sought to establish enrichment capabilities in future, the ideal pathway would be through a multilateral approach with partner countries. The participation of other countries in those activities provides an additional level of assurance that enrichment capabilities will not be used for non-peaceful purposes.[40]

Internationally, numerous multilateral approaches have been considered in the past, particularly in the context of enrichment services.[41] There are examples of enrichment service providers currently operating through a multinational model, particularly URENCO (established through treaties between Germany, the Netherlands and the United Kingdom). The International Uranium Enrichment Centre in Angarsk, Siberia also has multilateral participation. The advantages of multilateral approaches generally include[42]:

- minimising the spread of enrichment technology to facilities in multiple countries
- making the potential for any one participating country to withdraw from the NPT more difficult, particularly if that country seeks to do so without arousing suspicion at an early stage
- reducing the potential for HEU to be produced or diverted in secret
- allowing for the efficient application of safeguards to a centralised facility by the IAEA, especially if the multilateral arrangement incorporates IAEA oversight
- reassuring the international community that the development of enrichment capabilities is for exclusively peaceful purposes.

It is argued that the future establishment of multilateral arrangements (short of incorporating all existing domestic facilities into those arrangements) is unlikely to have any positive impact on non-proliferation efforts. As evidenced by the Pakistani nuclear scientist AQ Khan's ability to steal and distribute enrichment technology from URENCO in the past, the concept can present some risks.[43]

The practical implementation of a viable multilateral arrangement would not be simple and would need to address any vulnerabilities that have been exploited in the past. For a proposal of this nature to be attractive to customer countries who would otherwise develop domestic enrichment capabilities, a reliable supply of nuclear fuel would need to be assured without discrimination.[44] However, it is also true that a multilateral arrangement manages proliferation risks much more effectively than domestic arrangements.[45]

122. Nuclear fuel cycle activities give rise to security risks, which are comparatively lower in Australia than in other parts of the world. They are already managed at nuclear fuel cycle facilities in accordance with a mature international framework.

Security at nuclear fuel cycle facilities is broadly concerned with the risks of:

- unauthorised removal of nuclear materials
- the theft of proliferation-sensitive technology
- the sabotage of facilities.

In guarding against unauthorised removal of materials, the primary consideration is the extent to which the material could be used in a nuclear explosive device. This dictates how attractive the material might be to people seeking to construct such a device. Given that Australia possesses minimal quantities of attractive material (HEU or plutonium) and has a small number of nuclear sites, the level of security risk is much lower than in many other countries.[46] The likelihood of the material being removed for radiological dispersal is also a significant consideration.

In the case of technology theft, the concern is directed towards preventing the dissemination of enrichment and reprocessing technologies.[47] For sabotage, the main issue is the radiological consequences that could result from a malicious act directed at the nuclear facility.[48]

The international community places great emphasis on addressing threats to nuclear security, having created standards for that purpose and guidance for their implementation. The Convention on the Physical Protection of Nuclear Material (and its 2005 Amendment) and the International Convention for the Suppression of Acts of Nuclear Terrorism place obligations on nations to have a regulatory structure in place that effectively deters, resists and reprimands attempts to breach security at nuclear fuel cycle facilities and during domestic and international transport of nuclear materials.

The IAEA also has developed principles for assessing the magnitude of security risks and the appropriate response measures that should be implemented.[49] Most recently, the United States held the fourth in a series of Nuclear Security Summits, which was attended by more than 50 nations that reaffirmed their commitment to further strengthen the relevant international architecture and, in doing so, maintain international cooperation.[50]

New nuclear facilities are designed, constructed and operated in a manner that supports the effective management of security risks. For example, current nuclear reactor designs, given they are at higher risk of sabotage due to their inherent driving force for radiation dispersal, are developed to be able to withstand the impact of an aircraft collision.[51] Nuclear power plant operators also have stationed on-site teams that are highly trained in counter-terrorism operations to respond to security threats.[52]

In Australia, security risks are already managed in accordance with international guidance. In consultation with ASNO, the Australian Nuclear Science and Technology Organisation has developed a security plan for its nuclear reactor at Lucas Heights, to address credible hostile scenarios formulated on the basis of advice from national intelligence agencies.[53]

Security plans rely on the concept of defence in depth, which employs multiple layers of security to protect a facility from becoming vulnerable should a single barrier be overcome. The security layers incorporate physical barriers to restrict access, technological means including area surveillance, and measures to prevent cyber attack. Security plans are tested in exercises designed to simulate realistic threats. Current Australian arrangements were peer-reviewed in 2013 by the IAEA-led International Physical Protection Advisory Service, with positive feedback provided and recommendations made as to how they might be further strengthened.[54]

123. The development of a proposal to receive used fuel would require the construction of a new secured port and railway. However, the risk of intentional interference or misuse of used fuel is greatly limited by the characteristics of the fuel and the casks in which it is stored and transported.

There are numerous facilities around the world covering all aspects of the nuclear fuel cycle where security risks are managed in accordance with international standards and guidance. Measures in place at these facilities employ the principles discussed earlier to meet security threats by employing multiple barriers. The practical security arrangements, comprising physical, technological and procedural facets, are tailored to the relative sabotage and other threat risks presented by a specific facility.

In the context of used fuel storage and disposal facilities, used fuel incorporates barriers to potential security risks, particularly its inherent radiological properties and the nature of the casks in which it is transported and stored. The difficulties in physically removing the used fuel, followed by the need for reprocessing capabilities to recover any plutonium for use in a weapon, reduce its potential attractiveness for theft.

Used fuel is highly radioactive and needs to be isolated from people and the environment to ensure that its harmful effects are contained.[55] This is achieved during transport and storage, primarily through the use of purpose-designed casks, which are handled remotely as a further means of radiation safety. Casks containing used fuel are sealed and require specialist equipment to open them.[56] During storage, used fuel is contained in large casks made of steel, concrete or a combination of both.[57] The casks are stored in an area protected by multiple physical barriers and equipped with technological means to detect unauthorised access or intrusion.[58] The analysis undertaken by Jacobs for the Commission included financial provision for security barriers, security systems to complement them and contractors to provide security services.[59]

Attempts could conceivably be made to steal a cask during transport or to sabotage a consignment of used fuel. In an extreme case, sabotage could be attempted using heavy weapons, such as armour-piercing rockets.[60]

The risk of used fuel being stolen during transport is limited by the difficulty associated with moving the casks. The transport package incorporates extensive shielding to contain radiation and its structure is reinforced to withstand a wide range of accident conditions. Each package is about four to five metres long and weighs more than 100 tonnes.[61] Consequently, their transport requires heavy vehicles and their movement from one mode of carriage to another requires specialist equipment.[62]

To plan, resource and execute a breach of security would be extremely challenging. Even if an organisation had the physical capabilities to do so, the breach would need to be planned and performed without attracting the attention and subsequent intervention of international and national security agencies. Further, should an attempt at theft or sabotage be made, a transport plan would be in place that would incorporate appropriate emergency response measures, including the assistance of state and federal law enforcement agencies and even the military. Therefore, even in the unlikely event that one of these potential threats materialised, there would be a comprehensive framework in place to respond to the threat and mitigate any consequences arising as a result.[63]

NOTES

1 Submissions: Conservation Council of South Australia (CCSA), Australian Conservation Foundation (ACF) & Friends of the Earth Adelaide (FoE), p. 101; Medical Association for Prevention of War (Australia) (MAPWA) & Public Health Association of Australia (PHAA), pp. 21, 46; International Campaign to Abolish Nuclear Weapons (ICANW), p. 9.

2 Transcript: Floyd, pp. 1489–1490.

3 Nuclear Suppliers Group, 'About the NSG' and 'Participants', NSG, http://www.nuclearsuppliersgroup.org/en/about-us.

4 Australian Safeguards and Non-Proliferation Office (ASNO), *Annual report 2014–2015*, Australian Government, Australian Capital Territory, 2015, p. 65; International Atomic Energy Agency (IAEA), 'Safeguards legal framework – status of the additional protocol', IAEA, 26 February 2016, https://www.iaea.org/safeguards/safeguards-legal-framework/additional-protocol/status-of-additional-protocol.

5 ASNO, *Annual report 2014–2015*, pp. 107–110.

6 Nuclear Threat Initiative (NTI), *Nuclear security index: Building a framework for assurance, accountability, and action*, 3rd edn, NTI, Washington DC, 2016, pp. 36, 53.

7 Submissions: CCSA, ACF & FoE, pp. 94–95, 101; ICANW, pp. 9, 12; MAPWA & PHAA, pp. 21–22, 46.

8 Transcript: Sokolski, pp. 1474–1475.

9 Transcript: Evans, pp. 1553–1554.

10 ibid., pp. 1554, 1561–1563.

11 Transcripts: Evans, pp. 1554–1555; Sokolski, pp. 1483–1484. Submissions: CCSA, ACF & FoE, p. 107; ICANW, p. 10.

12 Transcript: Evans, p. 1554.

13 Joint Standing Committee on Treaties, *Report 151 – Agreement between the Government of Australia and the Government of India on cooperation in the peaceful uses of nuclear energy*, Parliament of the Commonwealth of Australia, Canberra, September 2015, pp. 31–33.

14 Australian Government, 'Australian Government response to the Joint Standing Committee on Treaties report: Report 151', Canberra, November 2015, pp. 1–2.

15 Transcript: Sokolski, pp. 1474–1475.

16 ibid., pp. 1478–1479.

17 ASNO, *Annual report 2014-2015*, pp. 14, 21.

18 J Carlson, 'Strengthening safeguards through regional cooperation: establishment of the Asia-Pacific Safeguards Network', paper presented to the annual meeting of the Institute for Nuclear Materials Management, Baltimore, 11–15 July 2010.

19 ASNO, *Annual report 2014-2015*, p. 117.

20 Transcript: Floyd, pp. 1491–1492.

21 ibid., p. 1493.

22 ASNO, *Annual report 2014-2015*, pp. 30–31.

23 Nuclear Suppliers Group (NSG), *Guidelines for nuclear transfers*, NSG guidelines, pt 1, NSG, June 2013; NSG, *Guidelines for transfers of nuclear-related dual-use equipment, materials, software and related technology*, NSG guidelines, pt 2, NSG, June 2013.

24 G Evans, T Ogilvie-White & R Thakur, *Nuclear weapons: the state of play 2015*, Centre for Nuclear Non-Proliferation and Disarmament, Canberra, 2015, p. 203.

25 Transcript: Sokolski, p. 1485.

26 Transcripts: Evans, pp. 1559–1560; Floyd, pp. 1506–1507.

27 Transcripts: Evans, pp. 1554, 1561–1563; Floyd, pp. 1491–1492.

28 IAEA Department of Safeguards, 'IAEA Safeguards: Serving Nuclear', p. 9.

29 Transcript: Floyd, pp. 1512–1513. IAEA Department of Safeguards, 'IAEA Safeguards: Serving Nuclear Non-Proliferation', IAEA, Vienna, 2015, pp. 11–13.

30 Transcript: Floyd, p. 1502. IAEA, 'IAEA Safeguards: Serving Nuclear', pp. 9, 13–14.

31 Transcript: Sokolski, pp. 1480–1481. Submission: CCSA, ACF & FoE, pp. 102–103.

32 Transcript: Floyd, pp. 1501–1502.

33 Transcript: Sokolski, pp. 1480–1481. Submission: CCSA, ACF & FoE, pp. 102–103.

34 Transcript: Floyd, pp. 1499–1500.

35 IAEA Department of Safeguards, 'IAEA Safeguards: Serving Nuclear', p. 16.

36 ASNO, *Annual report 2014-2015*, pp. 37–38.

37 Transcript: Floyd, p. 1513.

38 ibid., pp. 1490–1491.

39 ibid., p. 1498.

40 Transcript: Floyd, p.1495. Submission: Australian Government, p. 10.

41 G Evans, and Y Kawaguchi, *Eliminating nuclear threats: A practical agenda for global policymakers*, report of the International Commission on Nuclear Non-proliferation and Disarmament, Canberra, 2009, pp. 134–142.

42 Transcripts: Evans, p. 1557; Floyd, p. 1498. J Carlson, '*Peaceful' nuclear programs and the problem of nuclear latency*, discussion paper, Nuclear Threat Initiative, 19 November 2015, http://www.nti.org/analysis/articles/peaceful-nuclear-programs-and-problem-nuclear-latency/, p. 13; G Evans & Y Kawaguchi, *Eliminating nuclear threats: A practical agenda for global policymakers*, report of the International Commission on Nuclear Non-proliferation and Disarmament, Canberra, 2009, pp. 138–139, 144–145; G Evans, T Ogilvie-White & R Thakur, *Nuclear weapons: The state of play 2015*, Centre for Nuclear Non-Proliferation and Disarmament (CNND), Canberra, 2015, pp. 212–214; IAEA, *Multilateral approaches to the nuclear fuel cycle*, expert group report to the Director General of the IAEA, Vienna, 2005, p. 70.

43 Transcript: Sokolski, pp. 1484–1485. G Evans, & Y Kawaguchi, *Eliminating nuclear threats*, p. 139.

44 G Evans & Y Kawaguchi, *Eliminating nuclear threats*, pp. 144–145.

45 Transcript: Floyd, p. 1497.

46 NTI, *Nuclear Security Index: Building*, p. 36.

47 Transcript: Floyd, p. 1511. IAEA Department of Safeguards, *IAEA Safeguards: Serving nuclear*, p. 3; International Atomic Energy Agency (IAEA), *Nuclear security recommendations on physical protection of nuclear material and nuclear facilities*, INFCIRC/225/Revision 5, nuclear security series no. 13, IAEA, Vienna, 2011, p. 13.

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49 IAEA, *Nuclear security recommendations*; International Atomic Energy Agency (IAEA), *Nuclear security recommendations on radioactive materials and associated facilities*, nuclear security series no. 14, IAEA, Vienna, 2011.

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51 Transcript: Peterson, pp. 748–753.

52 Transcript: Edwards, p. 745.

53 Transcript: Floyd, p. 1511.

54 ibid., p. 1511.

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56 Jacobs & MCM, *Safety and risks in the transportation of radioactive materials to and in Australia*, report prepared for the Nuclear Fuel Cycle Royal Commission, Adelaide, 31 March 2016, pp. 40–41, http://nuclearrc.sa.gov.au/

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58 IAEA, *Nuclear security recommendations*, pp. 32–33.

59 Jacobs & MCM, *Radioactive waste storage*, pp. 138, 182.

60 Jacobs & MCM, *Safety and risks*, pp. 40–45.

61 Transcript: Brown, pp. 1320–1321; Dillich & Sarkar, pp. 1282–1283. Jacobs & MCM, *Safety and risks*, p. 33.

62 Jacobs & MCM, *Safety and risks*, p. 41.

63 ibid., pp. 33–37.

Transcripts and submissions can be found at the Nuclear Fuel Cycle Royal Commission's website:www.nuclearrc.sa.gov.au/transcripts and www.nuclearrc.sa.gov.au/submissions