# CHAPTER 1

## INTRODUCTION

1.1 Ionising radiation is released when the nucleus of an atom becomes unstable and disintegrates, releasing excess nuclear energy in the form of energetic radiation.[1] The rate at which atoms disintegrate in radioactive material determines the half life, which is the time it takes for the radioactivity of the material to decline by half. The half life of different radioactive materials varies from a fraction of a second to billions of years.

1.2 Everyone is exposed to background radiation from natural sources. As well, people may be exposed to radiation in their work, through contamination of the environment or during medical treatments. This Inquiry looked only at those aspects of radiation relevant to the management of radioactive waste.

1.3 For the purposes of this report the Committee has defined radioactive waste as all radioactive material for which no future use is foreseen. However, the Committee recognises that material currently regarded as waste under this definition may be a future resource.

1.4 Radioactive wastes arise from mining and milling operations, nuclear fuels, the disarmament of nuclear weapons or the dismantling of nuclear reactors. Relatively small amounts of waste are also created through the use of radioactive sources in medicine, industry and research. The management of this radioactive waste management must protect workers' safety, public health and the environment in a manner that also minimises the burden placed on future generations.[2]

### Biological Effects of Radiation

1.5 Ionising radiation creates electrical charge imbalances in atoms, which in the body can damage living cells. The long term health effects of radiation exposure are manifested by mutation of cells, increased aging capacity of the body, and increased incidence of leukemia, birth defects and cancer.[3] The

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1 This radiation is called *ionising* because it may turn atoms which it comes into contact with into electrically charged variants called ions. Hereafter in this report 'radiation' and 'radioactivity' refers to ionising radiation.

2 Organisation for Economic Co-operation and Development, *Environmental and Ethical Aspects of Long Lived Radioactive Waste Disposal*. Proceedings of an International Workshop, the Nuclear Energy Agency in Co-operation with the Environment Directorate, 1-2 September 1994, Paris, p. 17

3 Lannstrom, Transcript of Evidence, p. 190

extent of effects varies according to the dose, radiation type, duration of exposure, and whether the exposure is external or arises from inhaling or ingesting radioactive materials.

1.6 The three forms of radiation - alpha, beta and gamma - are all potentially harmful, but differ in penetrating power and effect on human tissue. *Alpha radiation* consists of relatively large particles which do not easily penetrate the outer skin layers but are highly dangerous within the body. Alpha sources, some of which are extremely long-lived, include heavy elements such as uranium, thorium, radium and plutonium. *Beta radiation* consists of energetic electrons which have more penetrating power (they can pass through one centimetre of human tissue), but are less damaging to tissues than alpha radiation. *Gamma radiation* is highly penetrating, however damage to tissues is much less than that caused by alpha particles.

1.7 At very low doses the effects of radiation on human health are not discernible; but whether there are *no* effects is unknown. As a precautionary measure the International Commission on Radiological Protection (ICRP) and most other observers assume that the effects are proportional to dose and that there is no safe dose. This approach ensures that standards for controlled exposures to artificial radiation are conservative.[4]

1.8 Recent research suggests that previous standards for exposure to radiation should be tightened. In a long term study of 110 000 Japanese atomic bomb survivors, it is now thought that the victims were exposed to doses only about half as great as previously thought; and current estimates of future deaths from fatal cancers are one and a half times greater than estimates a decade ago. The United Nations Scientific Committee on the Effects of Atomic Radiations published these findings in 1988. The ICRP subsequently recommended reducing the limits for occupational exposure by a factor of three.[5]

1.9 Exposure to hazardous radiation doses may result from accidents or inadequate safety measures. The safety measures required depend on the radioactive half life, concentration, heat generating characteristics, chemical form, radiotoxicity, physical form, method of encapsulation and the pathway via which the radiation enters the body.

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4 Higson D (1995) *The Biological Effects of Low Level Radiation*, Paper prepared for the Australian Nuclear Association, 17 July 1995, p. 3

5 Lokan, Transcript of Evidence, p. 98

1.10 The internationally accepted classification of radioactive wastes into different categories which has been developed is based on the types of hazard, to ensure that no one receives more than a permitted dose of radiation. The major categories are: *high level waste*, which generates significant quantities of heat; *intermediate level waste*, which requires shielding but which does not generate significant heat; and *low level waste* which requires no shielding during handling and transport, but whose radioactive content means that it cannot be disposed of as ordinary waste. A fourth category of *exempt waste* applies to waste with radioactivity so low that it is regarded as safe for disposal into the general waste stream.

1.11 The International Atomic Energy Agency's (IAEA) latest Safety Series has modified the categories, recommending periods of isolation needed to ensure the protection of workers and the public, depending on the activity and half life of the radioactive materials to which they are exposed.[6] The revised IAEA classification system distinguishes short lived and long lived intermediate level waste.[7]

1.12 Because the definitions are qualitative rather than quantitative, problems can arise over different views of which category a particular material belongs in. The Committee heard claims that the nuclear industry may try to reduce problems of handling waste by reclassifying it to a lower level.[8] The Committee believes it is essential that problems relating to definitions and categories be addressed as a matter of urgency because of their significance in developing a long term plan for managing radioactive waste.

## Background to the Inquiry

1.13 In 1990 and 1991 the Australian Nuclear Science and Technology Organisation (ANSTO) accepted for storage at the Lucas Heights Research Laboratories, 2000 cubic metres of low level radioactively contaminated soil from CSIRO's Fishermens Bend property in Victoria.

1.14 In July 1991 ANSTO contracted with Australian Defence Industries (ADI) to store and condition at Lucas Heights about 17 cubic metres of radioactive material from ADI's St Marys property. The planned closure of the

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6 International Atomic Energy Agency (1994) Safety Series No 111-G.1.1, *Classification of Radioactive Waste, A Safety Guide,* Vienna, 1994, p. 9

7 Ibid, pp. 10-11

8 Sutherland Shire Environment Centre, Submission No. 7, p. 2; Cohen, Transcript of Evidence p. 318

St Marys property and the release of the land for residential development meant that the radioactive waste on site had to be relocated.

1.15 In September 1991 the Shire of Sutherland challenged these actions in the New South Wales Land and Environment Court on the grounds that they contravened the *NSW Environment Planning and Assessment Act* 1979. In 1992, the Court ordered ANSTO not to store radioactive waste from any other source at Lucas Heights, and to remove the Fishermens Bend soil within three years.[9] The Commonwealth complied with the Court's order and the Fishermens Bend soil and St Marys waste were moved to Woomera Rangehead in South Australia.

1.16 The soil from Fishermens Bend was moved to Woomera between 17 November 1994 and 7 January 1995. During the transportation, a drum lid in one load became loose and water leaked from the drum while the waste was in transit through Port Augusta. The radioactive waste from St Marys was moved to Woomera on 18-19 May 1995. Public concern and publicity surrounding the transfer of this material prompted the establishment of the Senate Select Committee on the Dangers of Radioactive Waste on 9 March 1995.

## Scope of the Inquiry

1.17 The complexity of issues involving radioactive waste management are reflected in the terms of reference. Australia has a significant role in the nuclear fuel cycle which has been described as:

> a uranium producer, as a signatory to international and national agreements relating to the use of nuclear materials and the prevention of nuclear weapons proliferation, and as a nation carrying out research and development in nuclear science and technology.[10]

1.18 The Australian Atomic Energy Commission (AAEC) was established in 1953 to supply uranium to Britain and the United States for nuclear weapons production. However, Australia's uranium exports are now restricted to use in the nuclear power industry. The AAEC also provided a body of expertise in the expectation of a nuclear power program in Australia, for which the HIFAR

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9 *Environmental Law Reporter*, 27 March 1992, p. 34

10 Australian Science and Technology Council (1984) *Australia's Role in the Nuclear Fuel Cycle*, AGPS Canberra, p. 1

research reactor was built at Lucas Heights in the 1950s as a materials testing reactor.

1.19 In 1986 the AAEC was restructured and became the Australian Nuclear Science and Technology Organisation (ANSTO). ANSTO is a statutory body with both research and commercial activities. It produces radioisotopes for medical, industrial and research purposes. In 1992 a review of the replacement of the HIFAR nuclear reactor found that the disposal of the radioactive waste generated must be addressed before a decision could be made on HIFAR's future.[11] This and other issues relating to the radioactive waste currently stored on site and that likely to arise from ANSTO's future activities have been central to the Committee's deliberations.

1.20 The Committee also looked at the difficulties being faced by the State and Territory governments, hospitals, universities and industries in the management of radioactive waste.

**The Report**

1.21 Radioactive waste must be managed in such a way as to protect human health and the environment and to limit any burden placed on future generations. It is important when considering disposal and management options of radioactive waste that the whole burden on the biosphere is taken into account. Decisions made now must have sufficient flexibility not to close off options which may arise with future technological developments.

1.22 The Terms of Reference of the Inquiry were wide ranging and designed to include all aspects of the management of radioactive waste except waste generated by the uranium mining industry. An important issue was the nature, efficiency and effectiveness of the administration, monitoring and control of radioactive waste. The Committee briefly looked at the existing guidelines and legislation, most of which is currently under revision. There was a strong call for a nationally agreed system.

1.23 One of the issues which arose was whether radioactive waste disposal costs should be met by the private sector or whether they should receive some public sector subsidy if the broader community benefits from the source of the waste. It was also considered essential to ensure that issues relating to Lucas Heights waste were not permitted to overshadow policies developed to address

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11 Research Reactor Review (1993) *Future Reactions, Report of the Research Reactor Review*, August 1993, p. 216

the difficulties faced by hospitals, universities and small industries or the sand mining industry. It became apparent to the Committee at an early stage that there was no single solution and that a number of options would need to be considered.

1.24 The report treats the matters of creation, minimisation, transport, storage and disposal of radioactive waste separately, and in each context comments relate to the need for a national facility. Matters of risk assessment and community concerns are addressed in the latter part of the report. The last Chapter provides an overview of the Committee's findings.