CHAPTER 6

STORAGE AND DISPOSAL OF RADIOACTIVE WASTE

6.1 The issues of storage and disposal are quite separate. The major difference is that stored materials remain accessible whereas disposal assumes there is no intention of retrieving the radioactive waste. The principal considerations for storage facilities are containment, monitoring and security. Siting and design are the most critical factors for disposal facilities.[1] With both storage or disposal arrangements the primary concern is avoiding potential health effects on future, as well as current, generations.

6.2 The multilayer approach employs a series of physical and chemical barriers to provide protection from radioactive materials until the decay process reduces radioactivity to near background levels.

> The multibarrier approach sets standards for the safe disposal of radioactive wastes which go far beyond those now applied to the disposal of other toxic and hazardous waste.[2]

Short Term Storage

6.3 Although the quantities of radioactive waste in Australia requiring storage are not large, it was apparent to the Committee that there is a need to review the national inventory of material which might require storage in a national facility.

Commonwealth Storage Facilities

Australian Nuclear Science and Technology Organisation

6.4 One of the most pressing needs for the Commonwealth is to develop an appropriate management plan for dealing with ANSTO's radioactive waste held at Lucas Heights, including that resulting from the decommissioning of the research reactors.

6.5 A total of 1 140 cubic metres of radioactive waste stored on site at Lucas Heights, has been produced over a 40 year period of operation.[3] ANSTO told

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1 Smith, Transcript of Evidence, p. 663

2 Uranium Institute (1992) 'The management of radioactive waste' *The Mining Review* (August 1992): 8-15, p. 10

the Committee that it can store the low level waste at the site in the existing buildings for a couple of years before there is a need to construct new buildings.[4] The Committee was told that there are no physical limits on the storage of radioactive waste at Lucas Heights and technically there is no practical urgency to send the material to a national repository. However ANSTO is aware that the local community may feel differently.[5]

The Committee inspecting the low level solid radioactive waste store at Lucas Heights. (Photograph provided by ANSTO)

6.6 Greenpeace argued that above ground storage facilities on site are preferable to below ground burial facilities elsewhere, particularly for the radioactive waste produced by ANSTO:

> ANSTO is considered competent to operate a nuclear reactor at Lucas Heights which discharges radioactive gases over residential areas and effluent into the local river. According to the

3 Rolland, Transcript of Evidence, p. 63

4 Rolland, Transcript of Evidence, p. 70

5 Jostsons, Transcript of Evidence, p. 72

> Government they are able to do this without harm to the local residents, and may get permission to build a replacement reactor three times as large. How, then, can the Government maintain that an above ground store for low- and short-lived intermediate level radioactive waste at Lucas heights is unacceptable on safety grounds? ... Why putting radioactive wastes in a trench at a remote location is safer than storing it at a dedicated nuclear facility has never been properly explained by DPIE. Greenpeace still maintains that it is designed to put an embarrassing political problem for ANSTO "out of sight and out of mind".[6]

The building containing the spent fuel dry storage facility and the solid intermediate level waste storage facilities (Photograph provided by ANSTO)

6.7 Greenpeace argued that the main criticisms of above ground storage are the loss of knowledge of what is being stored on site, changing land uses of storage sites, companies going out of business and the risk of abandonment.[7]

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6 Greenpeace, Submission No. 48, p. 10

7 Ibid, p. 10

Greenpeace pointed out that none of these should apply to the ANSTO facility which produces 90 per cent of the radioactive waste that would go to a national facility.[8] ANSTO also told the Committee that:

> there is sufficient space at ANSTO site for storage of solid [radioactive] waste well into the 21st Century ...[9]

6.8 Sutherland Shire Council, however, told the Committee that the Safety Review Committee reported three years ago that on-site storage facilities at ANSTO were almost at exhaustion point and above ground ponds were being used to store the spent fuel rods.[10]

The Committee inspecting the irradiation pond, the principal wet storage facility for HIFAR spent fuel. The pond is also used as an irradiation research facility. (Photograph provided by ANSTO)

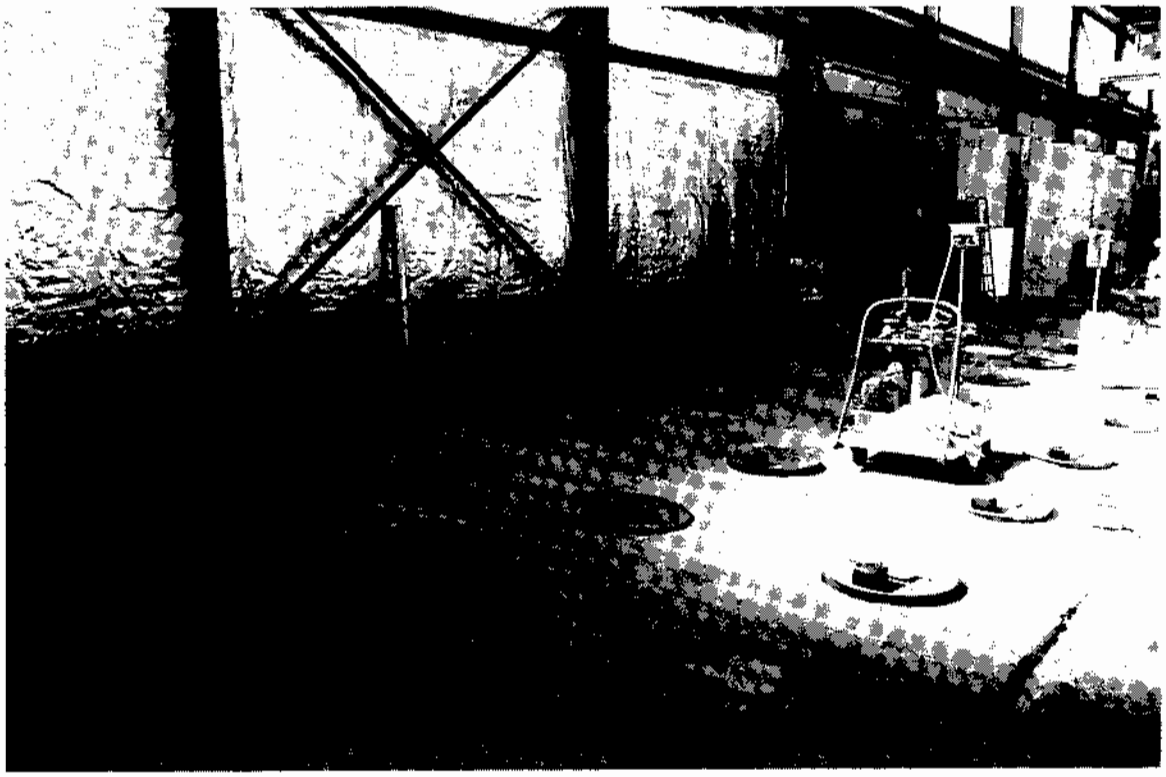
8 Greenpeace, Submission No. 48, p. 10

9 Ibid, p. 10

10 Carter, Transcript of Evidence, p. 582-583

6.9 The Committee was told that the site was inappropriate because it is located in the middle of one of the fastest growing urban communities in Sydney; it is on land situated on the water table for major waterways which feed into the Georges and Woronora Rivers; and is situated on Hawkesbury sandstone which is fissured and unstable.[11]

6.10 The *Future Reaction* Review in 1993 considered that the present interim storage at Lucas Heights is in conformity with world's best practice and is the safest and most practicable short term arrangement.[12] The Sutherland Shire Council stressed that this statement refers to world's best practice for a short term facility; and that it is not in accordance with world's best practice for a long term storage facility.[13]



The HIFAR spent fuel storage facility with dry storage for 1100 elements contained in stainless-steel-lined holes drilled into rock. The radiation shield plugs also seal the tops of these stainless-steel tubes in which the elements are stored in a dry nitrogen atmosphere. The trolley contains monitoring instrumentation (Photograph provided by ANSTO).

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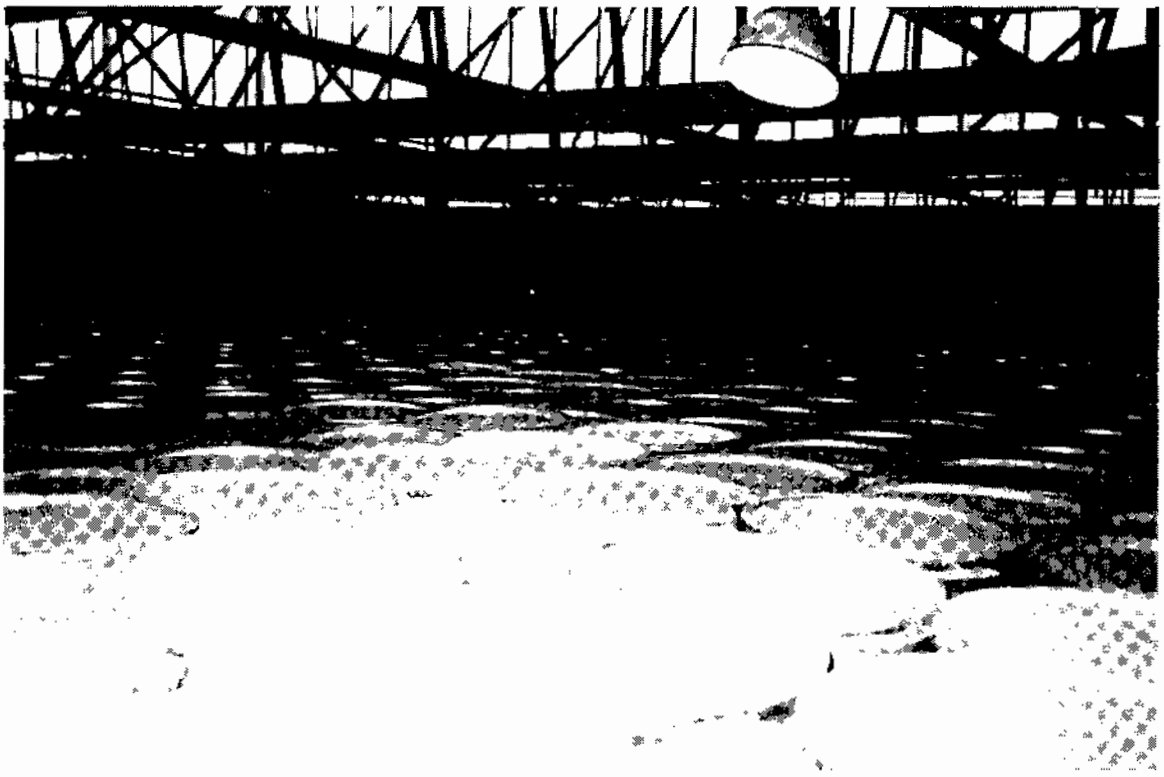
11 Robertson, Transcript of Evidence, p. 570; Rankin, Transcript of Evidence, p. 539

12 Research Reactor Review (1993) *Future Reaction: Report of the Research Reactor Review*, Commonwealth of Australia, August 1993, p. 216

13 Robertson, Transcript of Evidence, p. 563

Woomera

6.11 Most of the Fishermens Bend soil has very low radioactivity levels[14] and is currently stored in drums in a disused aircraft hanger at Woomera.



The Fishermens Bend contaminated soil stored at Woomera

6.12 The Australian Defence Industries material from St Marys is about half low level material and about half intermediate level material[15] and is now stored in the bunker at Woomera. The above ground bunker has a concrete wall three metres high on three sides with a raised earth mound on one side. The dose rates outside the bunker are less than one microsievert per hour. This level complies with the South Australian State regulations which require that areas accessible to the public do not exceed 25 microsieverts per hour.[16]

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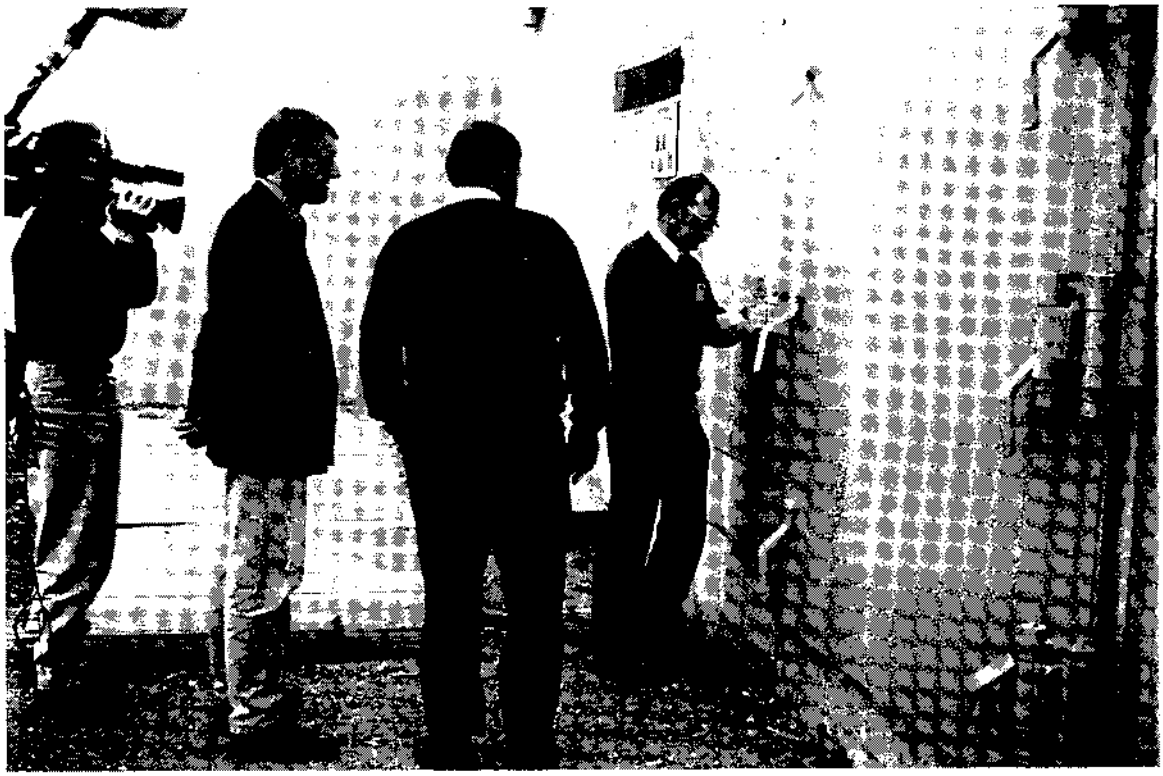
14 Burns, Transcript of Evidence, p. 105

15 Curtis, Transcript of Evidence, p. 116

16 Ibid, p. 127

6.13 An additional roof has been added to prevent rain water leakage and two chimney ducts were installed to prevent the build up of radon gas within the bunker.[17] The Committee notes that no radon monitoring equipment has been installed comparable to that in the Queensland's Esk facility. The Committee feels that the absence of monitoring equipment has left the Commonwealth open to future compensation claims, as evidence as to the low level or absence of radon gas in the facility cannot be provided. This will need to be considered, particularly if additional radioactive material is to be stored in the bunker.



The Committee Chairman inspecting the bunker at Woomera

6.14 It is expected that the radioactive waste presently at Woomera will remain there until the national facility is established.

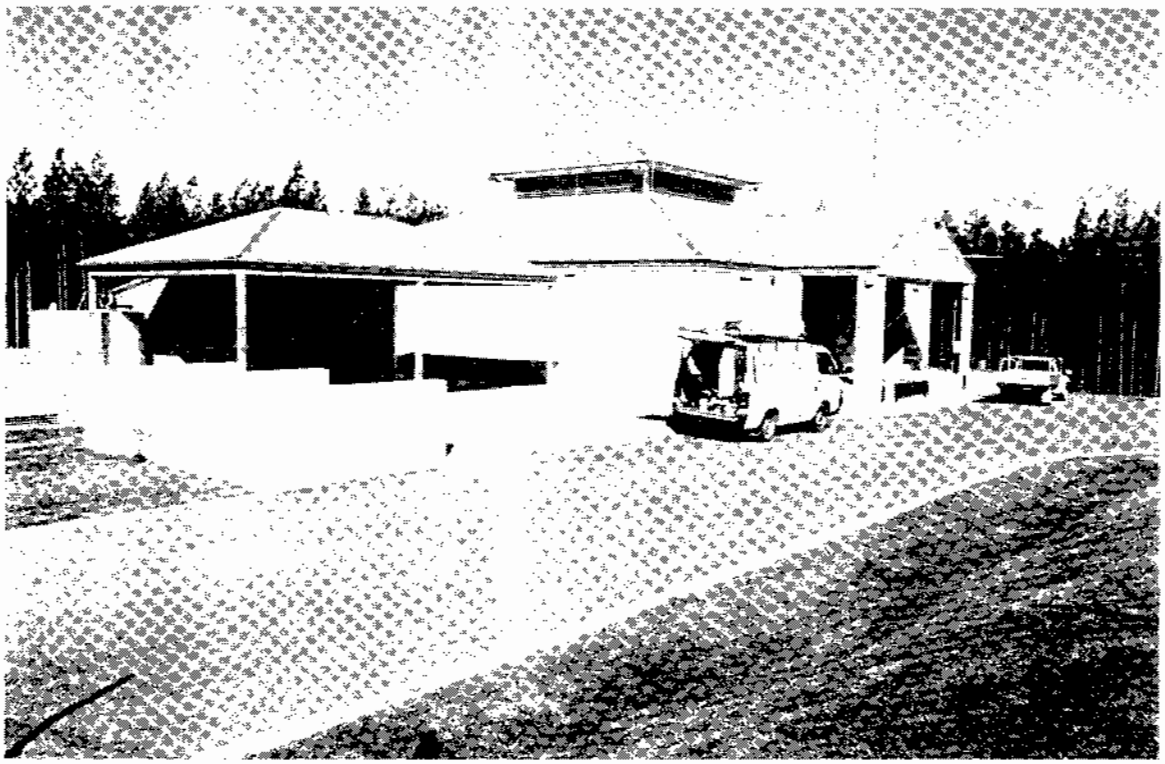
6.15 Other Commonwealth radioactive wastes are stored on site at a number of locations throughout Australia such as Department of Defence and CSIRO premises.

17 Curtis, Transcript of Evidence, pp. 119-20

State Storage Facilities

Esk Storage Facility

6.16 The above ground, purpose built concrete storage facility at Esk in Queensland enables the integrity of the structure to be monitored and any problems to be easily detected.



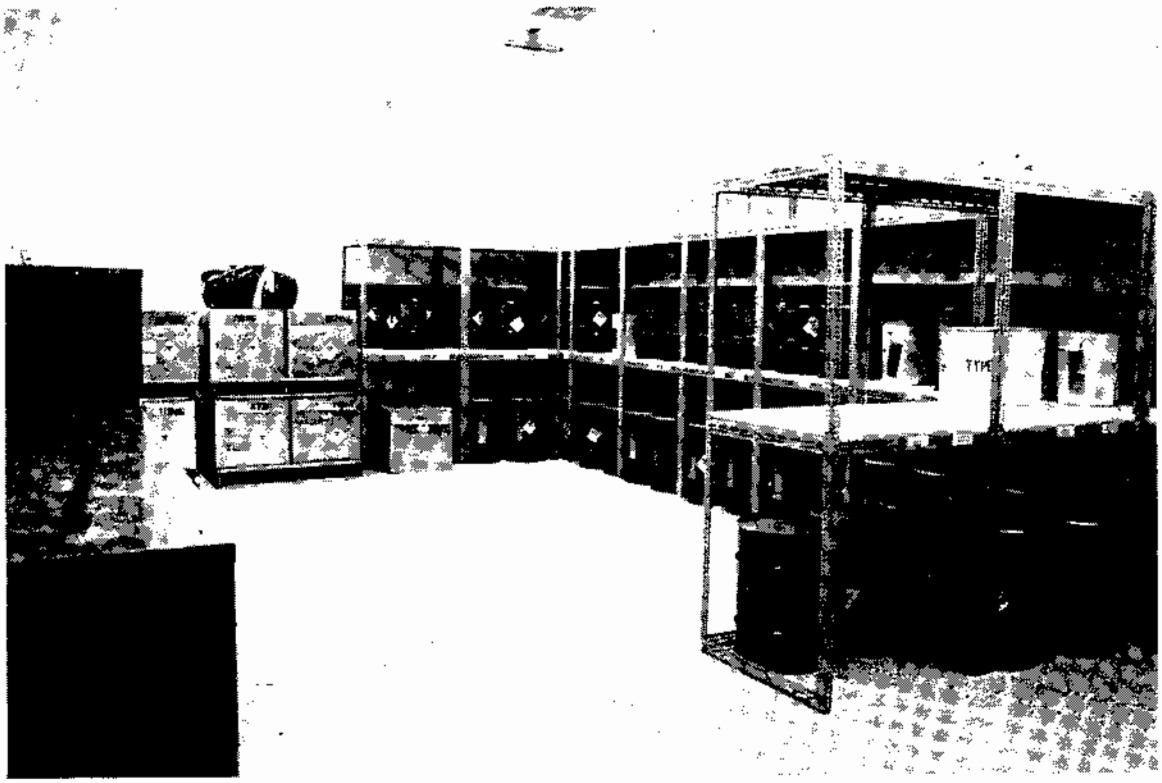
The Esk facility (Photograph provided by the Queensland Department of Health)

6.17 It has electronic surveillance. It is not far away from fire services and police. There is a full operational audit every month.[18] The Australian Radiation Laboratory commented that:

> The State of Queensland should be congratulated on its efforts, in view of the considerable opposition to the project and for leading

18 Kleinschmidt, Transcript of Evidence, p. 722

the country by providing this facility which will no doubt become the benchmark for the rest of the country to follow.[19]



The radioactive Waste Stored in the Esk Storage Facility (Photograph provided by the Queensland Department of Health)

6.18 The Queensland Greens expressed concerns about the location of the facility in the Brisbane River catchment area, which supplies water for south east Queensland and is surrounded by small farm crops which are irrigated from underground bores.[20] The Queensland Greens were concerned that there was no ground water quality monitoring to detect any long term contamination. The site is also located over a fault line.[21]

6.19 Disposal options have not been considered as this facility was always considered to be for storage only.[22] There are still significant amounts of

19 Cited in Queensland Government, Submission No. 30, p. 1

20 Mahoney, Transcript of Evidence, pp. 619, 622

21 Ibid, pp. 621- 622

22 Wallace, Transcript of Evidence, p. 713

radium stored which are not suitable for shallow ground burial.[23] The Committee was told that the Esk community is concerned that this higher level material will remain at Esk until the Commonwealth provides a radioactive waste facility.[24]

Other State Facilities

6.20 The Victorian Government has a new purpose built storage facility and the Northern Territory proposes constructing one in the near future. [25] The New South Wales Government has two storage facilities at Lidcombe.

Individuals and organisations

6.21 In the past, hospitals have been able to send sealed sources to the relevant State or Territory authority. However, in some states this is no longer an option.[26] Most hospitals have some radioactive materials they wish to send to the proposed national facility. Examples given to the Committee include St George Hospital which has a number of small point sources[27], Royal Perth Hospital which has some radium and caesium sources[28], Royal Adelaide Hospital which has a large cobalt[60] therapy source.[29] A doctor in Adelaide has a strontium[90] ophthalmic applicator.[30]

6.22 The Royal Alexandra Hospital for Children does not believe that the storage of long term radioactive waste on site in hospitals is the most desirable option.[31] Westmead Hospital has limited facilities for handling radioactive waste and is only able to store materials on a temporary basis. The hospital believes that this is fairly typical of large medical institutions.[32] The Committee was told that:

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23 Wallace, Transcript of Evidence, p. 714

24 Mahoney, Transcript of Evidence, p. 640

25 Victorian Government, Submission No. 37, p. 3; Northern Territory Government, Submission No. 14, p. 7

26 The Alfred Healthcare Group, Submission No. 67, p. 1

27 St George Hospital, Submission No. 66, p. 3

28 Royal Perth Hospital, Submission No. 69, p. 1

29 Paix, Transcript of Evidence, p. 224

30 Ibid, p. 224

31 Hanlon, Transcript of Evidence, p. 750

32 Westmead Hospital and Community Health Services, Submission No. 65, p. 2

> security of storage can often be a problem, as can ventilation, water inflow, flammable liquid storage etc. To my knowledge very few hospitals and universities have adequate radioactive waste storage and disposal arrangements (which should also include facilities for waste compaction).[33]

6.23 There are still a lot of caesium and radium sources.[34] The Committee was told that caesium[137] sources such as decommissioned radiotherapy sources should never be kept in hospitals because they are too dangerous.[35] Caesium has a half life of 32 years.[36] In the Soviet Union a terrorist bomb was made from caesium[137] combined with an ordinary explosive charge.[37]

6.24 Oncology departments will continue to use caesium in the foreseeable future although much of this will be returned to the manufacturer.[38] A number of large caesium sources used in the treatment of gynaecological cancer will need to be stored in 3-4 years time.[39] Mr Griffiths that it was more appropriate that:

> a single set of guidelines and a single repository for waste would be more appropriate than having it spread around the countryside.[40]

6.25 The Alfred Healthcare Group also provided a scenario in which changing staff and conditions at hospitals may lead to unidentified sources being disposed of in an unsafe manner.[41] Some States now have a system for registering radioactive sources, although this approach was not without criticism:

> Registration of these sources is better than doing nothing, but it will not guarantee the safe custody of sources over a very long period of time. In the past, difficulties have arisen because early pract[it]ioners have retired or died, records were incomplete or non-existent; labels deteriorated or were obliterated; storage safes were relocated, buildings have been renovated, designated for

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33 Westmead Hospital and Community Health Services, Submission No. 65, p. 3

34 Collins, Transcript of Evidence, p. 759

35 Ibid, p. 774

36 Ibid, p. 758

37 Elbourne, Transcript of Evidence, p. 803

38 Collins, Transcript of Evidence, p. 768

39 Griffiths, Transcript of Evidence, p. 753

40 Ibid, p. 753

41 The Alfred Healthcare Group, Submission No. 67, p. 1

> other uses or demolished. Given the half life of radionuclides such as radium-226 (1600 years), it would be a brave hospital administrator indeed who foresees no problems over the ensuing centuries.[42]

6.26 There are also some problems in some universities. Mr Paix told the Committee that when he:

> arrived on the scene and became a radiation safety officer, I was faced with this waste - improperly labelled, some of it rusting away and in poor condition. All I could do with the facilities and time I had was to check it for gamma emissions and make sure that it could be stored safely without any impact on staff or the environment.[43]

6.27 Hospitals and universities established 100 years ago, many of which are located in densely populated areas, could not have foreseen the need to store the variety and quantities of radioactive wastes that exist today. Mr Fleischmann expressed his concern that organisations such as hospitals and scientific facilities are not set up to store their own waste indefinitely.[44]

6.28 This is a situation where radioactive waste may be stored locally and is 'in sight and in mind', but long term better facilities are required for these wastes.[45] The Committee notes that much of this material is derived from obsolete techniques. A balance is needed between the 'in sight in mind' concept and public safety in populated areas. The Committee considers that public safety provides a powerful argument for a central facility to store intermediate level radioactive waste.

One Site or a Number of Storage Sites

6.29 The Commonwealth Environment Protection Agency believes that a national repository for long term storage of radioactive materials would provide stronger environmental safeguards than the present system of multiple storage

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42 Towson, Submission No. 38, p. 2

43 Paix, Transcript of Evidence, p. 215

44 Fleischmann, Transcript of Evidence, p. 479

45 Lewis, Transcript of Evidence, p. 648

sites.[46] Others argue that organisations using radioactive material should be required to keep it in a safe and secure storage facilities on site.[47]

6.30 Conservation groups believe that a purpose built, fully enclosed, storeroom on the site of production is the preferred option.[48]

> on site, surface engineered, monitored storage is preferable to a single national repository. This is especially true if that repository makes use of a discredited disposal mode such as shallow-land burial. If this disposal mode is chosen for all LLW then, we argue, much of the waste in Australia may in fact be better contained in its existing sites and structures. This does of course, depend highly on the exact conditions in which the waste is currently stored.[49]

6.31 Mr Ian Taylor argued that this approach is not suitable for Western Australia:

> the ad hoc storage of these wastes and the ad hoc solution for Western Australia is not a reasonable or proper solution.[50]

6.32 The Committee's concern is that a number of witnesses commented on the inadequacy of some existing storage sites and the difficulties in having facilities upgraded due to tight budgetary constraints. The Committee was told that storage facilities in some states are inadequate.[51] The Committee believes that the existence of a central storage facility would provide an additional option on a user pays basis for those in this situation. Those having adequate storage facilities could be expected to retain the radioactive materials on site.

6.33 There are risks to staff and members of the public if waste is retained in inadequate facilities. Some intermediate level discrete sources are of particular concern. Many hospitals have adequate facilities for dealing with low level wastes but are concerned about keeping higher level waste in a public facility.

6.34 The Committee was told that there are probably more than one hundred radioactive waste storage sites at the moment.[52] The former Minister for

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46 Johnston, Transcript of Evidence, p. 691

47 Botten, Transcript of Evidence, p. 171

48 Pearson, Transcript of Evidence, p. 464; Nuclear Issues Action Group, Submission No. 42, p. 4

49 Friends of the Earth, Submission No. 47, p. 3

50 Taylor, Transcript of Evidence, p. 862

51 Hartley, Submission No. 24, p. 1

52 Hochman, Transcript of Evidence, p. 216

Primary Industries and Energy puts the figure at 50 sites.[53] The advantages of needing to maintain security at only one site must be balanced against the risks of transportation. When a number of locations are involved there is an increased danger of somebody accidentally stumbling across the material, the building burning down[54] or deliberate or accidental breaches of security.[55]

6.35 Security for a central facility as opposed to a number of local storage sites is an important issue. The safe storage of higher level radioactive waste in the public domain such as a public hospital would be much more difficult than security at a dedicated facility.[56]

> As it is virtually impossible to assure absolute security in a hospital, this remains a matter of constant concern.[57]

6.36 Another problem identified with having many on-site stores is the increased potential for abandonment and mishandling of that waste. The storage of long lived sealed sources which are used for therapy purposes in hospitals is of particular importance.[58] There have been some particularly nasty incidents in other countries where institutional control has been lost. Mr Fleischmann told the Committee that one of the worst radiation accidents involved a medical source.[59] The human consequences of lack of institutional control were evident in Goiana in Brazil.[60] Several people died, many were contaminated and hundreds of truckloads of contaminated waste had to be stored.[61]

6.37 The University of South Australia has 'good' security for a concrete room but is concerned that in the event of a major fire, a dispersal hazard could be created by the radioactive materials.[62]

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53 Collins B, (1994) former Minister for Primary Industries and Energy, *Phase Two of Radioactive Waste Repository Site Selection Study Released for Public Comment,* Media Release 18 July 1994, p. 1

54 Hochman, Transcript of Evidence, p. 217, 223

55 Paix, Transcript of Evidence, p. 224

56 Towson, Transcript of Evidence, p. 523

57 Royal Alexandra Hospital for Children, Submission No. 5, p. 5

58 Towson, Transcript of Evidence, p. 524

59 Ibid, p. 524

60 Davoren, Transcript of Evidence, p. 37

61 Elbourne, Submission No. 53, p. 2

62 University of South Australia, Submission No. 27, p. 1

6.38 The Westmead Hospital believes that in the absence of a national repository:

> the conflicting waste disposal guidelines of the NHMRC and the various states, it is virtually impossible to dispose of radioactive waste until it is of very low activity ... Most hospitals allocate a relatively small area of greatly varying levels of security and suitability for waste storage. In some cases these are a potential source of risk, from say, flooding and forced entry.[63]

6.39 One of the problems with having a number of storage facilities in cities is the likelihood of future redevelopment of sites in populated areas. For example, the Royal Alexandra Hospital for Children has recently moved from Camperdown. The redevelopment of the Australian Defence Industries site at St Marys required the removal of waste stored there.

6.40 One of the difficulties associated with covering radioactive waste with soil, particularly in a metropolitan area, is the construction of a multistorey building or installation of water pipes which requires digging to a greater depth than that required for a standard house. Mr Fleischmann does not believe it is a good practice to leave radioactive waste at any disused site or potential redevelopment site.[64]

6.41 The current practice in mineral processing operations is for tailings to be returned to the mine site and covered with at least five metres of non mineralised sand. The location is recorded to ensure that no inappropriate use may take place in the future.[65] In the case of Westralian Sands, the company maintains those sites on its own land.[66] The Committee is concerned that these pockets of high level radioactivity may present a risk in the future if the area is breached. The costs of transporting mineral sands tailings to a national repository, however, is generally considered prohibitive.[67]

6.42 The Committee was told that:

> the very clear preference of every government in Australia is that we have a central facility. Issues of efficiency are involved - the

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63 Westmead Hospital and Community Health Services, Submission No. 65, p. 2

64 Fleischmann, Transcript of Evidence, p. 495

65 Fee, Transcript of Evidence, p. 280; Dench, Transcript of Evidence, p. 278, 280; Schache, Transcript of Evidence, p. 277

66 Dench, Transcript of Evidence, p. 280

67 Rawson, Transcript of Evidence, p. 42

> costs of maintaining a whole lot of separate stores are quite large over the nation.[68]

6.43 The opposing argument is that the long term risks of concentrating all radioactive waste in one place are enormous and there is an additional increase in transporting that waste over long distances.[69] It was suggested that the disposal of this material at a convenient site in the middle of nowhere would not discourage the creation of further radioactive industries.[70]

6.44 The evidence to the Committee indicates that most radioactive waste producers can cope with the storage of the radioactive waste they generate annually, but it is waste of historic origin that causes the most concern. In the past a number of organisations have stored radioactive waste for others. The future management of any radioactive material from the closure of hospitals or private medical practices must be considered on a case by case basis.

6.45 A possible compromise would be to retain most on site waste with a capacity for the relevant authority to consider requests from individuals or organisations to store certain materials at a national facility. The Committee believes that this approach would enable assessment of situations which may constitute a potential public health risk, while not encouraging the increased production of radioactive materials simply because there is an easy storage solution.

Above Ground Storage Versus Underground Disposal

6.46 Evidence to the Committee suggests there was considerable opposition to the shallow burial of the radioactive waste even at the levels permitted under the *Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia 1992.*

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68 Davoren, Transcript of Evidence, p. 32

69 Lowe, Transcript of Evidence, p. 319

70 Ibid, p. 319

Above Ground Storage

6.47 Storing radioactive waste above ground will enable the maximum number of management options to be available in the future.[71] Stored wastes remain accessible if new technologies for processing it, are developed.

6.48 Dr Fenton believes that a technology which will enable the destruction of heavy radioactive nuclei will eventually be developed.[72] He gave the example of the natural spallation process in which heavy nuclei are broken into smaller fragments as a result of collisions with interstellar gas atoms or in the top of the earth's atmosphere.[73] This process can be reproduced in overseas laboratories and it is possible that:

> fundamental research with colliding beams of accelerated nuclei, now being undertaken in the US and Europe, may lead to such spallation processes becoming a practical reality.[74]

6.49 Friends of the Earth pointed out that at l'Aube in France, the heavily engineered vaults designed to last for 10 000 years and to be out of reach of ground water, come very close to being above ground permanent storage.[75] The Committee was told that the French would be storing their high level waste until the year 2010.[76] They will then determine what they will do with it.

6.50 Australia produces about 50 cubic metres per year compared with France's one million cubic metres per year.[77] Some hold the view that storage should be temporary until the scientific community can determine safe disposal methods or recycling or reuse options. Western Australia built its first above ground storage facility in 1967. It is still useable and in quite good condition.[78] It follows therefore that a storage facility of the standard recently constructed at Esk in Queensland would be able to store Australia's radioactive waste until international research is able to develop technologies capable of dealing with the waste materials.

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71 Baker, Transcript of Evidence, p. 150

72 Fenton, Transcript of Evidence, p. 732

73 Ibid, p. 732

74 Fenton, Submission No. 18, p. 1

75 Hallam, Transcript of Evidence, p. 442

76 Munslow-Davies, Transcript of Evidence, p. 307

77 Ibid, p. 308

78 Ibid, p. 304-305

6.51 On the other hand, it was argued that an above ground storage facility would result in double handling of the waste; would require greater maintenance than shallow burial repository; and that buried waste is more secure, as earth moving equipment would be needed to recover it.[79]

6.52 Mr Fleischmann told the Committee that it is perceived that above ground storage facilities were automatically safer.[80] An illustration that this is not necessarily the case was that of a radiotherapy source stored in a building in Brazil. It was obtained and broken open by a scrap metal dealer. Half the city was severely contaminated and four people died.[81]

6.53 An important consideration is the suitability of shallow ground burial for only low and some intermediate level waste. Higher level wastes need to be in above ground storage.[82] There is an ongoing need to store radium and americium, which are not suitable for shallow ground burial, above ground.[83]

6.54 A further advantage of above ground storage is that if a national repository could accommodate higher level radioactive waste, existing low level waste could be concentrated, shredded or compacted to reduce its volume, provided adequate safeguards were used.[84]

6.55 The Committee supports the establishment of an above ground waste facility over the burial option because:

- higher level radioactive wastes could be accommodated which are currently being stored in less than optimum circumstances;
- radium and some other materials are not suitable for burial;
- it is not economically feasible to build a deep burial facility for Australia's current quantities of radioactive waste; and
- above ground storage allows the retrieval of the waste if new technologies are developed to use or process the waste, while burial, for practical purposes, makes waste irretrievable.

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79 NSW Environment Protection Authority; Supplementary Submission No. 45a, p.2

80 Fleischmann, Transcript of Evidence, p. 476

81 Ibid, p. 476-477

82 Colgan, Transcript of Evidence, p. 393-394

83 Wallace, Transcript of Evidence, p. 714

84 Wong, Transcript of Evidence, p. 742

6.56 Radioactive waste could be stored for the next 100 years and if no solution is found, it could then be buried, utilising experience and knowledge gained during that period. For example, at Oak Ridge National Laboratory Tennessee the disposal method for solid low level waste was radically changed from unlined shallow trenches in 1986 to concrete silos and lined auger holes and in 1994 to above ground tumulas.[85]

6.57 With burial there is a risk of contaminating the environment through leakage to ground water. It was pointed out that the engineering costs associated with ensuring that the burial facilities are not likely to leak, could be better spent on an above ground facility which will have the capacity to store all levels of radioactive waste, without the same risks.[86]

Below Ground Storage

6.58 One submission suggested the storage of low and intermediate radioactive waste below ground in coal mines. It was suggested that this is a technically feasible and cost effective solution. Advantages include the close proximity to the major source of radioactive waste, accessibility by road and rail and location in an area not heavily inhabited.[87] This method may be suitable for high level waste if the design was modified to deal with potential problems with high temperatures.[88]

6.59 Chambers could be made earthquake resistant and any size required; other technical requirements can be accommodated at increased cost.[89] The chambers would form a controlled environment through continuous monitoring and regular inspections of the materials.[90]

6.60 Germany and Sweden use different forms of deep geological storage for high, intermediate and low level waste and Sellafield in the United Kingdom uses this storage method for both intermediate and low level waste.[91]

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85 Kendrick C (1994) *Environmental Restoration and Management of Low-Level Radioactive and Mixed Waste at Oak Ridge National Laboratory*, Institute of Engineers Australia and Australian Nuclear Association, 9th Pacific Basin Nuclear Conference, Sydney, 1-6 May 1994, , p. 965

86 Fenton, Transcript of Evidence, p. 735

87 Bhattacharyya, Transcript of Evidence, p. 817

88 Ibid, p. 814

89 Bhattacharyya, Transcript of Evidence, p. 815; Fairclough, Transcript of Evidence, p. 820

90 Bhattacharyya, Transcript of Evidence, p. 813

91 Friends of the Earth, Submission No. 47, p. 4

6.61 The Committee believes that any proposal to place radioactive waste underground in the Illawarra region or any other populated area would generate considerable community concern.

Disposal Options

6.62 Radioactive material cannot be destroyed. Hence, the term 'disposal' in this context refers to the isolation of longer lived or higher level radioactive waste from the environment. There was concern within the community that:

> The notion that radioactive waste can be disposed of is dangerous and erroneous.[92]

6.63 Disposal in the context of radioactive waste means putting it somewhere where retrieval is not intended. A great deal of effort has gone into finding a suitable method of disposing of radioactive waste but this has not yet been achieved.

> It is almost certain that more effort and resources have been devoted to finding an acceptable and safe disposal route for radioactive wastes than for any other kind of waste.[93]

6.64 Near-surface disposal of low-level waste, usually in steel drums buried in shallow earth or concrete lined trenches, at depths of about thirty metres, has been practised internationally for over thirty years.

6.65 There is an international trend away from shallow ground burial due to problems with existing sites.[94] Many countries have had to remediate their earlier dangerous procedures, where material has migrated into the surrounding areas, either through inadequate packaging, poor engineering, or unsuitable location. Some early burial sites were just holes in the ground.[95]

6.66 The Committee was given some notable examples. At Maxey Flat in the United States, plutonium has migrated more than two miles off site in less than nine years, although estimates were that it would migrate half an inch in 24 000 years.[96] At Hanford in the United States, a high level facility leaked 500 000

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92 Women Opposing Uranium Mining, Submission No. 39, p. 6

93 Uranium Institute, (1992) 'The management of radioactive waste' *The Mining Review* (August 1992): 8-15, p. 11

94 Greenpeace, Submission No. 48, p. 5

95 Fleischmann, Transcript of Evidence, p. 486

96 Schrader-Frechette, Submission No. 2, p. 1-2

gallons of waste into the soil at Columbia River and the Pacific Ocean.[97] In Soviet Kasli, 22 square miles were made uninhabitable by high level radioactive waste that went critical three decades ago.[98]

> The US government has extrapolated, on the bases of past leaks at its nuclear waste facilities ... that future leaks should occur at the rate of two to three per year. Using US government-estimated exposure levels (580 person rem) at each radwaste site, each existing facility could cause approximately 12 cancers and 116 genetic deaths per century, and ultimately, tens of thousands of cancers per storage site.[99]

6.67 It was also pointed out that future generations can not be guaranteed that repositories would not be breached:

> through war, terrorism or drilling for minerals or that water and heat will not combine to create nuclear reactors in underground waste, as already has happened in the USSR.[100]

6.68 Dr Schrader-Frechette told the Committee

> Radioactive waste probably ought not be buried permanently. First because no geology will be stable in perpetuity and because the threats to health and safety of future generations are severe.[101]

6.69 Reinforced vaults or tumulas, with protective covering layers, are now the preferred solution. Since 1990, major engineered disposal facilities for low level and short lived intermediate level waste have been commissioned in France (Centre de l'Aube, above-ground vault,), Japan (Rokkashomura, below-ground vault), Spain (El Cabril) and Canada (Chalk River Laboratories).

6.70 A number of European countries including Germany are examining the disposal of combined low level and intermediate level wastes in specially excavated caverns or disused mines at depths of more than 50 metres. So far, no country has decided on a permanent repository for high level wastes, although it is the topic of much discussion. According to an OECD

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97 Schrader-Frechette, K, (1991) Discussion Papers, Ethical Dilemmas and Radioactive Waste; A Survey of the Issues, *Environmental Ethic* 13 (Winter 1991): 327-343, p. 328

98 Ibid, p. 328

99 Ibid, p. 328

100 Ibid, p. 331

101 Schrader-Frechette, Submission No. 2, p. 1

international workshop held in September 1994, disposal facilities for long-lived waste will not be operational before about 2010-2020.

Near Surface Disposal

6.71 Near surface disposal is the burial of radioactive waste, with or without engineered barriers, on or below the ground surface where the final protective covering is of the order of a few metres thick, or in caverns a few tens of metres below the surface. The Department of Primary Industries and Energy's discussion paper published in 1993 stated that:

> Disposal of radioactive waste in a near surface repository is preferable to above-ground storage as the substrate provides a natural barrier to radioactivity and there is less risk of vandalism or removal of radioactive material.[102]

This view was not supported by many of those participating in this Inquiry.

6.72 The *Code of Practice for the Near Surface Disposal of Radioactive Waste in Australia* (1992) deals with the general site characteristics, site selection criteria, waste characteristics, facility design and operational requirements. The code recommends conditions for disposing, by shallow burial, of waste[103] such that doses received by anyone in the vicinity should be no higher than those recommended by the National Health and Medical Research Council.

6.73 The Committee was told that shallow land burial is being used at Drigg in Cumbria, Hanford in the United States, Barnwell and Centre de l'Aube in France.[104] The Drigg facility is currently being upgraded with the construction of concrete lined cells which contain specially made steel containers.[105]

Mt Walton Intractable Waste Disposal Facility, Western Australia

6.74 The Mt Walton East Intractable Waste Disposal Facility was established in 1992 by the Western Australian Government for the disposal of hazardous

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102 Department of Primary Industries And Energy, (1993) *National Radioactive Waste Repository Site Selection Study* Phase 1 A Report on Public Comment, August 1993, Australian Government Publishing Service, Canberra, p. 8

103 other than waste covered by the *Code of Practice on the Management of Radioactive Wastes from the Mining and Milling of Radioactive Ores* (1982), or the *Code of Practice for the Disposal of Radioactive Waste by the User* (1985)

104 Davoren, Transcript of Evidence, p. 38

105 Davies, Transcript of Evidence, p. 258

and intractable wastes including monazite residue.[106] To date there have been two disposal operations of waste collected by the Health Department including an old phosphoric acid plant.[107]

6.75 At Mt Walton, waste is cased in cement and placed in drilled two metre diameter bore holes. A concrete slab weighing several tonnes is placed on top then there are five metres of clay and then another shaft of concrete inside which are two layers of drums. Each bore hole is fenced, the area of two hundred square metres is cleared and fenced and gates have radiation warning signs.[108] The Radiation Protection Office in Western Australia has accepted a 100 year institutional control period. Over the 300 years design lifetime, after which the concrete will crack and be incorporated into the surrounding soil, the concrete provides the mechanical containment and the alkaline environment will help stop the migration of cations of metallic radionuclides.[109]

6.76 The Committee was told that this creates several layers of security and there is really no prospect of anybody reasonably being able to extract waste from the repository.[110] The site is visited about once a month for statutory monitoring and reporting requirements.[111] A number of witnesses from the region commented on the lack of security in terms of a permanent presence on site.[112]

6.77 The radioactive waste deposited at Mt Walton includes discrete sources which are quite active. The Committee was told that the Mt Walton East facility met the ideal selection criteria published by the International Atomic Energy Agency except for the criterion relating to proximity to transport routes.[113]

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106 Newton, Transcript of Evidence, p. 711

107 Davies, Transcript of Evidence, p. 267; Hutchinson, Transcript of Evidence, p. 386; Schuster, Transcript of Evidence, p. 246

108 Schuster, Transcript of Evidence, p. 255

109 Munslow-Davies, Transcript of Evidence, p. 306

110 Davies, Transcript of Evidence, p. 257; Hartley, Transcript of Evidence, p. 353

111 Schuster, Transcript of Evidence, p. 256

112 Nilsson, Transcript of Evidence, p. 346; Wright, Transcript of Evidence, p. 869; Botica, Transcript of Evidence, p. 853; Peebles, Transcript of Evidence, p. 847; Conservation Council of Western Australia, Submission No. 44, p. 1

113 Hartley, Transcript of Evidence, p. 352

6.78 The Department of Environmental Protection considers Mt Walton East to be one of the most geologically stable areas in Australia.[114] On the other hand the Committee was told that a minor earthquake in January 1990 at Bullfinch, approximately 100 kilometres from Mt Walton, resulted in the cracking of a quite thick concrete slab.[115] Australia is moving slowly in a northerly direction and may eventually collide with South East Asia. However, Rhone Poulenc believe that this will not impact on the geological stability of the Yilgarn Block.[116]

6.79 Mt Walton East is considered a very arid region. However, it does rain heavily at times.[117] With global warming it is predicted that rainfall events may be heavier but less frequent.[118] The Country Women's Association of Western Australia is concerned that water from Mt Walton could flow into Lake Deborah East, Lake Seabrook and the Avon and Swan Rivers.[119] Rhone Poulenc told the Committee that even with the scenarios of global warming there is no prospect of the Mt Walton East site being flooded from the melting of polar ice caps.[120]

6.80 Ground water is a major factor in causing radioactive waste to migrate from the place of disposal.[121] The statutory monitoring process at Mt Walton requires the monitoring of ground water[122] although no ground water has been found on the site in the 50 wells drilled.[123] The Committee was told that even in the event of a substantial climate change, it is unlikely that a water table would ever form in the area because of the nature of the soils.[124] The site was purposely chosen away from surface drainage channels. Rhone Poulenc, however, told the Committee that:

> There are ancient drainage channels in the area and it is supposed that any free ground water would eventually find its way into them,

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114 Schuster, Transcript of Evidence, p. 251

115 Nilsson, Transcript of Evidence, p. 347

116 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 11

117 Schuster, Transcript of Evidence, p. 251

118 Hartley, Transcript of Evidence, p. 706

119 Nilsson, Transcript of Evidence, p. 343

120 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 11

121 Munslow-Davies, Transcript of Evidence, p. 305

122 Schuster, Transcript of Evidence, p. 262

123 Hartley, Transcript of Evidence, p. 353

124 Davies, Transport of Evidence, p. 262

> unless first lost through evaporation or transpiration. Evaporation and transpiration exceed precipitation by a factor of about ten.[125]

6.81 Rainfall at the site is trapped by the cap rock layer and does not penetrate below to the level where the waste is placed. A clay capping is added so that rain water cannot infiltrate to the waste.[126] The Committee questions the adequacy of the clay capping as a mechanism to provide long term impermeability considering the half lives of some of the radioactive material.

6.82 The Committee was also told that Mt Walton is not a remote location as it is only 35 kilometres north of Southern Cross; and the Western Australian Planning Commission predicts a forty per cent population increase in the Goldfields Region by the year 2026 to 76 000.[127]

Rhone Poulenc Rare Earth Project

6.83 Rhone Poulenc believe that in the case of an accident during transport the radioactive material problems could be contained and managed by normal emergency procedures.[128] The Radiation Health Section of the Health Department and Rhone Poulenc would train emergency crews.[129]

6.84 Waste from the Rhone Poulenc rare earth project may be suitable for disposal at the Mt Walton East site.[130] Rhone Poulenc will need to dilute the uranium and thorium waste by a factor of 1.4 to meet the Disposal Code requirements, and will cover the waste with layers of neutral material to reduce the radiation levels to the average activity for the disposal structure.[131]

6.85 The bulka bags used to transport the Rhone Poulenc radioactive waste, although industrial heavy duty polypropylene, are not intended to be a long term barrier. The clay structure surrounding it is designed to contain the material.[132] Mr Fleischmann told the Committee that:

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125 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 6

126 Davies, Transcript of Evidence, p. 263

127 Nilsson, Transcript of Evidence, p. 342; Goldfields Against Serious Pollution, Submission No. 57, p. 4

128 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 11

129 Ibid, p. 12

130 Schuster, Transcript of Evidence, p. 254

131 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 5

132 Newton, Transcript of Evidence, p. 705

> using plastic drums to contain thorium hydroxide and putting them in a shallow burial site was that plastic would probably last a considerable amount of time and, if ultimately they did break up and the stuff leached out it would only generally tend to mix with the soil and ultimately break down. ... I could not imagine it representing a major hazard if it is in a remote location.[133]

6.86 It is proposed that this waste be placed in a pit in the granite covered by three metres of compacted clay and various other geotextile materials to prevent intrusion of water and roots into the waste.[134] If this waste is required to be placed in a strictly monitored secure engineered facility, the cost for Rhone Poulenc would be higher and thus the project would be less economically viable.[135]

6.87 The materials are very fine talc particle size (<1µm)[136] and Ms Peebles believes that issues relating to dusting were not covered adequately in the documentation.[137] Rhone Poulenc argued that on drying, the material forms a hard solid and does not dust.[138]

6.88 It was suggested that should the Rhone Poulenc proposal proceed, then the institutional control period of about one hundred years would not be adequate. Thorium has a half life of 14 billion years, uranium half life of 10 billion years and radium half life of 1 600 years.[139] The Statewide Network of Action Groups told the Committee that radium is highly radiotoxic and that one gram is sufficient to cause cancer in 1000 humans.[140] The Western Australian Department of Minerals and Energy pointed out that the codes of practices allow this type of disposal for long half life radioactive waste provided it is of low enough activity.[141]

6.89 Radon from the barium sulphate material in the Rhone Poulenc waste can be expected to escape more readily than from the monazite but still has to get

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133 Fleischmann, Transcript of Evidence, p.486

134 Hartley, Transcript of Evidence, p. 355

135 Siewert, Transcript of Evidence, p. 324

136 Southern Cross Community Workshop, *WA Rare Earth Project*, 14 June 1995, p.15

137 Peebles, Transcript of Evidence, p. 846

138 Southern Cross Community Workshop, *WA Rare Earth Project*, 14 June 1995, p.19

139 Statewide Network of Action Groups *et al*, Submission No. 50, p. 4

140 Ibid, p. 6

141 Hewson, Transcript of Evidence, p. 260

through five metres of clay.[142] Monazite is up to three times more radioactive than yellowcake and the gangue wastes made up of thorium, radium and uranium are up to nine times more radioactive than uranium yellowcake.[143] The trenches will remain open for two years while they are filled.[144] Should a problem arise in the future or an alternative use be found for this material, a simple mining operation could recover this waste.[145]

6.90 Rhone Poulenc believe that:

> It is probable that exposure of the population to the material will be less, at least in the short term, if placed in secure disposal site than if monazite is released on the Swan Coastal Plain.[146]

Deep Burial

6.91 Geological disposal is the isolation of radioactive waste at depths up to several hundreds of metres using a system of engineered and natural barriers within a geologically stable formation.

6.92 There was some support for deep burial in mines as a method of disposal.[147] The concept of burial was opposed by conservation and environmental groups.[148] However, intermediate and low level waste radioactive waste has been deposited in salt mines in Germany, Sweden and New Mexico.[149] The Uranium Institute points out that:

> Assessments in various countries have concluded that even in the worst case human exposure to ionising radiation from a deep geological repository would be much less than that received continuously from natural background radiation.[150]

6.93 Department of Primary Industries and Energy consider that a deep underground facility would be more expensive than a near surface facility

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142 Hartley, Transcript of Evidence, p. 370

143 Statewide Network of Action Groups *et al,* Submission No. 50, p.2

144 Peebles, Transcript of Evidence, p. 840

145 Hartley, Transcript of Evidence, 361

146 Rhone Poulenc Chimie (Australia) Pty Ltd, Submission No. 71, p. 9

147 Harvey, Submission No. 54, p. 1; Burch, Submission No. 17, p. 1

148 The Nuclear Issues Group of the Conservation Council of South Australia, Submission No. 42, p. 4; Friends of the Earth, Submission No. 47, p. 60; Greenpeace, Submission No. 48, p. 8

149 Uranium Institute, 'The management of radioactive waste' *The Mining Review*, August 1992, p. 11

150 Ibid, p. 10

unless an abandoned mine or other existing facility could be used.[151] Overseas quotes of US$17 billion and $14.45 billion Canadian have been suggested for the construction of deep burial sites.[152]

6.94 The issues that need to be addressed if deep geological burial is considered include the potential ingress of water, adequate knowledge of deep geohydrological pathways and geological stability and the generation of gases by radiolytic and biological processes.

Coal Mines

6.95 Burial in coal mines, which was suggested by Dr Bhattacharyya *et al* as a form of disposal of radioactive waste, is arguably a form of storage because of the accessibility, rather than disposal.

> The disposal of low - to intermediate - level radioactive waste in appropriately designed near surface repositories provide the ideal environment for the secure and managed containment of such material, using continuous monitoring of excavation stability and the atmospheric and hydrological conditions.
>
> In this context, the abandoned coal mines in the Southern Coalfield of NSW offer the facility for establishing carefully engineered repositories for such waste with the advantages of geological suitability, accessibility, ease of construction, site security, monitoring and moderate costs.[153]

6.96 It was pointed out that there have not been any successful attempts at this method of disposal overseas because suitable conditions do not exist in the majority of coal basins in Lorraine (France), Ruhr (West Germany), Silesia (Poland), Donbass and Kuzbass (Russia) or Bowen (Queensland).[154] In many of these situations, the presence of groundwater has rendered such a proposal inappropriate.[155]

6.97 Geological data collected over many years would enable the identification of geological weaknesses and location of areas free of strata movements, subsidence or the presence of ground water.[156] It is estimated that

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151 Department of Primary Industries and Energy, Submission No. 28, p. 6-7

152 Sutherland Shire Environment Centre, Submission No. 7, p. 4

153 Bhattacharyya, Supplementary Submission 52a, p. 1

154 Bhattacharyya, Submission No. 52, p.2

155 Bhattacharyya, Supplementary Submission No. 52a, Appendix 3, p.8

156 Ibid, p. 3

the construction of a 3 000 metre long disposal chamber in an existing coal mine would cost less than ten million dollars.[157] The Committee believes that a proposal such as this is unlikely to be successful in the Sydney coal basin because of its proximity to population centres.

Uranium Mines

6.98 It was suggested that the rehabilitation phase of uranium mines is also a logical way to dispose of low level or medium level waste.[158] Uranium mines leave highly radioactive and chemically toxic tailings and an excavated site from which the original ore was extracted.[159] The Committee was told that tailings dams need to be rehabilitated, and the addition of low and intermediate level waste from other sources including sealed radioactive sources would not measurably increase the hazards.[160]

6.99 Dr Burch stressed that the tailings dams have thousands of curies of radium and other salts. The Committee was told that the disposal of some discrete sources of radium in an operating uranium mine may be appropriate because the quantities involved would be relatively insignificant compared to the radium already present.[161]

6.100 In 1992 the Olympic Dam Joint Venturers and the South Australian Government were prepared to cooperate with the Commonwealth Government in a feasibility study into the disposal of radioactive materials in uranium mines.[162] The Committee believes that this option should be further explored.

6.101 The CSIRO soil from Fishermens Bend contains naturally occurring uranium and thorium. The radioactivity of the soil is about eight times that of granite or one tenth that of uranium ore.[163] Sixty per cent of the waste is at a sufficiently low level to meet the criteria to permit disposal at a municipal tip approved for that purpose.[164] This material has not been placed in a municipal

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157 Bhattacharyya, Submission No. 52, p.3

158 Burch, Transcript of Evidence, p. 499

159 Co-Tech Management Pty Ltd, Submission No. 17, p. 1

160 Burch, Transcript of Evidence, p. 502-503

161 Hartley, Submission No. 24, p. 6

162 South Australian Government, Submission No. 23, p. 3

163 Rolland, Transcript of Evidence, p. 51.

164 Commonwealth Scientific and Industrial Research Organisation, Submission No. 25, p. 5

tip because although the specific activity is very low, shallow burial standards limit the total activity.[165]

6.102 The Australian Nuclear Association suggested that the Fishermens Bend soil would almost certainly be suitable for use as land fill, and the separation of the few drums of soil which have significant radiation emission levels would cost money and potentially irradiate the workers who do the separation.[166] The Committee believes that the possibility of disposing of that portion of the CSIRO waste which is considered suitable for disposal in a municipal tip in an active uranium mine should be considered. The Committee believes that the feasibility study should determine to what extent the contaminated soil could be disposed of in this way without increasing the hazards already present in the tailings.

Recommendation 13

The Committee recommends that a feasibility study be conducted into the suitability of disposing of the low level contaminated soil from Fishermens Bend in an active uranium mine.

6.103 ANSTO has requested a site to dispose of some low level radioactive waste as landfill, but permission has not been granted by the New South Wales Government.[167] The possibility of disposing of this low level waste from ANSTO in a uranium mine should also be considered.

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165 Smiles, Transcript of Evidence, p. 87

166 Hardy, Transcript of Evidence, p. 615

167 Sutherland Shire Environment Centre, Submission No. 7, p. 5

Recommendation 14

The Committee recommends that a feasibility study be conducted into disposing in an active uranium mine of that portion of the ANSTO waste that is suitable for disposal at a municipal tip.

6.104 In 1978, the New South Wales Government attempted to remove about 3000 tonnes of radioactive soil containing thorium and radium residues from Hunters Hill in Sydney to decontaminate six house blocks. Efforts to relocate the waste to a remote rural site at Manara (NSW) and then South Australia were unsuccessful.

6.105 The Committee does not know to what extent other states have similar problems but believes that some of this material may also be suitable for disposal in uranium mines. The potential for this should be investigated in a joint company/State/ Commonwealth project.

Recommendation 15

The Committee recommends that the Commonwealth Government ascertain the extent to which the States and Territories could benefit from disposal of low level wastes in uranium mines.

Other Burial Options

6.106 Mr Fleischmann believes that a fully developed underground burial site is preferable to above ground storage facilities.[168] Stable disposal chambers would include intrinsically safe technologies for remotely operated

168 Fleischmann, Transcript of Evidence, p. 477

construction of seals, control and monitoring systems.[169] The chambers could be made air tight by impregnating the rocks.[170]

6.107 The Committee believes that to construct an underground burial facility may be a protracted and costly process. The United States are planning to build the world's first permanent repository for high level nuclear waste at Yucca Mountain, Nevada. However, 80 per cent of the community militantly opposed the site and no one else is willing to take the waste.[171] A stalemate now exists and protracted legal and political debate continues.[172]

6.108 The question with deep burial is not whether the containment of waste will leak, but when. The National Radiological Protection Board of the United Kingdom pointed out that confidence in any predictions must decrease with increasing timescale. For a period of 100 years normal controls may be sufficient, but for time periods greater than one million years assessments can only be qualitative.[173]

6.109 The Committee believes that the construction of a burial facility for radioactive waste is inappropriate and unnecessary for the type and quantity of radioactive waste which currently needs management in Australia.

Other Methods of Disposal

Sending Radioactive Waste Overseas

6.110 In 1963, 150 spent fuel elements were returned to the United Kingdom from ANSTO's Lucas Heights reactor.[174] In July 1995, the British Government announced a policy of accepting for reprocessing spent sources which had been manufactured in the United Kingdom.[175] On 27 October 1995 the Government announced that ANSTO would negotiate the return of the remaining HIFAR spent fuel rods to the United Kingdom; Australia owns 1100 spent fuel rods of

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169 Bhattacharyya, Submission No. 52, p.2

170 Ibid, p.3

171 Schrader-Frechette, Submission 2, p. 2

172 Ibid, p. 2

173 Cooper J, Barraclough I & Mobbs S, (1992) *The Development of NRPB Advice for the Disposal of Solid Radioactive Waste*, International Radiation Protection Association Conference, Montreal 1992, cited in Rhone Poulenc, Submission No. 71, p. 10

174 Australian Nuclear Science & Technology Organisation, Submission No. 32, p. 7

175 Parliament of the United Kingdom, *Review of Radioactive Waste Management Policy*, Final Conclusions, London, July 1995, p. 39

British origin. The residue from the reprocessing of the spent fuel rods will be returned to Australia.

6.111 Australia will also pursue the return of spent fuel rods which originated in the United States, to that country.[176] In the case of fuel rods being sent to the United States, Australia will not be required to take back the residue from any reprocessing operations. Sutherland Shire Council does not believe that spent fuel rods should go overseas and that Australia has to take responsibility for them.[177]

6.112 Other radioactive materials to be sent overseas include decommissioned radiotherapy sources from hospitals which have been shipped to Asia under aid programs, and radioactive materials that are returned to the manufacturer who is responsible for their reuse or disposal.

Discharge to Normal Waste Stream

6.113 Other disposal options are based on the dilute and disperse principle. Waste which does not contain isotopes above the threshold limits can be buried at secure sites in a way similar to other hazardous waste.[178] The Committee was told that radioactive waste could be disposed of by dividing the waste into a number of loads which each fell below the threshold thus dispersing it and therefore saving months of storage of bulky material.[179] Some Committee members are concerned with the acceptability of the basic principle of dilute and disperse for the 'disposal' of radioactive waste.

Discharge to Sewers

6.114 The National Health and Medical Research Council *Code of Practice for the Disposal of Radioactive Wastes by the User (1985)* defines the maximum activities of each radionuclide which can be discharged into the sewer at twenty times the Annual Limit on Intake by Ingestion for radiation workers, during any period of seven days.

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176 Senator Peter Cook (former Minister for Industry Science and Technology) and Senator Bob Collins (former Minister for Primary Industries and Energy), *Spent nuclear fuel to leave Australia*, Joint Press Release, 27 October 1995, p.1

177 Rankin, Transcript of Evidence, p. 581

178 Wong, Transcript of Evidence, p. 743

179 Ibid, p. 741

6.115 ANSTO discharges liquid waste containing low level radioactivity to the sewer under contract with Sydney Water.[180] Low level liquid waste from ANSTO is disposed of to the cliff ocean outfall adjacent to the Cronulla Beach Complex in Bate Bay in Sutherland Shire.[181] The Committee was told that ANSTO routinely releases amounts of tritium into the sewer which would not be permissible in the United States.[182]

6.116 The Committee was also told that at Potter Point at Cronulla, the sewer system is subject to surcharging into stormwater drainage quite close to the ANSTO facility and presumably before any particular dilution effects occur.[183] As the large tanks containing sedimented liquid effluent become full during heavy rainfall, ANSTO releases the material into the system.[184]

6.117 The Committee was told that ANSTO has substantially increased discharges to sewer of alpha radioactive materials and tritium since 1980 but the measurement of environmental impact of emissions was last conducted in 1981.[185] Mr Fleischmann believes that this was not a major hazard because of the enormous amount of dilution, and the detection of isotopes at the point of ocean discharge or in the food chain would be difficult.[186] When ANSTO discharged into the Georges and Woronora Rivers sampling of fish and oysters detected only very low radioactivities.[187]

6.118 Iodine[131] is emitted in peaks of activity over short periods of time.[188] The maximum levels of emissions required from ANSTO are yearly averages although monthly checks are done to ensure annual limits are not exceeded.[189]

6.119 Defined concentration levels in relation to medical institutions highlighted another problem:

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180 Robertson, Transcript of Evidence, p. 545

181 Sutherland Shire Council, Submission No. 20, p. 7

182 Ibid, p. 8

183 Smith, Transcript of Evidence, p. 547

184 Ibid, p. 548-549

185 Sutherland Shire Council, Submission No. 20, p. 8

186 Fleischmann, Transcript of Evidence, p. 490

187 Ibid, p. 490

188 Smith, Transcript of Evidence, p. 547

189 Fleischmann, Transcript of Evidence, p. 491

> The concentration method can be interpreted in a number of ways, too, and it is a period over which you average your concentration. If you average over a long period, such as a month, you can get away with a lot more than if you are working at the other extreme which is effectively an instantaneous concentration where you are averaging over a few hours or a day or something like that. At the moment, the methods usually average over a month, which is pretty lenient.[190]

6.120 The Committee is concerned that ANSTO is only required to meet yearly averages and believes that maximum monthly and weekly levels should be applied and monitored.

Recommendation 16

The Committee recommends that appropriate maximum emission levels as well as average monthly limits be imposed on emissions of tritium and iodine[131] from ANSTO.

Disposal in Landfill

6.121 The use of domestic smoke detectors is increasing rapidly. It was argued that the disposal of smoke detectors to municipal tips should be prohibited. On the other hand the Committee was told that the radioactive source in each detector is in an insoluble form and the risk associated with its disposal to landfill is considered low.[191] Mr Fleischmann gave the example of two radioactive sources from smoke detectors being swallowed which passed through the body with no known radiation dose to the patient.[192]

6.122 Mr Carter differentiated between americium in general, and the sources used for smoke detectors which meet the current requirements:

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190 Collins, Transcript of Evidence, p. 754

191 Samuel, Transcript of Evidence, p. 390

192 Fleischmann, Transcript of Evidence, p. 478

> Americium is hazardous only when it gets inside the body and stays inside the body. The problem is whether it is soluble and whether it can be dispersed into the air. The evidence on both of those is no ...They [the sources] are quite insoluble and they are resistant at quite high temperature fires.[193]

6.123 It was also argued that the amount of material that ends up in the tip provides an adequate level of dispersal for the volume of smoke detectors distributed in it.[194] The Australian Fire Protection Society (AFPA) and the Fire Protection Industry Association of Australia (FPIAA) support this view.

> The amount of radioactive material contained in any domestic smoke detector is minute ... The associations collectively, the AFPA and the FPIAA, are both of the view that disposal through normal landfill is the way to go.[195]

6.124 Both groups would like to see a nation-wide policy of disposal, as is the case in Western Australia, where the Government allows the disposal of smoke detectors in household garbage provided the americium source does not exceed 40 kBq.[196]

6.125 The Committee believes that insufficient is known about the effects of low levels of radiation and the potential risk in the disposal of ionising smoke detectors to municipal tips in increasing numbers or the unknown effects of the detectors synergising with other chemicals in tips.

6.126 The Committee heard arguments for and against the disposal of smoke detectors to municipal landfills. The Committee appreciates that to ban the disposal of smoke detectors to landfills is impractical and may not be necessary. The Committee is particularly concerned that any attempt to do so by alerting the community to potential danger in smoke detectors may discourage people from installing them, thus endangering lives.

6.127 The Committee believes, however, that a program should be implemented to encourage householders to return smoke detectors to central locations so that they can be returned to the manufacturers or suppliers. The Committee supports industry and government initiatives to develop

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193 Carter, Transcript of Evidence, p. 827

194 Fleischmann, Transcript of Evidence, p. 477

195 Coate, Transcript of Evidence, p. 790

196 Fire Protection Industry Association of Australia, Submission No 76, pp. 8-9; Radiological Council of Western Australia, Amendment to Regulations under the *Radiation Safety Act*, December 1992

mechanisms to facilitate the return of smoke detectors to suppliers, manufacturers or to local collection points.

Incineration

6.128 Incineration is not widely used for the disposal of radioactive materials in Australia. The Edith Cowan University disposes of radioactive waste by incineration after it has decayed to a level when it is no longer considered radioactive.[197] The problem is finding a company which is willing to incinerate the material.[198] The Health Department of Western Australia considers that it may be preferable to incinerate some solid waste from radioisotope laboratories, given the co-existing pathological nature of the material.[199] The Committee is concerned that if incineration is to be used for the disposal of radioactive materials then appropriate measures must be taken to deal with the residues in the ash and the possibility of radioactive emissions.

Immobilisation in other Materials

6.129 The possible use of vitrification for radioactive wastes will depend on the chemical composition of the waste and the pretreatment required to transport the waste from its current storage.

6.130 The Synroc process developed at the Australian National University relies on the incorporation of radioactive elements in a crystal structure of synthetically produced minerals. Nuclear Waste Management Pty Ltd has a commercial agreement for a licence from the Australian National University and has negotiated an agreement with a Russian group to establish a demonstration plant. The process has now stalled as a result of lack of interest by the Australian investors.[200] The Committee was told that costs may restrict the use of Synroc to highly radioactive material such as spent fuel or residues from its reprocessing.[201]

6.131 Tests have been done in the United Kingdom and in Japan using Synroc with radioactive material.[202] On-going research and development has

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197 Edith Cowan University, Submission No. 72, p. 1-2

198 Ibid, p. 2

199 Health Department of Western Australia, *Incineration of Solid Waste from Radioisotope Laboratories*, Approved by the Radiological Council at its 93rd meeting, 9 June 1994, p. 1

200 Dickinson, Supplementary Submission No. 1, p. 1

201 Ibid, p. 1

202 Jostsons, Transcript of Evidence, p. 65

established Synroc as a good technology[203] but the time to develop the process is symptomatic of the long lead times in the industry.[204] The Committee is concerned that this technology may end up overseas because of the lack of large Australian companies with the appropriate technical background required to utilise it.

6.132 Sir Ben Dickinson urged the Committee to support further developments on the process and the development of a pilot plan.[205] He argued that the radioactive material could be put into Synroc and buried in deep holes or shafts.[206]

6.133 Although the Committee supports the export of Synroc technology, it does not accept that it should ever be used as justification to import radioactive waste into Australia. The Labor Government's position was that it would not establish an industry that imports radioactive waste.[207]

6.134 Professor Samarin suggested encapsulating radioactive waste in building and construction material, as there are 40 million tonnes of concrete produced in Australia annually.[208] The technology already exists for encapsulating small quantities of heavy metals and some other hazardous material into building materials. These can be physically encapsulated as well as chemically and physiochemically immobilised in high performance concretes.[209] Some of these wastes can actually serve the same function as the admixture or additive and improve the quality of the product.[210]

6.135 At Hanford in the United States the Department of Energy experienced difficulties in getting the cement to set in trials with radionuclides, nitrates and organic chemicals,[211] so there needs to be further experimental work on this option before it could be used in Australia. Some naturally radioactive

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203 Hollway, Transcript of Evidence, p. 66

204 Jostsons, Transcript of Evidence, p. 66

205 Dickinson, Transcript of Evidence, p. 201

206 Ibid, p. 201-202

207 Crean S (1992) former Minister for Primary Industries & Energy, *National Radioactive Waste Repository Site Study Released for Public Comment*, Media Release, 7 October 1992, p. 1

208 Samarin, Transcript of Evidence, p. 512

209 Samarin A (1995) 'Encapsulation of Hazardous Heavy Metal Wastes in High Performance Concrete'. Australian Academy of Technological Sciences and Engineering, *Focus* 87:11-14, p.11

210 Samarin, Transcript of Evidence, p. 513.

211 Institute of Energy and Environmental Research, "Hanford', *Science for Democratic Action* 3(3), 1994, p. 17

materials such as granites are used anyway. If the appropriate mixtures were used then the levels of radiation would not be any higher than radiation from that naturally occurring building material while providing a very cost effective way of dealing with the waste.[212]

6.136 The Committee is concerned that workers should not be exposed to additional radiation levels and the precautions needed to ensure the safe handling may increase the cost of road building, but this may be favourably compared with the economics of other radioactive waste disposal options.[213]

Putrescible Waste

6.137 Long term storage of putrescible material such as animal wastes containing long life radioactive substances is a problem,[214] particularly where burial of radioactive material is not permitted by the relevant waste disposal authority.[215] Radioactive putrescible materials at the University of New South Wales are stored in refrigerators in laboratories where they are produced.[216]

6.138 The Committee appreciates the difficulties posed by the requirement to manage putrescible radioactive waste but considers that it is unlikely that a national repository will be able to accommodate it.

Conclusions

6.139 The Committee believes that the national accumulation of radioactive waste has changed significantly since the Commonwealth/State Consultative Council looked at this situation in 1986. The Committee is not convinced that a shallow ground burial site for low level radioactive waste is the appropriate solution.

6.140 The Committee supports a feasibility study into disposing of very low level radioactive waste such as the CSIRO Fishermens Bend contaminated soil in an active uranium mine. This will significantly reduce the volumes of material that would have been suitable for shallow ground burial and may make the proposition totally uneconomic.

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212 Samarin, Transcript of Evidence, p. 514-515

213 Samarin, Transcript of Evidence, p. 520-521

214 Rosen, Transcript of Evidence, p. 751

215 Westmead Hospital and Community Health Services, Submission No. 65, p. 3

216 University of New South Wales, Submission No. 75, p.2

6.141 The Committee believes that there is a significant problem with intermediate level waste which requires urgent attention. The Committee would like the efforts of the Commonwealth Government to be focused on this issue.

6.142 The Committee notes that some of the States and Territories have made substantial progress in managing their radioactive wastes. The Committee applauds this and looks forward to a cooperative, coordinated, national approach which will ensure that all those responsible for the management of radioactive waste will meet the improved standards.