CHAPTER 4

AVOIDANCE AND MINIMISATION

Introduction

4.1 A commitment to waste avoidance and minimisation principles is essential in the development of waste management strategies, as these attack the cause of the problem rather than dealing with the results through storage or disposal.[1] The hierarchy of waste management - reduction, reuse, recycling and treatment before disposal - should be applied to radioactive waste in the same way that it applies to other types of waste. Greenpeace told the Committee that:

> after nearly 90 years of creating radioactive waste, Australia still does not have an acceptable strategy for dealing with it ... Ultimately, however, any radioactive waste policy must be based on a simple, unavoidable truth: there is no known environmentally acceptable way of permanently disposing of radioactive waste. With current knowledge and technology the only thing we can achieve is long term storage. Given this, waste avoidance and minimisation must be an integral part of any waste management strategy.[2]

4.2 While some conservation groups may argue for zero production, and therefore zero waste, given the importance of the use of radioactive isotopes in medicine and industry and Australia's work in the field of international research, this is not a realistic short term option.

Justifying the Use of Radioactive Materials

4.3 The Committee was told that the International Commission on Radiological Protection's principles of justification, optimisation and minimisation, if rigorously applied, effectively reduce the creation of radioactive waste.[3]

> Everybody is a lot more careful about the future now, so research proposals have to come before a radiation safety committee which says, 'What are you going to do about your waste handling?' They

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1 Baker, Transcript of Evidence, p. 137

2 Greenpeace, Submission No. 48, p. 1

3 Hanlon, Submission No. 5, p. 1

> will have to really think twice if they are using a long-lived isotope.[4]

4.4 It was argued, however, that:

> Because many of the reagents used have hazardous characteristics other than those pertaining to the radioactivity, more 'radioactive' waste is probably generated than is strictly necessary. However it is probably unwise and unpopular and possibly unsafe to too strongly encourage minimisation of radioactive waste.[5]

4.5 Radiation safety officers cooperate with users of radioactive materials in hospitals and universities to assist them in avoiding excess waste creation. The University of Western Australia described their procedure:

> They have to tell us ... what isotopes they are going to use, how much of it, where they are going to do it, what sorts of monitors they have on hand to monitor the work they are doing and what sort of waste they are going to produce.[6]

4.6 Some regulatory authorities require organisations or individuals intending to use radioactive sources to provide information on the purpose and duration of use and indicate storage or disposal options. Registration procedures can be used to provide advice to users on appropriate recycling, reuse and reduction options, as well as the best possible disposal options if no alternatives are available. The Committee considers it important that such procedures are implemented for all users of radioactive material.

4.7 The Committee is also concerned that the difficulties encountered in storing or disposing of radioactive waste could mean that valuable research could be jeopardised:

> The difficulties of the disposal of long lived active putrescent waste sometimes prevent certain types of research work being undertaken ... To some extent then, not only in our university but elsewhere, people tailor their research programs because of this problem of disposal.[7]

4.8 The Committee believes that a balance must be struck between minimisation strategies and the restrictions this may place on important

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4 Towson, Transcript of Evidence, pp. 768-9

5 Royal Alexandra Hospital for Children, Submission No. 5, p. 7

6 Munslow-Davies, Transcript of Evidence, p. 299

7 Rosen, Transcript of Evidence, p. 751

research. One example is the use of sodium[22] and chlorine[36] in research into the enterotoxigenic *Escherichia coli* at the Royal Alexandra Hospital for Children which has the potential to save children's lives.[8] The justification process must weigh the benefits of the research against the difficulties and disadvantages of managing the waste created.

4.9 This caution should be taken in the light of comments that:

> It seems to be a popular conception of the public that all things nuclear are somehow justified by nuclear medicine ... Medical waste is only a very tiny minority of waste which is generated.[9]

4.10 The Committee believes that more can be done to avoid or minimise the amount of waste being produced in some areas. The Committee believes that in cases where long lived radioactive waste will be produced that a full justification process should be undertaken at the hospital or research institution and by the proposed Australian Institute of Radiation Protection if the radioactive waste is to be stored in a national facility.

Strategies for Avoiding the Use of Radioactive Materials

4.11 The Committee believes that organisations using radioactive materials should be encouraged to find alternative procedures where practicable. Particular attention should be paid to radioactive materials such as plutonium, which is radiotoxic if inhaled and long lived.[10] The Queensland Greens claimed that:

> We actually subsidise the creation of radioactive waste as there are hidden subsidies for the use of radioactive materials in industry, science and medicine. If the full costs were paid by users then cheaper and safer alternatives would be developed ... Full cost recovery would mean that charges would reflect the full cost of production of radioactive isotopes, the costs incurred by governments in regulating the nuclear industry and the full costs of the disposal of radioactive waste and site clean-up.
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> At present the production of radioisotopes is heavily subsidised with ANSTO ... supplying its isotopes from its Lucas Heights reactor at prices cheaper than at cost ... If isotopes were to be sold to industry only at a realistic price, the attitude of industry and its willingness to make use of these techniques might be very

8 Hanlon, Transcript of Evidence, p. 417

9 Lowe, Transcript of Evidence, p. 319

10 Pearson, Transcript of Evidence, p. 456

> different. The consumers of radioactive isotopes ... do not have to pay the real cost of operating and servicing a reactor nor its eventual decommissioning perhaps 100 years down the track.[11]

4.12 The use of radioactive materials in Australia in medicine, both in diagnosis and therapy, is steadily expanding as the incidence of cancer increases. In many cases, alternative methods are not available. However, in pathology, radioactive iodine[125] is being replaced by non-radioactive assays thus reducing the use of radioactivity in this area.[12] Replacement isotopes are being used as better ones become available, such as the replacement of radium with iridium.[13]

4.13 Some industries have also been able to switch to cost-effective non-radioactive technologies such as the use of microwave units instead of radiation gauges by companies working in remote areas.[14]

4.14 Other avenues of avoidance may become apparent in the future and government funded research could be directed towards this. The Committee was told that:

> knowledge is changing over time and technology is changing over time. It is quite easy to look back now ... and to say that they used far more than perhaps they should have. Perhaps in 25 years time, people will look back at what we are doing and say that we have been using more than we should have too.[15]

> There are a number of types of work, particular molecular biology and genetics ... which use radioisotopes, based on techniques that have been well established in those fields for some time. Perhaps these people, if given the incentive to look at non-isotopic methods of detection, may change to that.[16]

4.15 The Committee believes that consideration should be given to increased funding for research into alternative technologies using non-radioactive materials, with the long-term goal of reducing the amount of radioactive waste created.

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11 Queensland Greens, Submission No. 15, p. 2

12 Smart, Transcript of Evidence, p. 766

13 Towson, Transcript of Evidence, p. 526

14 Northern Territory Government, Submission No. 14, p. 11

15 Hochman, Transcript of Evidence, p. 216

16 Hanlon, Transcript of Evidence, p. 770

4.16 Smoke detectors are an example where other technologies are available but those containing radiation sources are being used because they are cheaper. It was suggested that the use of a more expensive type of smoke detector which uses a photo-electric device, instead of a radioactive source, could overcome to some extent the problem of the disposal of large numbers of these radioactive sources into the general waste stream in the future.

4.17 However, it was argued that photo-electric smoke detectors are not suitable in most domestic or occupational situations because they do not respond as well to the early emissions from a fire.[17] On the other hand the Fire Protection Industry Association of Australia told the Committee that:

> Photoelectric type smoke detectors offer several advantages over the more common ionisation type smoke detectors. Photoelectric smoke detectors, in addition to containing no radioactive material, are more sensitive and reliable than ionisation type smoke detectors ... It is believed that a combination of market pressures and technology improvements will reduce the price of photoelectric type smoke detectors. This, coupled with the superior performance of photoelectric type smoke detectors may lead to the eventual withdraw[al] of domestic ionisation type smoke alarms from the market.[18]

4.18 It was suggested that the differences of opinion were due to 'horses for courses', with each type of detector having the advantage in a particular type of fire.[19]

4.19 The Committee believes that this is an important issue that governments should consider. If photo-electric smoke detectors are superior in these respects, economic incentives may be appropriate to encourage the increased use of these rather than the ionising radiation types. This is a complex issue because an increased cost to cover the storage or disposal of the radioactive materials after the useful life of the smoke detectors may discourage the installation of these in homes thus potentially risking lives.

4.20 Another potential reduction in the amount of radioactive waste might come from mining rare earths from less radioactive sources than those presently proposed.[20] The Committee was told that the clay from the Pinjarra site has 9 to 15 times more radioactive thorium dioxide than the world

17 Wallace, Transcript of Evidence, p. 724

18 Fire Protection Industry Association of Australia, Submission No. 76, p. 13

19 Orr, Transcript of Evidence, p. 794-795

20 Siewert, Transcript of Evidence, p. 334

average.[21] Other rare earth ores, containing little or no radioactivity, are available in China and Mt Weld-Meenaar, Western Australia. The Rhone Poulenc plant at La Rochelle is already using the non-radioactive bastnaesite from China to avoid the problems associated with storing radioactive waste.[22]

Strategies for Reducing the Volume of Radioactive Waste

4.21 In many cases the volume of solid radioactive wastes can be reduced by compaction, especially materials such as paper, plastics, protective clothing, laboratory glassware and other material contaminated during research or medical activities. ANSTO compacts much of its low-level solid radioactive waste achieving a volumetric reduction of six- to eight-fold.[23] Compaction is routinely carried out overseas at storage sites and repositories such as the Centre de l'Aube repository in France.[24]

4.22 The Committee received evidence that there is a need for such strategies to be more widespread:

> Possible only one hospital has compaction facilities. Much of the laboratory waste is in the form of bulky items such as paper products, and the resultant bags of waste have a large volume, much of which is air. Compaction is a well-recognised tool for handling any waste. US institutions virtually all use compaction as a means of volume reduction, yet it is hardly used at all in Australian hospitals at least, probably because of the cost of the equipment and the need for space to operate it.[25]

4.23 Mr Wong also commented on this difficulty:

> One management strategy that could help reduce the national stockpile in a physical sense is shredding this material so that it can occupy less space ... you would need to be able to account for all the emissions from that mechanical process ... that process has to be done with quite specific safeguards.[26]

4.24 The New South Wales Environment Protection Authority believes that by removing non-radioactive material and consolidating what is left, the

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

22 Ibid, p. 7

23 Australian Nuclear Science & Technology Organisation, Submission No 32, pp. 3-4

24 ANDRA, Explanatory video on the Radioactive Waste Facility at Centre de l'Aube, France, 1995

25 Westmead Hospital and Community Services, Submission No 65, p. 4

26 Wong, Transcript of Evidence, pp. 741-742

amount of radioactive waste held by the NSW government could be reduced from 100 to 30 cubic metres.[27] The Committee would like to see greater use of compaction in institutions using radioactive material, and provision should be made for this in the design of new buildings.

4.25 Radioactive waste is often of mixed categories and/or activity, and sorting this waste could facilitate volume reduction by enabling shorter lived radioactive materials to be disposed of after the radioactivity has decayed. On the other hand, if this requires greater handling of the material, it may increase the exposure of workers to radiation:

> Although, in principle, further segregation and volume reduction of existing wastes is possible, the gains must be carefully assessed against the resources required and the additional radiation exposures to operational staff.[28]

4.26 The 'concentrate and contain' strategy for reducing volume, either by chemical methods or by evaporation, can be used in proposals such as the Rhone Poulenc rare earths project, where wastewater would be sent to evaporation ponds.[29] Another example is sending discarded smoke detectors to a central facility where the radioactive source could be removed, thus reducing the volume of waste.[30] The 'concentrate and contain' strategy will, however, produce a secondary waste stream which has a higher specific activity than the original.[31]

4.27 In some countries incineration of low-level solid radioactive waste is also used as a means of volume reduction, and the resultant radioactive ash and gases are stored until it is safe to dispose of them into the environment. This is not widely used in Australia and statutory emission standards and ash contents need to be considered.

Strategies to Minimise the Quantity of Radioactive Waste Created

4.28 A number of witnesses expressed the view that radioactive waste should be stored at the site of production.[32] The Committee was told that only when

27 Colgan, Transcript of Evidence, p. 390

28 Australian Nuclear Science & Technology Organisation, Submission No. 32, p. 22

29 Rhone Poulenc, *Rare Earth Project, Pinjarra, Western Australia, Environment Review and Management Programme*, September 1995, p. 3-10

30 Wallace, Transcript of Evidence, p. 725

31 University of Western Australia, Submission No 22, Attachment 1, p. 60

32 Lannstrom, Transcript of Evidence, p. 190; Pearson, Transcript of Evidence, p. 464; Botten, Transcript of Evidence, p. 171; Nuclear Issues Action Group, Submission No. 42, p. 3

people are required to deal with the waste they produce will they implement practices to minimise the amount of radioactive waste created.

4.29 ANSTO has established a working party to review and monitor their waste management strategy and practices on a continual basis.[33] ANSTO told the Committee that it's approach is one of:

> minimising its current waste generation both *at source* (by adopting processes which minimise the creation of waste) and in subsequent waste treatment (to avoid or minimise the creation of secondary waste streams).[34]

4.30 The Committee is concerned that this is not always the case. Mr Pearson pointed out that:

> Ironically, the biggest Governmental producer of radioactive waste in Australia - ANSTO - has recently switched its HIFAR reactor to a Technecium-99m (T-99m) production method that has actually increased the amount of radioactive waste created. This was done because the "dirtier" method was cheaper, as ANSTO conceded to Greenpeace in 1993.[35]

4.31 The Committee believes that the proposed Institute of Radiation Protection should consider as a matter of urgency any departures by ANSTO from its stated position in relation to waste minimisation and ensure that appropriate remedies be implemented as soon as possible.

4.32 The Committee was told that regular waste audits being carried out in New South Wales hospitals have been able to reduce the amounts of radioactive wastes requiring storage or disposal.[36] Greenpeace recommended a government audit of all industries which produce radioactive waste, with the aim of identifying ways in which they could avoid or minimise waste production.[37] The Committee believes that a nationally coordinated approach to auditing would avoid duplication.

4.33 A potential area of future radioactive waste minimisation is the use of cyclotrons instead of reactors in the production of medical radioisotopes. Greenpeace estimated that if cyclotrons were used to produce these isotopes

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33 Jostsons, Transcript of Evidence, p. 58

34 Australian Nuclear Science & Technology Organisation, Submission No. 32, p. 21

35 Greenpeace, Submission No. 48, p. 3

36 Smart, Transcript of Evidence, p. 766

37 Greenpeace, Submission No. 48, p. 2

then approximately one per cent of the radioactive waste would be created compared with that produced if a reactor was used.[38]

4.34 Cyclotrons can not currently solve all problems. Technetium^{99m}, which is produced using molybdenum as a source, represents 80 to 90 per cent of radiopharmaceuticals used in nuclear medicine.[39]

Mr Nigel Wood explaining the production of technetium-99 generators used for medical purposes. On the trolley are two assembled generators (Photograph provided by ANSTO)

4.35 ANSTO maintains that a huge step forward in cyclotron technology would be required before it could be routinely applied in nuclear medicine, because at the moment it is not possible to generate a quantity of molybdenum^{100} sufficient for Australia's needs.[40]

4.36 The Research Reactor Review also found that more research was needed on the feasibility of cyclotron production of technetium^{99m}.[41] It was suggested

38 Greenpeace, Submission No. 48, p. 4

39 Egan, Transcript of Evidence, p. 783

40 Australian Nuclear Science & Technology Organisation, Submission No. 32c, p. 4; Jostsons, Transcript of Evidence, p. 69

41 Research Reactor Review (1993) *Future Reactions, Research Reactor Review Report*, August 1993, Recommendation 5.4, p. 49

that prior to the approval of a new research reactor, it would make good economic sense to look at technologies producing short lived radioisotopes, and to import others from overseas if necessary.[42] It may be, as the Research Reactor Review found, that cyclotron-produced and reactor-produced radioisotopes are complementary and that a reactor based source will continue to be essential in Australia.[43]

4.37 Dr Egan, of the Positron Emission Tomography Centre, said that:

> just after the Reactor Review Committee's report was published [August 1993] it was clear to us that in the interim five-year period that the reactor report committee identified, there needed to be a concerted effort to try and establish the feasibility or not of other production techniques for technetium.[44]

4.38 Professor Lagunas-Solar, who is creating technetium^{99m} in experimental situations,[45] conceded that further studies are needed on questions of radionuclidic purity and dosimetry.[46] The Committee was told that since 1993, Professor Lagunas-Solar has advanced his research and Dr Egan is confident that some of these claims, such as those relating to radioisotopic purity, have now been substantiated.[47]

> I think that ... a medium energy cyclotron can produce a significant amount of technetium ... the answers to questions about production yields and purity and so on ... would be fairly well resolved in the next two years.[48]

4.39 If cyclotron technology becomes a viable option, adequate and regular distribution to individual hospitals may require a number of regional cyclotrons to be set up. It is possible that such cyclotrons would be smaller, and therefore less expensive, than the 30MeV cyclotron in Sydney, which in 1992 cost $25 million. The cyclotron used at the PET Centre at the Austin Hospital is 10MeV. The cost of replacing the HIFAR reactor was estimated to be no less

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42 Smith, Transcript of Evidence, p. 570

43 Research Reactor Review (1993) *Future Reactions, Report of the Research Reactor Review*, August 1993, p. 88

44 Egan, Transcript of Evidence, pp. 778-779

45 Pearson, Transcript of Evidence, p. 458

46 Lagunas-Solar, M, *Production of TC^{99m} and MO^{99} for Nuclear Medicine Applications via Accelerators as an Option to Reactor Methods*, Paper presented at the 18th Annual Conference of the Australian Radiation Protection Society, Sydney, October 1993

47 Egan, Transcript of Evidence, p. 781

48 Ibid, p. 783,786

than $250 million in 1992. Running costs of cyclotrons are also much less than reactors.

4.40 The Cyclotron and PET Centre at the Austin Repatriation Medical Centre, Melbourne and the Crocker Nuclear Laboratory at the University of California, Davis, USA, are collaborating to determine the feasibility of this new accelerator-based production method for Australian nuclear medicine. This will provide essential information for the final decision of the Australian Reactor Review Committee, due in 1998.[49]

4.41 In 1992 Greenpeace requested that the Federal government provide $1 million, over three years, to finance Australian participation in a cyclotron feasibility study, but this request was rejected by the former Federal Government.[50] Speaking about the project, Dr Egan said:

> We needed to establish factually some of these questions that were being raised and, based on those facts, we could then develop a model, a facility that would be sufficient to produce what was needed in Australia and then we would know what the ultimate cost benefit would be of such an investment. It has become a bit clearer in the interim two years but it is still not fully decided, by any stretch, as to exactly what type of cyclotron facility one would need to have to achieve this production for Australia's requirements.[51]

4.42 Dr Egan's plea was echoed by the Sutherland Shire Council:

> they [ANSTO] do not seem to be keen to put any intellectual investment into alternatives to reactors for medical radioisotope production ... we made a good case that economically it would make reasonably good sense to look at accelerator technology for production of expensive short-lived radioisotopes for medicine and import some short-lived ones from overseas if necessary without a reactor technology. It would be a major reduction in the waste and probably come out ahead economically.[52]

4.43 Dr Egan confirmed the continued relevance of a grant for collaboration with Professor Lagunas-Solar in his research.[53] An amount of approximately $500 000 is required over three years to determine whether any of the identified

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49 Egan, Submission No. 77, p. 1

50 Pearson, Transcript of Evidence, p. 458

51 Egan, Transcript of Evidence, pp. 785

52 Smith, Transcript of Evidence, pp. 569-570

53 Egan, Transcript of Evidence, p. 781; Egan, Submission No. 77, p. 1

radioactive impurities in cyclotron produced technetium^{99m} may preclude its use in clinical nuclear medicine.[54] Under the proposal, the University of California would undertake the production of technetium^{99}. The Australian team would then study the characteristics of that for clinical imaging and diagnostic scanning purposes.[55]

4.44 The Committee considers that Dr Egan's submission comprises a modest request for research funding, the results of which may provide a useful basis for decision-making associated with the replacement of Australia's research reactor. The Committee believes that the Government should look at all options for the future production of radioisotopes in Australia before deciding on the possible replacement of the existing reactor.

Strategies for Return and Reuse of Radioactive Materials

4.45 A significant way of reducing radioactive waste is to recycle or reuse the source. It was suggested that prior to the purchase of a radioactive source, the user should determine whether the supplier of the radioactive source is prepared to have it returned at the end of the equipment's useful life.[56] The Victorian Government has been able to reduce its inventory of radioactive materials by 84 curies, by returning various items to the country of origin.[57]

4.46 The Committee was told that many radioactive sources have very long half lives which makes it feasible for them to be reused. In many cases the useful life of the equipment is much shorter than the time necessary for the radioactivity of the source to decay.[58]

4.47 Although recycling is a very attractive option it is not always viable.[59] The Committee was told that the problem with recycling is often one of logistics:

> That is, checking the source to ensure that [it] is still in a useable condition, storing it pending reissue and finding a new application for it.[60]

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54 Egan, Submission No. 77, p. 4-5

55 Egan, Transcript of Evidence, p. 779

56 Samuel, Transcript of Evidence, p. 389

57 Victorian Government, Submission No. 37, p. 3

58 Fleischmann, Transcript of Evidence, p. 478

59 Ibid, p. 478

60 Fleischmann, Submission No. 9, p. 4

4.48 Most radioactive waste from hospitals is not suitable for recycling, although the packaging materials are already reused.[61] Shorter lived materials such as cobalt[57] and iridium[192] are replaced on a 6 or 12 month basis, the company removes the old source when delivering a replacement.[62] When a source is operational for 15 or so years then the company may not still be in existence.[63]

4.49 CSIRO confirmed this difficulty:

> In the past suppliers [in Australia and overseas] have often suggested that this material could be returned. With the exception of 5 americium[241] and 2 caesium[137] sources returned to Amersham UK in 1992, these assertions generally have proved unfounded.[64]

4.50 The Victorian Government has returned approximately 80 curies of tritium EXIT signs to suppliers in the United Kingdom and the United States.[65] New South Wales has 300 to 400 tritium exit signs which can be sent overseas at a disposal cost of £30 per item. This represents a significant reduction in the volume of waste but at a substantial cost.[66]

4.51 An important aspect that must be considered in returning material to companies overseas is whether approval can be gained from the government authority in the receiving country.[67] The willingness of governments to accept back radioactive material which they have exported is not necessarily predictable:

> A company may have all the intention of taking material back on signed agreements but a government could change its policy, there could be a change of government and they could say: 'That's it; we're not taking any more of that material back'.[68]

4.52 If a national inventory was prepared for Australian radioactive waste it would facilitate the shipment of large quantities of these materials overseas for reuse being negotiated at a lower unit cost.

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61 Westmead Hospital and Community Health Service, Submission No. 65, p. 4

62 Smart, Transcript of Evidence, p. 759

63 Ibid, p. 759

64 CSIRO, Submission No. 25, p. 4

65 Victorian Government, Submission No. 37, p. 3

66 Colgan, Transcript of Evidence, p. 414

67 Samuel, Transcript of Evidence, p. 414

68 Wallace, Transcript of Evidence, p. 723

> At the moment the only disposal available is via people who know how to do the export paperwork and can get agreement from somebody like the Radio Chemical Center at Amersham. They charge a terrific amount to take off your hands embarrassing radioactive sources. I think it is a serious economic problem.[69]

4.53 While sending radioactive waste back to the manufacturer may foster an 'out of sight out of mind' attitude, the costs of sending radioactive sources overseas may be an incentive to waste minimisation.

4.54 There may be possibilities for local reuse. The Committee was given an interesting example of a university purchasing a cobalt[60] source from a hospital for $1000. The university was later told that it could have been given the source free because the cost of transporting it back to Lucas Heights was so high.[70]

4.55 For some sources processing for reuse is likely to be more expensive than making new sources and storing old ones.[71] An industrial user told the Committee that the cost of having some old sealed sources taken away would be in the order of $4000 - $5000 per source.[72]

4.56 The Committee was given a number of other examples concerning the difficulty of correctly disposing of sources that are no longer needed, including a radiotherapy source of 1000 curies no longer used by a Newcastle hospital[73], a cobalt[60] therapy source and a strontium[90] ophthalmic applicator.[74] The cost of returning these to Britain would be considerably more than the original cost of their supply.

4.57 These logistic and economic difficulties are a significant disincentive to return and reuse. The Committee was told that it is easier to dispose of a source than to find another owner.[75] However, some old caesium sources which are no longer considered practical to use in Australia are shipped to developing

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69 Paix, Transcript of Evidence, p. 225

70 Hochman, Transcript of Evidence, p. 223

71 Collins, Transcript of Evidence, p. 759

72 Penrice Soda Products, Submission No. 55, p. 2

73 Elbourne, Submission No. 53, p. 1

74 Paix, Transcript of Evidence, p. 224

75 Fleischmann, Transcript of Evidence, p. 480

countries under private aid programs, on the basis that an old source is better than no source at all.[76]

4.58 The NSW Environment Protection Authority believes that there is significant potential to recycle the radioactive sources in smoke detectors.[77] Australian Standards require that detectors be marked so that they can be returned to supplier or health authorities.[78] Mr Wong commented to the Committee:

> The real cost of recycling to a commercially acceptable product, in most cases and probably in this case, would exceed the cost of buying a new americium product.[79]

4.59 It was argued that the disposal of smoke detectors to landfill was acceptable because the radioactive source is insoluble and the associated risk is therefore considered low.[80] The Committee considers that because of the increasing numbers of discarded smoke detectors, a way of recycling them needs to be found. The Committee was told by Mr Carter:

> I see no radiological problem in disposing of them to municipal tips. That does not mean that if there were an easy way of getting them into a good repository they should not go into the tips.[81]

4.60 The Committee suggests that more work should be put into researching the latest developments in the design of smoke detectors with the aim of selecting one which allows the radioactive source to be recycled into a new detector. In present designs the radioactive material is difficult to remove from the detectors so a degree of redesign is needed.[82]

4.61 The possibility of using other radioactive materials with shorter half lives may be another way of approaching the problem. Currently there is a mismatch in that the life of the radioactive source far exceeds the life of the smoke detectors:

> we would see something like an americium smoke detector as a real mismatch. You have got a job you want to do, which is to

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76 Collins, Transcript of Evidence, p. 773

77 NSW Environment Protection Authority, Submission No. 45, p. 3

78 Coate, Transcript of Evidence, p. 789

79 Wong, Transcript of Evidence, p. 743

80 Samuel, Transcript of Evidence, p. 390

81 Carter, Transcript of Evidence, p. 824

82 Samuel, Transcript of Evidence, p. 407

> monitor a particular room for, at most, 20 or 30 years before somebody wants to re-wire it or re-paint it or something, and into that you put a source with a 400-year half-life. In a physiological study, like a nuclear medicine one, you try and match the half-life to the purpose, as a general principle.[83]

4.62 There is a well-established system in place for the return of commercial smoke detectors, and the Committee believes that there should be provision for the return of domestic smoke detectors.

> Certainly, in the commercial environment, any organisation that imports detectors has to enter into an agreement to return any spent detectors to the original manufacturer or supplier.[84]

4.63 If central collection of the smoke detectors is envisaged, each local tip could designate a special place or accept detectors in the recycling section of domestic garbage bins, to be sorted out at the recycling depot. In this way, the problem of the safe disposal of batteries included in the detectors could also be addressed. The Committee was told that Brisbane City Council has a collection service for all forms of hazardous waste, including smoke detectors, available on request at no cost to the consumer.[85]

4.64 One approach suggested overcoming difficulties for people living in rural areas by amending legislation so that domestic smoke alarms could be returned by ordinary mail. The industry spokesperson suggested that if necessary, special packaging for this purpose could be designed and sold through Australia Post.[86]

4.65 The Committee believes that relevant overseas practices should also be examined. The European Commission is planning a series of studies as part of its approach to achieving harmonisation at European Union level of radioactive waste management practices. One of these studies focuses on waste minimisation for goods, such as smoke detectors and calibration mechanisms which rely on small radioactive sources but do not have regulatory controls after manufacture.[87] The results of this study should be taken into account in any future revision of policy aimed at managing the disposal of smoke detectors.

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83 Towson, Transcript of Evidence, p. 526

84 Coate, Transcript of Evidence, pp. 789

85 Lewis, Transcript of Evidence, p. 634

86 Fire Protection Industry Association of Australia, Submission No. 76, p. 10

87 Commission to Study Harmonised Nuclear Waste Practice, *European Report*, Brussels, September 1995

4.66 If it is decided that the smoke alarms must be returned to the supplier, industry and government need to ensure that appropriate avenues exist so such a policy is practicable.[88] Further, the Committee would like to see government and industry discuss this matter and develop a united position to avoid confusion which may undermine public confidence. A program of community education should be established on the return and reuse of smoke detectors.

Incentives for Avoiding and Minimising the Creation of Radioactive Waste

4.67 The Committee believes that there are three approaches to providing the necessary incentives for waste minimisation:

- the waste should remain on site and the user bear the cost of storing it appropriately;
- the costs of storage in a central facility should be met by the creator of the waste; and
- the cost of buying the radioactive source should include a levy to cover the cost of disposal or storage. This should encourage the prospective user to purchase the minimum amounts.

On-site management and storage

4.68 The Friends of the Earth argue that:

> On site storage of radioactive waste at the site of origin will lead to waste minimisation. In this way, the onus of responsibility and costs falls on the producer, providing the motivation for producers to minimise the amount of waste created.[89]

4.69 The Friends of the Earth also told the Committee that in the United States, where there is no national or regional repository and utilities are held responsible for the waste, users are implementing waste minimisation practices to which they might not otherwise have resorted.[90]

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88 Fire Protection Industry Association of Australia, Submission No. 76, p. 10

89 Baker, Transcript of Evidence, p. 137

90 Hallam, Transcript of Evidence, p. 441, citing Oyen L (1993) *Low level Radioactive Waste Disposal and Nuclear Plant Storage Designs in the United States;* Paper presented at the Institution of Engineers Australia and Australia Nuclear Association 9th Pacific Basin Nuclear Conference, Sydney, 1-6 May 1993

4.70 In New South Wales prior to 1993 radioactive waste was accepted by the Health Department at no cost. However, today the Environment Protection Authority's policy is in line with that used for the management of hazardous waste, making waste generators responsible for its management, including on-site storage.

4.71 An analogy was drawn to illustrate the disadvantage of having a national facility:

> a local shire suddenly announcing that they were not going to have any rubbish collection any more and householders were suddenly made responsible for all their own domestic rubbish. We would see consumer patterns change instantly ... The fact that you can put it in your big green garbage bin and send it somewhere else means that we will continue to go to the supermarket and buy packaging and so on, whereas if I had to bury that in my own backyard I would be a lot more cautious.[91]

4.72 It was argued that the availability of a national facility would not change the need for its cost to be included in each justification procedure.

> It just means that there will be a solution and also there will be a cost associated with it. In other words, they will have to build the cost or removal of the waste into their research application.[92]

4.73 Different problems are associated with the storage of short-lived and long-lived wastes. On-site storage may be an appropriate strategy for waste which will rapidly decay, but not for waste which will last thousands of years, is highly radiotoxic, high level radioactive waste or where public health issues may arise. The Committee received many pleas for the removal of small amounts of intermediate level, long lived radioactive wastes from premises at which it had been stored for up to thirty years.

4.74 A general policy of on-site storage may not be appropriate where public safety needs to be ensured, especially when these wastes are generated from obsolete procedures which have been replaced with better technologies. Another concern for the Committee is the potential loss of institutional control as a result of hospital and medical practice closures. The Committee considers, however, that the on-site management of short lived, low level waste should continue to be the generator's responsibility.

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91 Lowe, Transcript of Evidence, p. 322

92 Smart, Transcript of Evidence, p. 769

User Pays Principle for Radioactive Waste Storage

4.75 A user-pays for storage would seem an obvious way to encourage waste minimisation. A difficulty arises in determining how much and who should be charged for medical wastes. Secondly, some waste generated years ago, is held by those who were in no way responsible for its creation.

4.76 Other factors such as the possible need for compensation to the community hosting the facility[93] and variations in activities and half lives of different wastes may make it hard to calculate a pricing regime for indefinite storage. If the charges are too high there is an incentive for radioactive waste owners to avoid the charge by disposing of waste incorrectly. High costs might lead to hoarding waste on-site as long as possible to avoid payment, as has happened in hospitals and research laboratories of California.[94]

4.77 Further, most of the radioactive waste in Australia which is likely to be sent to a national facility is generated by Commonwealth bodies, hospitals and universities, which are funded by the taxpayer who will pay for waste management anyway.

4.78 The Committee believes that there are limitations to the applicability of a user-pays system as a means of encouraging avoidance and minimisation of radioactive waste, except in the case of industrial waste.

4.79 It was suggested to the Committee that a charge might provide an incentive to use methods not involving radioactive materials.

> There are a number of types of work, particularly molecular biology and genetics, being done at the Children's Hospital which use radioisotopes, based on techniques that have been well established in those fields for some time. Perhaps these people, if given the incentive to look at non-isotopic methods of detection, may change to that. Building the costs into the research project may, in fact, give them that incentive.[95]

4.80 Ms Peebles also pointed out that the user-pays principle was working from the negative end in attacking the results not the cause. She said:

> It would be much better if they develop their research and work to minimise it in the first place. As a lot of the institutions are part of

93 Hartley, Transcript of Evidence, p. 358

94 Mcmenamin B (1994) 'Don't Drink the Water', *Forbes* 153 (March 1994): 92-93, p. 92

95 Hanlon, Transcript of Evidence, p. 770

> the public purse, then, in the end, it is us paying for it, and that is not acceptable.[96]

4.81 Several witnesses before the Committee maintained, however, that if manufacturers who create radioactive materials are charged for the waste disposal, they would presumably keep its creation to a minimum.

4.82 If the manufacturer passed on the cost of disposal to the consumers then attitudes to the use of radioactive materials may change. The Committee was told that:

> If isotopes were to be sold to industry only at a realistic price, the attitude of industry and its willingness to make use of these techniques might be very different. The consumers of radioactive isotopes, usually industries like ICI, BHP, Comalco or Pacific Power, do not have to pay the real cost of operating and servicing a reactor nor its eventual decommissioning perhaps 100 years down the track.[97]

4.83 ANSTO is the only manufacturer of radioactive sources in Australia. The Committee was told that in the case of ANSTO, the concept of user pays is meaningless because the user is not paying the full cost of operating or decommissioning the reactor.[98] Its prices must compete with those of imported sources, such as those produced by Amersham International in Britain. Government intervention would be necessary to keep prices of the imported products at an artificially high level, in order to discourage purchase.

4.84 It was also pointed out to the Committee that the use of the Mt Walton East facility for disposal is very expensive and that this encourages waste minimisation and recycling and treatment wherever possible.[99]

4.85 ANSTO maintains that the high costs of transport to a national facility provides a strong economic incentive for waste minimisation, as shown in France, the United Kingdom, Spain and Sweden, where the volumes of waste being received at low level repositories are below projected volumes (typically,

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96 Peebles, Transcript of Evidence, p. 838

97 The Queensland Greens, Submission No. 15, p. 2

98 Sutherland Shire Environment Centre, Submission No. 7, p. 9

99 Davies, Transcript of Evidence, p. 267

by about 25 per cent).[100] The reduction is attributed to the effects of waste minimisation.[101]

4.86 The user-pays principle is complicated where central storage or disposal is the preferred option. The process of charging for the collection and storage or disposal including whether to charge an up front sum or an annual registration fee, has to be considered. Another choice would be the possible exemption for certain materials.

4.87 The Committee believes that consideration must be given to a number of special cases in determining pricing structures for waste which might be considered is a national repository is established:

- hospitals, universities, CSIRO, ANSTO and Defence and other tax payer supported facilities;
- research which provides net community benefits;
- companies which have already implemented changes to non-radioactive technology and retain only sources of historic origin;
- mining activities which generate large amounts of waste; and
- waste produced in the future, particularly where alternative technologies are available.

4.88 The Radiation Protection Office in Western Australia does not have an up-front charge for waste disposal at the University. It is a centrally funded facility and running costs include handling waste from different departments. Hospitals are charged on a cost recovery basis for the use of the service.[102]

4.89 The Committee was told that hospitals are already paying to have pathological waste removed, which usually includes radioactive waste. An additional charge made to remove radioactive waste to a central repository, may provide an incentive to hold waste for decay rather than remove it. Hospitals would prefer regular removal of radioactive waste, with only a minimum inventory being held.[103]

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100 Australian Nuclear Science & Technology Organisation, Supplementary Submission No. 32b, p. 6

101 Ibid, p. 6

102 Munslow-Davies, Transcript of Evidence, p. 300

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

4.90 On the other hand, some charge to hospitals was thought to provide an incentive for minimisation.

> If there was a charge involved that was realistic, there would be a great incentive and the charge would have to be cost recoverable. It would have to be realistic and it would have to include all the components of the waste minimisation and handling. I think that would provide an incentive, particularly if it was passed back down to the bottom of the chain.[104]

4.91 One problem when referring to medical treatment is deciding whether the hospital or the patient is the bottom of the chain. The Committee considered the possibility of including radiopharmaceutical treatment in the Medicare schedule, to draw attention to the cost associated with radioactive waste generated by nuclear medicine procedures.

4.92 The Committee is concerned that a project being undertaken at the Royal Alexandra Hospital for Children, on the enterotoxigenic organism, similar to that which recently caused serious food poisoning in South Australia, would not have proceeded if the researcher had to raise the funds for the radioactive waste disposal. Under a user pays system, when society benefits from a project such as this, should the hospital pay the cost? What should be the contribution by the community that benefits from the use of radioactive materials?

4.93 One of the problems with a user-pays system is how to reasonably account for long term costs of managing waste when such enormous lengths of time are involved.[105] For proposals such as the Rhone Poulenc rare earth plant, the costs of the disposal operation are easy to quantify over the twenty year project.[106] Appropriate financial mechanisms, however, would be required to calculate the cost of monitoring and managing that material for the institutional control period of 200 years.[107]

4.94 There are a number of industries which have made the transition to using non-radioactive materials but may still store radioactive sources from obsolete technologies. The Committee believes that the user-pays penalty should be applied to companies who continue to produce radioactive waste, but a special case may need to be considered for those companies who have done the right thing. A lenient approach may encourage other companies to follow suit.

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104 Collins, Transcript of Evidence, p. 771

105 Lowe, Transcript of Evidence, p. 320

106 Schuster, Transcript of Evidence, p. 265

107 Ibid, p. 265

4.95 Dr Fenton suggested to the Committee that:

> a fee for service or user pays policy should not be introduced for recovering the cost of storing radioactive materials acquired by their current owners prior to the year in which the national repository becomes operational - that is the cost must be borne by the Australian community.[108]

4.96 A suitable pricing regime will need to be determined and decisions on which waste will be exempt from a user pays system will need to be considered if the Government decides to proceed with a national facility.

4.97 The Committee believes, however, that the extent to which organisations would be prepared to send material to a national storage site or repository would depend on the fees charged, compared with the cost to that organisation of continued self-storage. If companies have built a storage facility or have a room available to store radioactive material, they can continue to produce and store that material until that room or facility is full. Therefore, the user-pays system may not be very effective in encouraging minimisation strategies in the short term.

4.98 It was pointed out that any charging regime would have to be accompanied by sanctions.

> There has to be provision for regulations and fines for people who do not comply.[109]

4.99 Any user-pays system should be uniform throughout Australia. Until a national approach to radioactive waste storage is determined, a pricing structure is impossible to establish:

> The reality is that the users who want to obtain the benefits of these things should ultimately be paying for the disposal of these things. So yes, there should be charges and we will charge for taking material on to the Esk facility. We are yet to develop a charge regime. There are complicated reasons why we have not, and one of them is related to the national shallow ground facility.[110]

4.100 The national facility concept requires that the Commonwealth Government, as the main generator of radioactive waste, and therefore the

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108 Fenton, Transcript of Evidence, p. 731

109 Wallace , Transcript of Evidence, p. 718

110 Wallace, Transcript of Evidence, p. 718

taxpayer, would bear the cost. The Friends of the Earth believe that it is inevitable that any national facility will be at taxpayers' expense.[111]

4.101 The Committee was told that economies of scale would be achievable in having one central site which would service all Australia.[112] However a number of States have recently established their own facilities which will be adequate for a number of decades and they will not need to pay the cost of sending material to a national repository in the immediate future.

An Up Front Levy for Storage and Disposal Costs

4.102 It was suggested to the Committee that a levy could be placed in a fund and used for storage or disposal of radioactive wastes. An up-front cost at the time of purchase would provide an incentive to minimise the use and also remove the problem mentioned above, that a charge at the time of disposal might encourage illegal disposal.[113] Dr Hartley believes that economic factors in relation to the disposal of radioactive waste dictate the degree of waste minimisation.[114]

4.103 If the up front cost of disposal of the radioactive source is paid and the manufacturer or retailer subsequently goes out of business, then the upfront disposal payment would be lost.[115] An option of an upfront fee in the form of a levy payable to government would address this concern.

Conclusions

4.104 The Committee considers that waste minimisation strategies should be established during the justification phase of any project. In some situations, this is a fairer way of achieving what economic incentives may not necessarily accomplish and which may in fact mitigate against the undertaking of valuable research projects.

4.105 The Committee believes that in any proposal to restrict the use of radioactive material, consideration needs to be given to the benefits which may outweigh the risk. It is important that the costs and benefits be assessed in the broadest possible context, including the potential effects of radioactive waste

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111 Hallam, Transcript of Evidence, p. 448

112 Ibid, pp. 422-423

113 Hartley, Submission No. 24, p. 7

114 Ibid, p. 7

115 Griffiths, Transcript of Evidence, p. 767

on future generations. Factors such as the number of lives saved by smoke detectors and research into fatal medical conditions should be considered. In these cases the emphasis may need to be on finding reuse and recycling options for the waste produced and developing alternative technologies.

4.106 The Commonwealth Government should promote research into alternative technologies in both industry and medicine which will lead to the avoidance or reduction of radioactive waste.

4.107 A problem inhibiting effective management of radioactive waste has been the on going promise of a national repository to deal with the low level waste. When States are required to manage their own wastes then there may be an attempt to achieve waste minimisation through legislation.[116]

> Promoting a repository creates an atmosphere where producers are not encouraged to minimise or avoid waste creation or to take responsibility for the waste regardless of the rhetoric ... Failure to discourage the creation of radioactive wastes is not in keeping with the most modern concepts of industrial practice.[117]

116 Peebles, Transcript of Evidence, p. 838

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