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OBJECTIVES, CONCEPTS AND STRATEGIES FOR THE MANAGEMENT OF RADIOACTIVE WASTE ARISING FROM NUCLEAR POWER PROGRAMMES

Report by
an NEA Group of Experts

September 1977

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B. CONSEQUENCES FOR WASTE MANAGEMENT .....

i) National and regional decisions .....
ii) The "throw-away" option .....
iii) The reprocessing option .....

a) Cooling time of spent fuel before reprocessing .....
b) Availability of a suitable waste solidification and conditioning technology .....
c) Availability of disposal solutions .....
d) Siting considerations .....

C. WASTE DISPOSAL OPTIONS .....

i) The form and grouping of waste .....
ii) Actinide separation .....
iii) Containment time and the risk to future generations .....
iv) Disposal options for short-lived wastes .....

a) Shallow land disposal .....
b) Sea dumping .....
c) Emplacement in deep cavities .....

v) Disposal options for long-lived wastes .....

a) Terrestrial disposal .....
Deep geological formations on land .....
Geological formations under the ocean floor .....
Disposal on the ocean floor .....
Disposal in glaciated areas .....
b) Extra-terrestrial disposal .....

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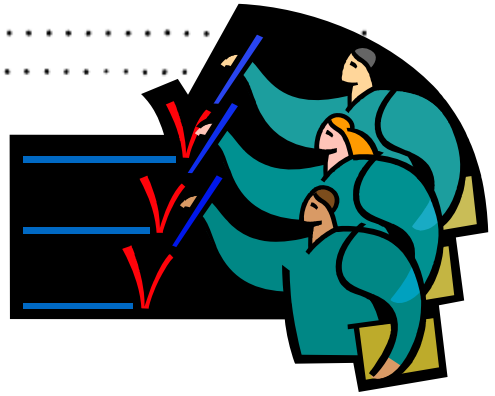

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This report has been prepared by a Group of Experts for the consideration of the Committee on Radiation Protection and Public Health and the Radioactive Waste Management Committee of the OECD Nuclear Energy Agency. It provides a comprehensive description of problems, current practices and policies in the field of radioactive waste management as well as recommendations relating to the long-term management of waste. In addition to the purely technological aspects of treatment, storage, transport and disposal of waste, consideration has been given to siting, licensing, administrative and financial problems.

The report identifies areas for discussion and is designed to stimulate this discussion by presenting a number of options for the management of radioactive wastes. However, the Group does not claim to have considered all the options which may be under examination by national authorities.

The publication by inter-governmental organisations of reports such as this may contribute to the development of an international consensus on matters of public concern. It in no way commits governments or the international organisations involved.

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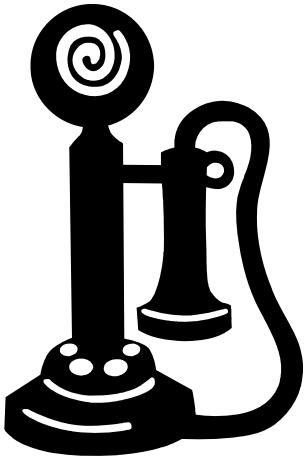

3. One of the main issues underlying the difficulties of developing nuclear power programmes more rapidly is the management of radioactive wastes. This certainly presents complex safety and technological considerations with potentially significant implications for present and future generations if proper policies and practices are not applied. This problem was in fact identified at the very beginning of nuclear energy activities more than 30 years ago; but even after substantial research and development work, particularly in the last decade, there is as yet no industrial facility in operation anywhere in the world for the disposal of the most hazardous types of radioactive waste. This situation needs to be evaluated in the light of the overall development of nuclear energy and all other relevant factors.

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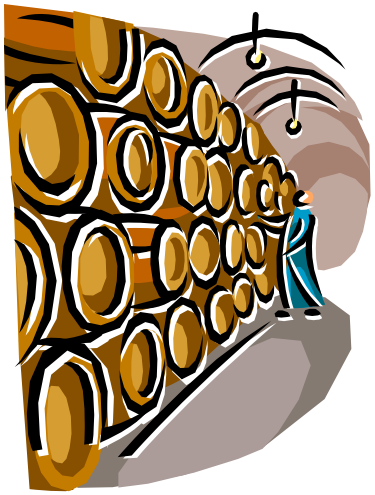

5. More specific factors concerning radioactive waste management have also to be considered. The need to minimize the very long-term hazard represented by some categories of radioactive waste is the most serious one. Present generations have the technical capability to store such wastes safely for as long as may be necessary. However, storage requires continuous surveillance by man. Various social and ethical considerations make it necessary to consider safe methods for eventual disposal. Consequently, it is desirable to develop solutions which will achieve the required degree of isolation of these wastes from man's environment without the need for further action. In principle, this is not a new problem, unique to nuclear energy production, since man is already confronted with the need for the safe management of highly-toxic chemical wastes which, unlike radioactive materials, present a hazard which may not decrease with the passage of time. Wastes containing heavy metals such as lead and mercury are typical exemples of such substances.

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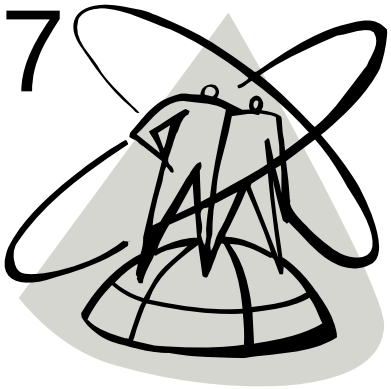

10. On this basis, radioactive waste management should have the following safety and environmental objectives:

(a) to comply with radiological protection principles for present and future generations;

(b) to preserve the quality of the natural environment;

(c) to avoid pre-empting present or future exploitation of natural resources;

(d) to minimize any impact on future generations to the extent practicable.

In order to achieve these objectives, it is important that waste management is undertaken within satisfactory systems of control, with due attention to the minimization of waste arisings through the selection of approriate processes, and to the strategic siting and planning of nuclear operations.

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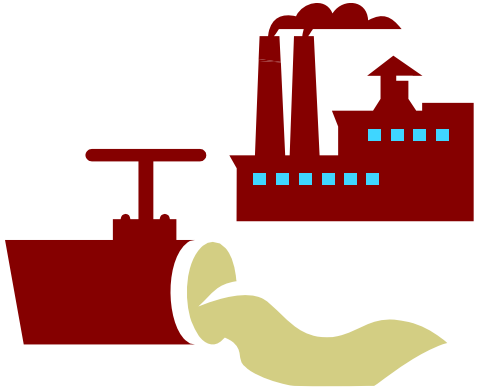

b) *Courses of action for waste management*

33. To comply with these radiological protection objectives and principles, two fundamental but contrasting courses of action are available. These are:

(a) containment of radionuclides in order to achieve the required degree of isolation from man's environment by suitable storage or disposal methods;

(b) dispersion and dilution of radionuclides into the environment through release of effluents.

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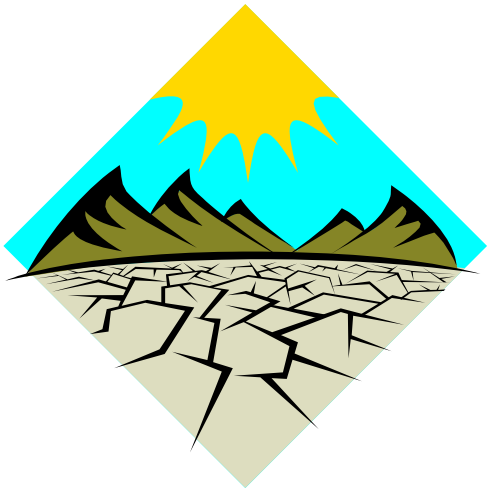

iv) LONG-TERM CONSIDERATIONS

47. Most of the radioactivity in wastes resulting from nuclear power generation is now contained and isolated from the biosphere and contributes nothing to the radiation exposure of the public. However, some of the wastes will remain hazardous for time periods which extend well beyond the predictable future, and no reliance can be placed on containment and isolation over such periods of time if their integrity is to depend on continued human intervention. Suitable means must be found for protecting future generations from these long-lived hazardous materials, taking into account social and even geological and climatic uncertainties.

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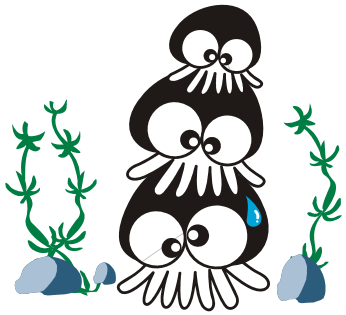

iv) LONG-TERM CONSIDERATIONS

48. One responsibility of present generations, relying on nuclear fission for their energy needs, is not so much the consequences of deliberate releases of effluents to the environment, which can be adequately controlled even in relation to possible cumulative effects, but the need to manage the remaining waste in such a way that it does not become a burden for future generations. To achieve this objective, present generations should look for technical solutions for the required degree of long-term isolation for the long-lived radioactive waste, in such a way that future generations will not be faced with conditions that we would not accept ourselves.

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iv) LONG-TERM CONSIDERATIONS

49. The realisation of radiation and environmental protection objectives is therefore very complex and involves technical as well as social and ethical judgements. As with all human activities, risks are involved which cannot be reduced to zero, whatever technical and financial resources are invested. Achievement of the objectives calls for the exercise of fine judgement and a sense of responsibility.

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67. At this stage it is important to define two widely used terms for the purposes of this report.

Storage: means the emplacement of waste materials with the intention of retrieving them later. Storage is a temporary measure which requires continuing surveillance.

Disposal: means the release or emplacement of waste material without the intention of retrieval. Disposal can be totally irreversible, as for example in the case of environmental release of effluents. Retrieval may be possible, as in some geologic disposal schemes for solid waste, but it is the absence of the intention to retrieve which implies disposal. Disposal concepts do not require continued surveillance. However, in particular cases, surveillance over limited time periods may be desirable.

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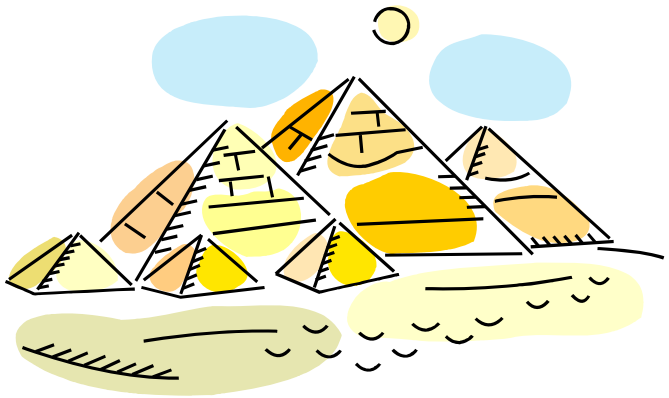
109. It is not possible to evaluate rationally potential waste containment systems unless the duration of the containment required has been established. In this respect radioactive wastes fall naturally into two main groups:

(a) the relatively short-lived wastes, which include most reactor wastes as well as decommissioning and reprocessing wastes containing concentrations of actinides below prescribed levels; these wastes need containment for up to a few hundred years;

(b) the long-lived wastes, which include high-level wastes, cladding hulls and alpha wastes; these need a high degree of containment for much longer time periods.



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115. Geologic disposal systems are not meant to provide absolute waste containment for all time, but can be considered as providing a long period of delay before gradual release of radioactivity to the biosphere. If geological environments can be found capable of ensuring reliable containment for a few hundred years and for 100,000 years or so for short-lived and long-lived wastes respectively, presently available technology is adequate for their disposal.

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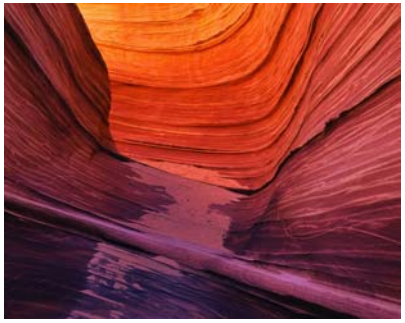

v) DISPOSAL OPTIONS FOR LONG-LIVED WASTES

129. Several disposal concepts that might be applied to high-level and other long-lived wastes have been proposed in recent years. The majority relate to some form of terrestrial disposal, although attention has also been directed to other schemes, such as extra-terrestrial disposal and destruction of the long-lived component of the waste by nuclear transmutation. Almost all the proposed schemes are still at a conceptual stage of development, the major exception being disposal into salt formations, which has been extensively investigated in the Federal Republic of Germany and in the United States. There are considerable differences between the various disposal concepts with regard to the degree and reliability of the containment provided for the waste, the consequences of containment failure, the complexity and cost of the disposal operation, and even its viability in the light of currently available technology.

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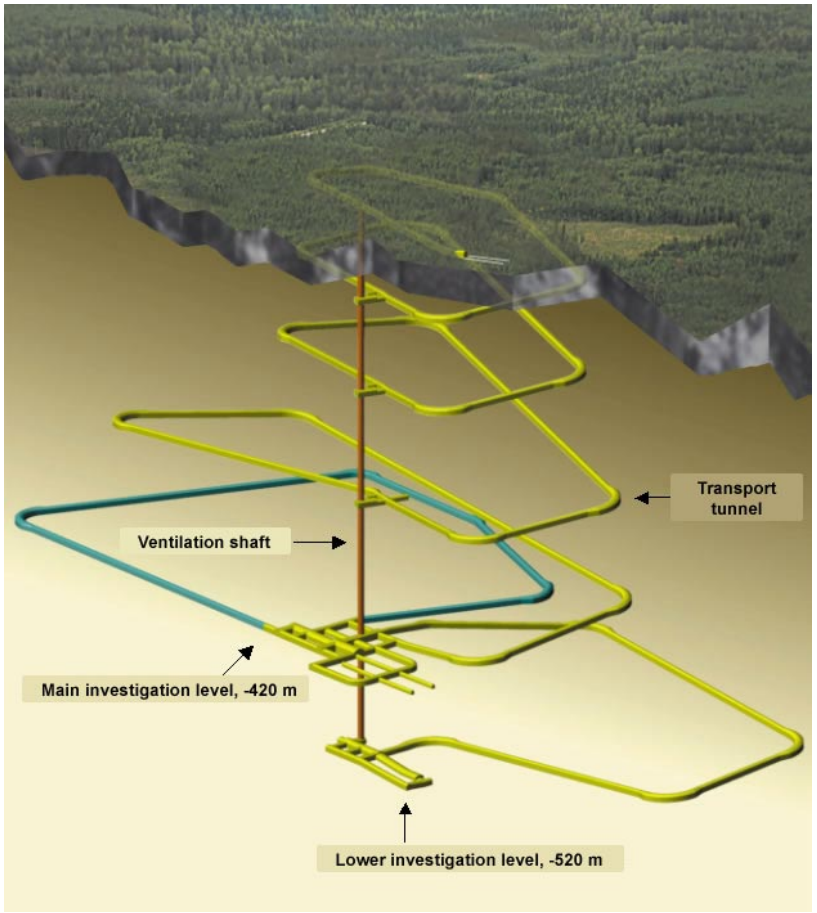

136. The geological formations which have been considered for the disposal of long-lived wastes can be categorised into three groups. Most attention has been directed to disposal into salt although more recently argillaceous and hard rock formations have also been considered.

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vi) CONCLUSIONS

157. Current waste management plans, which involve the engineered storage of the various long-lived wastes, provide an adequate level of safety for the coming decades. Full use should be made of this storage period to evaluate the most attractive disposal concepts in detail. This should lead to the identification of the optimum disposal concepts and to the demonstration of their safety. Once the adequacy of the disposal option has been demonstrated, it should be implemented without delay, since the greater isolation from man's environment that most disposal concepts imply, would further increase the overall safety of waste management.

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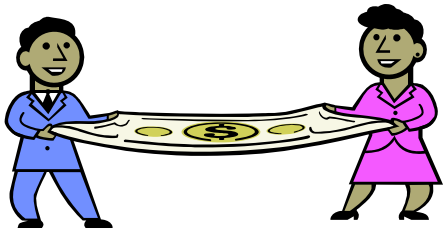

V. ADMINISTRATIVE, LEGAL AND FINANCIAL FRAMEWORK FOR THE LONG-TERM MANAGEMENT OF RADIOACTIVE WASTE

158. The safe management of radioactive waste is strongly related to the development and demonstration of appropriate technical methods, but it involves also other equally important aspects notably from the administrative, legal and financial points of view. In order to ensure satisfactory implementation of waste management techniques, these aspects have to be fully evaluated and a suitable framework needs to be established in this respect.

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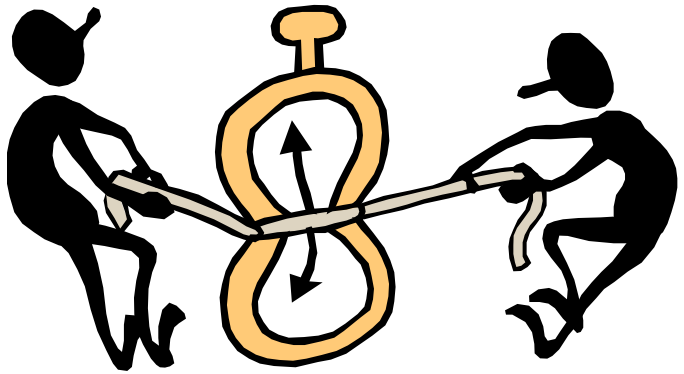
VI. CONCLUSIONS AND RECOMMENDATIONS

183. For long-lived wastes the objective of radioactive waste management is to ensure the required degree of isolation from man over a time scale which precludes completely any form of reliance on long-term surveillance. Chapter IV of the report covers this matter in detail and concludes that several different approaches are likely to lead to acceptable disposal solutions; containment in stable geological formations on land is at present the most advanced. However, it is essential to be assured that the safety and reliability of the disposal method are sufficient for the type of waste and amounts involved before it is actually implemented. Meanwhile, the current practice of storing long-lived waste in engineered facilities provides an adequate degree of safety.



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185. More research and development work on disposal methods is obviously needed in order to better assess all the safety, technical, economic and social factors involved and to optimise them in such a way as to reach a high degree of safety without unnecessary costs. Such a balance is not easy to achieve because of technical and social uncertainties about the future and the value judgements which therefore have to be made. Such judgements will always be necessary, whatever efforts are made in the R & D field and whatever the state of scientific and technical knowledge.

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189. Appropriate technology is available for dealing with waste management problems raised by the large-scale introduction of nuclear energy. A demonstration phase is nevertheless necessary before full-scale application of waste management techniques, in order to obtain sufficient practical experience and to keep pace with the development of nuclear energy programmes. Demonstration facilities must therefore be designed, constructed and operated, particularly for the conditioning of high-level and alpha-bearing wastes. Waste disposal programmes would also benefit from in situ experiments in geological formations with limited quantities of radioactive waste. It is the task of the responsible authorities to make the relevant decisions so that demonstration activities can be undertaken on a much larger scale than in the past.

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190. For almost all these suggested activities, it would be desirable to adopt an international approach which would ensure a better use of available resources, a uniform and probably higher overall degree of safety, and possibly, increased public confidence. The adoption and acceptance of suitable disposal concepts would be considerably facilitated and it is strongly recommended that a common methodology be developed at the international level for the safety assessment of disposal options.

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191. Provided that the above recommendations are followed and supported with commensurate resources, the Group of Experts is convinced that the solutions presently developed for the disposal of radioactive waste will fulfil all the safety and other objectives listed in chapter II of the report. It is therefore the task of everyone concerned, both from the technical side and from the administrative and political viewpoints, to ensure that it is actually so.